Critical Learning Episodes in the Evolution of Business Start-ups:

Business Incubators in South-Eastern Brazil

Ariane Agnes Corradi

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KRITIEKE LEEREPISODES IN DE ONTWIKKELING VAN STARTENDE ONDERNEMINGEN:
BUSINESS INCUBATORS (INNOVATIECENTRA) IN ZUIDOOST-BRAZILIË

Thesis

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Dedication

To those who, despite the path, pursue their dreams passionately and constructively

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Acronyms

AMITEC:	Programa de Apoio à Melhoria e Inovação Tecnológica (Programme of Support to Technological Improvement and Innovation)
ANPROTEC:	Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores (Brazilian Association of Science Parks and Business Incubators)
ANVISA:	Agência Brasileira de Vigilância Sanitária (Brazilian National Health Surveillance Agency)
BA:	Bahia
BI:	Business incubator
BDS:	Business development service
BRIC:	Brazil, Russia, India, China
CLE:	Critical learning episode
FAPEMIG:	Fundação de Amparo à Pesquisa do Estado de Minas Gerais (Minas Gerais Research Foundation)
FAPESP:	Fundação de Amparo à Pesquisa do Estado de São Paulo (São Paulo Research Foundation)
FGV:	Fundação Getúlio Vargas
FIEMG:	Associação das Indústrias do Estado de Minas Gerais (Association of Industries of the Minas Gerais State)
FIESP:	Associação das Indústrias do Estado de São Paulo (Association of Industries of the São Paulo State)
FINEP:	Financiadora de Estudos e Projetos (Studies and Projects Financing Entity)
FUMSOFT:	Sociedade Mineira de Software (Minas Gerais Software Association)

GDP:	Gross domestic product
GEM:	Global Entrepreneurship Monitor
GO:	Goiás
IBGE:	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute for Geography and Statistics)
IEL:	Instituto Euvaldo Lodi (Institute Euvaldo Lodi - Knowledge for enterprise competitivity)
ISIC:	International Standard Industrial Classification of All Economic Activities
IT:	Information technology
MG:	Minas Gerais
MT:	Mato Grosso
MS:	Mato Grosso do Sul
NPT:	Núcleo de Planejamento Tecnológico (Nucleus of Technological Planning)
OECD:	Organization for Economic Cooperation and Development
PAPPE:	Programa de Apoio à Pesquisa em Empresa (Enterprise Research Support Programme)
PIPE:	Pesquisa Inovativa em Pequenas Empresas (Innovative Research in Small Enterprises)
PRIME:	Primeira Empresa Inovadora (First Innovative Enterprise)
RBV:	Resource-based view
RHAE:	Programa de Formação de Recursos Humanos em Áreas Estratégicas (Human Resources Formation in Strategic Areas)
RJ:	Rio de Janeiro
R&D:	Research and Development
RMI:	Rede Mineira de Incubadoras (Minas Gerais Incubators' Network)
RS:	Rio Grande do Sul
SCA:	Sustainable competitive advantage
SEBRAE:	Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (Brazilian Service of Support for Micro and Small Enterprises)

SENAI:	Serviço Nacional de Aprendizagem Industrial (Brazilian Service for Industrial Learning)
SESI:	Serviço Social da Indústria (Industry Social Service)
SME:	Small and medium enterprise
SNA:	System of National Accounts
SP:	São Paulo
T&D:	Training and Development
UNICAMP:	Universidade de Campinas (Campinas University)
USP:	Universidade de São Paulo (São Paulo University)
VIRN/O:	Valuable, Inimitable, Rare, and Non-substitutable resources of and Organization

Acknowledgements

This thesis is one of various outcomes of a long journey: a journey that could only be accomplished because I was not walking alone. It is my greatest personal academic achievement, beyond the range of dreams I believed realizable. This thesis, just as most start-ups have one entrepreneur, has one author. However, just as those entrepreneurs had, I too had the privilege to be able to count on a wide support network, even before starting this PhD. My trajectory is marked, as the trajectories of business start-ups, by many critical events. Here, I highlight some of these episodes and the key persons and institutions in them.

I start by thanking my parents, who always fed my appetite for books, reading, and writing with strong incentives to do well in school. My parents, Elizabete and Paulo, were the first to believe that my ideas could be worth sharing, even at the age of four. This is when my mother would write down one of the poems I recited off the top of my head and my father would take it to a magazine that published it.

Thanks to my English language teacher, Cida Gandini: I eagerly absorbed some basic knowledge of this language which was so far from my bed. Dona Cida faced all the hurdles of teaching English in a Brazilian public primary school in a small industrial town, without adequate material, technology or a shared social interest in this subject. Thanks for remaining a steady and proud supporter of my studies. Later, at secondary school, I was asked by one of my most rigorous and passionate teachers of Portuguese language, Iolanda Bichiato, what I wanted to be when I grew up. When I replied that I wanted to be a writer, she came close to me and said, very eloquently, 'You are a writer!' I believed that and never stopped writing, although sharing with others was out of question for long time.

This dream to be a writer was pushed aside, however, during the Psychology course at the University of São Carlos. I was embraced by theories, fieldwork duties, and the research fellowship activities that provided my study allowance. Deisy das Graças de Souza is the key person of this period, for teaching me the beauty and challenge of doing research. Soon it became clear that this was my professional path, the source of fulfilling work. With Deisy I learned, among

many other academic skills, respect for the people involved in our research, and a social commitment to research that matters. I gained a strong role model of researcher, a friend, and a supporter for life. Through Deisy, I thank all my lecturers and professors at that beautiful UFSCar campus.

It was also at UFSCar that I discovered my interest for social and organizational psychology. This was primarily thanks to the strong support offered by Lisa Barham, our first specialist in the area, who became my research paper supervisor. With Lisa I ventured my first steps into statistics applied to organizational studies, at that time still in SPSS 7.0 (DOS version!). Lisa was the first to throw in the idea that I should try a Master programme abroad. However, since life follows non-linear paths, it would take me another nine years to set foot abroad - for this PhD.

Those were very busy nine years. Seven of them I spent in Brazil's capital city. There I pursued a Masters in Psychology at the University of Brasília, and started my academic career. Claudio Vaz Torres, my supervisor who soon became a friend, has been one of my key supporters across this PhD. Moreover, Claudio accepted to be the guarantor, to the Brazilian government, that I would finish the PhD. I am extremely thankful for his unbreakable faith in my ability to achieve, for his continuous support with recommendation letters, e-mails, tricky questions, anecdotes, visits, and efforts to untangle bureaucratic knots. Thanks, my friend-brother.

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For those whose names are not laid out here; as I write, I have vivid memories of our time together and I am grateful for that. Your presence pulses in my heart.

Abstract

This study investigates the evolution of business start-ups in the first three to five years. Evolution is defined here as a non-continuous learning process of entrepreneurs that creates and changes organizational routines. Two concepts are central: critical learning episodes and pathways. Critical learning episodes are discontinuous learning events in the storyline of these business start-ups. A critical learning episode is composed of endogenous or exogenous events that trigger search activities to acquire or create resources, which, when applied to the firm, will change the current organizational routines. Pathways are arrangements of critical learning episodes. This study develops a multidisciplinary analytical framework with concepts of learning from organizational psychology, concepts of the internal dynamics of firms for the Penrosian resource-based theory, and concepts of economic change from evolutionary economics. This thesis fills in the gap of describing evolutionary and learning processes of business start-ups in the resource-based theory of the firm. The research question about how learning-based pathways explain the evolution of business start-ups was investigated through semi-structured interviews with entrepreneurs of 43 business start-ups. All these start-ups were linked to business incubation programmes in the two most resource-rich regions of Brazil: São Paulo and Minas Gerais. These start-ups were in three sectors: a) manufacturing, b) information and communication, and c) professional, scientific and technical activities. The analysis of these narratives combined qualitative (i.e., grounded theory principles) and quantitative (i.e., descriptive statistics, cluster analysis, social networks analysis) techniques in a mutual feedback fashion. Five main categories of critical learning episodes resulted from these analyses: entry and survival in the market, production-related issues, entrepreneur-specific issues, management issues, and others. Further examination of relationships between critical learning episodes in the individual trajectories of these firms resulted in five typical pathways that clustered the cases. The main distinction between these types relies on the resource investment on the core

product or service *versus* a combination of core and secondary products or services. Dynamics of these pathways were explained in terms of individual, firm, network, and institutional factors. The study claims the importance of micro-processes of learning for a more comprehensive theory of the firm. More specifically, it redefines traditional concepts of evolutionary economics and resource-based theory of the firm through empirical testing of their applicability to contexts of entrepreneurship and business start-ups. The methodological discussion argues that the mixed methods approach was crucial to unpack learning dynamics and to identify typical pathways of business start-ups beyond the classical linear model. Moreover, the role of business incubators is discussed in terms of network brokerage and the provision of problem-based support in addition to well-known packages of services.

Keywords: *evolution of business start-ups, critical learning episodes, typical evolutionary pathways, mixed methods, theory building, and business incubation programmes.*

Kritieke leerepisodes in de ontwikkeling van startende ondernemingen:
business incubators (innovatiecentra) in Zuidoost-Brazilië

Samenvatting

Dit onderzoek gaat over de ontwikkeling van startende ondernemingen in de eerste drie tot vijf jaar. Ontwikkeling wordt hier gedefinieerd als een leerproces met onderbrekingen dat ondernemers doormaken en waarin de werkwijze binnen organisaties vormgegeven en veranderd wordt. Daarbij staan twee begrippen centraal: kritieke leerepisodes en leerroutes.

Kritieke leerepisodes zijn discontinue gebeurtenissen waarvan geleerd wordt in de ontstaansgeschiedenis van deze startende ondernemingen. Een kritieke leerepisode bestaat uit endogene of exogene gebeurtenissen die een zoekproces in gang zetten dat leidt tot het verwerven of genereren van middelen die de bestaande gang van zaken binnen de organisatie zullen veranderen. Leerroutes zijn een samenstel van kritieke leerepisodes. In dit onderzoek wordt een multidisciplinair analytisch kader gehanteerd op basis van ideeën over leren uit de organisatiepsychologie, ideeën over de interne dynamiek van bedrijven uit de *resource-based* benadering van Penrose en ideeën over economische verandering uit de evolutionaire economie. Dit proefschrift voorziet in een lacune in de *resource-based* benadering van bedrijven door de evolutie en leerprocessen van startende ondernemingen te beschrijven.

De onderzoeksvraag hoe leerroutes de ontwikkeling van startende ondernemingen verklaren is onderzocht met behulp van semi-gestructureerde interviews met ondernemers uit 43 startende ondernemingen. Alle startende ondernemingen namen deel aan ondersteuningsprogramma's voor startende ondernemingen in de twee regio's van Brazilië met de meeste natuurlijke hulpbronnen: Sao Paulo en Minas Gerais. Deze startende ondernemingen waren actief in drie sectoren: a) industrie, b) informatie en communicatie en c) professionele dienstverlening, wetenschap en techniek. Bij de analyse van de data is gebruik gemaakt van zowel kwalitatieve technieken (de *grounded theory*-benadering) als kwantitatieve technieken (beschrijvende statistiek,

clusteranalyse, analyse van sociale netwerken) waarbij er sprake was van wederzijdse feedback.

Uit de analyse komen vijf hoofdcategorieën van kritieke leerepisodes naar voren: het betreden van en overleven op de markt, zaken die met productie te maken hebben, aan de ondernemer gerelateerde zaken, managementkwesties en overige zaken. Verder onderzoek naar de relatie tussen kritieke leerepisodes in de individuele trajecten die deze bedrijven doorlopen liet zien dat de onderzochte gevallen onder te verdelen zijn in vijf kenmerkende leerroutes. Deze vijf typen verschillen vooral in hoe er geïnvesteerd wordt: of middelen geïnvesteerd worden in het belangrijkste product of de belangrijkste dienst *of* in een combinatie van belangrijkste en secundaire producten of diensten. De dynamiek van deze leerroutes wordt verklaard in termen van individuele, bedrijfs-, netwerk- en institutionele factoren.

Het onderzoek wijst op het belang van micro-leerprocessen voor een veelomvattender theorie van het bedrijf. In het bijzonder herdefinieert dit onderzoek traditionele begrippen uit de evolutionaire economie en de resource-based benadering van de onderneming door de toepasbaarheid ervan in de context van ondernemerschap en startende ondernemingen empirisch te toetsen.

In de methodologische discussie wordt gesteld dat de *mixed methods*-benadering (combinatie van verschillende methoden en technieken) essentieel is om de dynamiek van het leren te ontrafelen en om kenmerkende leerroutes van startende ondernemingen te identificeren en daarmee verder te gaan dan het klassieke lineaire model. Daarnaast wordt de rol van business incubators besproken die een compleet dienstenpakket bieden met netwerkrelaties, gerichte ondersteuning en andere bekende diensten.

Trefwoorden: *ontwikkeling van startende ondernemingen, kritieke leerepisodes, kenmerkende evolutionaire leerroutes, mixed methods, theorievorming, business incubators en innovatieprogramma's.*

1 Introduction

"Knowing is not enough; we must apply.
Willing is not enough; we must do." – Goethe

This PhD dissertation is about evolutionary processes in business start-ups. It examines learning processes in depth, exploring their impacts in the formation of firm's pathways. This is a new approach to firms in general and, more specifically, to business start-ups. This novelty is justified by, first, the focus of theories of the firm on complex organizational units, with rare studies on small businesses (e.g., Aramand, Valliere 2012). Second, entrepreneurship is lacking in most of these theoretical elaborations, leaving agency issues aside (e.g., Xu 2011, Casson 2005). Third, evolutionary approaches to the firm have emphasize aggregated levels of analysis, such as industry (e.g,, Nelson, Winter 1982) and populations of organizations (e.g., Hannan, Freeman 1977); not individual firm's processes. Fourth, although some authors point out the importance of combining different approaches to a more comprehensive theory of the firm, the elaboration of such theory remains a gap in the literature (e.g., Bataglia, Meirelles 2009, Zollo, Winter 2002, Hillman, Withers et al. 2009, Nienhüser 2008). Given this theoretical scenario, this introduction positions the thesis in relation to the main theories of the firm and justifies the choice for an evolutionary approach that combines resource-based theory and psychological theories of learning. It starts with an overview of theories of the firm; then examines four of them that emphasize dimensions of firms: resource-based theory, dynamic capabilities, resource dependence theory, and population ecology.

1.1 Telling two short stories

In this section the narratives of two of the case studies are organized, along the lines of the analytical framework. The first case is a small female tank top manufacturer, operating since 2006, and the second is a start-up in the information and communication sector specialised in built-in software, also operating since 2006. Each start-up is located in a different region and relies on different sets of resources. The narrative was guided by the following guiding question[1]: *Tell me the story of your business, from the beginning of the idea up till now, based on the most critical events that characterize the evolution of your business. Please think of those events that you see changed what the business used to be, or how you thought it would be at first, in relation to what it is now.*

Case A: Manufacturing sector (clothing)

Wife and husband started the business informally, at home, following the advice of relatives who had expertise in the field – owners of a clothing business in a big city. They hired some sewers and started producing female tank tops. They worked informally for one year. During this period they faced problems with low quality suppliers that resulted in the loss of a significant number of pieces at once. Nevertheless, sales increased, the production process was intensified and the space in the house was no longer large enough.

The need to move to a bigger infrastructure led them to search for an affordable place to install the business. They eventually found the business incubator and applied to join the programme. The selection process was based on the business plan, additional documents and an interview. Enrolment in the programme was conditional to formalising the business. The first six months of incubation enlarged the support network by introducing important regional and local actors. For instance, these entrepreneurs had access to production consultants, who assisted the professionalization of the production system. They learned techniques to optimize the use of inputs, to shorten the production time and to assess and guarantee the quality of the products. However, the withdrawal of the main support institution from the programme caused the collapse of this support network, the end of the production consultancy and training courses, and a reduction in other consultancies (finances and marketing).

The strategy to cope with this critical episode was to bounce back to the family experts and rely on the consultancies that were left. The knowledge acquired during these first six months was maintained, but did not advance. In an attempt to grow, the entrepreneurs expanded their network of buyers and distributors (*sacoleiros*). Their strategy was to sell large quantities to distributors outside their geographical region. They also occasionally diversified the mix of products, trying to work in various sub-niches, i.e., winter cardigans, shorts, uniforms, fashion models. All these trials took place in the business' third year (second year of incubation). Most of these production and selling experiments went wrong and led to a deeper understanding of the specific dynamics of different segments of the market. For instance, the production of winter clothes is expensive and non-profitable for a region that has few weeks of winter; fashion models are more difficult to sell in large quantities, since small shops (their main buyers at that time) request exclusivity over this type of clothing but can only purchase small amounts.

The strategy used to cope with these failed experiments and survive was to stop all production lines apart from the two successful ones: basic tank tops and special sizes (extra-large and above). The production of special sizes was still in an initial stage at the time of the interview, reflecting an important learning outcome: the mind-set of the entrepreneurs had changed towards a more cautious strategy of 'trying the market' before producing large quantities.

At the end of the third year of business activity, the international financial crisis indirectly affected the firm's financial health, characterized by significant buyers in default and reduced purchases by regular buyers. This caused a series of losses. Their bank profile was hindered and their access to credit restricted, workers were fired and trust-based relationships collapsed. The strategy to survive the crisis was to shrink the size of the business. The organizational routines at the time of the interview were based on selling to only a few reliable buyers who were geographically close, and 'putting the house back in order' until the economic scenario stabilizes.

Case B: Information and communication sector (built-in software)

This is a business start-up that develops built-in software for palm computers used in bars and restaurants, and also a cost control system adapted for SMEs (small and medium enterprises). The idea of the busi-

ness originated from a university student, who invited two others to join the project. They were pursuing their majors in computer engineering and combined the elaboration of the business plan with their last year at university.

From the beginning they sought the support of the business incubator because none of them had an entrepreneurial background. In this case, the incubator is part of the university and has close connections with the academic environment, so it is well known by and accessible to the students. The incubator provided continuous guidance and access to its courses during the six months of elaboration of the business plan. They started the incubation programme in mid-2006 and soon realized that the initial idea of producing software per demand would not work. They therefore decided to create their own first product. At this point, their network had expanded towards other incubatees and former colleagues who were employed in big companies and from whom they could access critical information about innovation, trends, and technology in the field.

In spite of the relatively wide network on the supply side, they faced several difficulties in accessing the market after two years dedicated to the development of the product. Having exhausted their investment and working capitals, they were desperate to generate some income. The strategy of 'selling at any cost' led to financial losses and the risk of having to close down the business. One desperate action led them to securing a bank loan on behalf of a buyer who ended up defaulting. This episode deepened the financial trouble of the start-up. They sued the buyer and after months recovered the equipment and part of the money. They also tried to go into partnerships with professional sellers, which did not succeed due to the entrepreneurs' poor knowledge of the market. They were not able to instruct the sellers about the business model and other issues related to marketing in their market niche.

Meanwhile, an angel investor showed interest in their technology and competences, so they started developing a new project together. The approach was opposite to the one applied by the entrepreneurs so far. With this investor they learned how to sell before developing the product. The project, which was too advanced for the Brazilian market at that time, did not succeed. Nevertheless, the entrepreneurs incurred no losses, became 'aware' of the market and learnt to start with the markets needs and interests, before investing in product development. This new under-

standing of the relationship between product development and market inverted the lessons learnt at the university.

Once the venture capital initiative did not work and the unsuccessful selling strategies aggravated the critical financial situation, they decided to learn how to sell. For a period of eight months these entrepreneurs tried several business models, yet without success. Finally, they adopted the most usual business model – selling the basic version of the product plus software license – and sales leveraged. In one year they developed new products, took over the regional market from bigger enterprises established in other regions, won the prize of 'Best Enterprise of 2008', and won a public grant to cover consultancy costs. Most of these episodes took place in 2008, the second year of the business and the last year of the regular incubation period. By the time of the interview they were about to move to a technological park (under construction) and were associated with an incubated start-up in a spin-off business. Furthermore, they are also in partnership with a university professor to develop a new product: a cost control system for SMEs. This system was adopted by all business start-ups in that incubator.

In contrast to Case A, this start-up increased its support network, reached out to buyers from bigger enterprises, established longer-term formal partnerships with other incubatees, linked academic knowledge to product development and could count on the continuous support of the business incubator. But what do these two cases have in common that helps our understanding of the evolution of business start-ups?

Drawing some initial arguments

These two stories, although far from being representative of the whole set of cases that compose this thesis in terms of type of business, sequence, timing and types of episodes, illustrate the main points of this study.

Both cases developed, in their particular ways, organizational routines to cope with critical events. At the organizational level, this resulted in new meanings, relationships and methods of work. All these changes characterize the individual evolutionary process of these businesses. These start-ups show, after initial years of struggle, a certain degree of maturity in exploring the market and balancing market demands and product development. They also illustrate that entrepreneurs in both low

and high R&D-intensive activities may face similar challenges in the first years of their businesses. One example is the development of solutions to balance out the firm's productive capacity and market demands. It is clear that the availability of knowledge and other resources, i.e., social capital, equipment, etc. affects the entrepreneurs' perception of criticality of events. Hence, the impacts of these critical learning episodes in start-ups' evolution is explained by a combination of factors. The three main categories of factors analysed in this thesis are human and social capital, temporal and structural factors.

An examination of these two cases shows the initial reliance of entrepreneurs on previous knowledge about production and management competences. In Case A, until entrepreneurs had access to specific support by the business incubator, this knowledge was exogenous and dependent on the expertise of family members. In Case B, knowing how to develop the product was endogenous, since it was part of the entrepreneurs' academic background. Knowledge about the market was gained from the negative consequences of their initial choices and by new knowledge from a private investor. The establishment of networks with resourceful actors, for both cases, was crucial to insert innovation into these pathways, and to create and strengthen entrepreneurial competences.

In addition to building market-oriented networks to access resources, networks to distribute the start-ups' outputs to the market are another critical need. These networks, as shown in the cases described above, are buyers, distributors, and even other incubatees. Networking activities are central in the entrepreneurs' narratives, but it is noteworthy that they are not highlighted by many incubators (see Chapter 3 for details).

The theoretical and analytical tool to examine these critical events in the evolution of business start-ups is the concept of critical learning episodes (CLE). As detailed in Chapters 2 and 4, this concept allowed for bracketing of the narratives in time and space, and identifying specific triggers and new routines that compose each CLE. Between triggers to change and routines, strategies used by entrepreneurs to make use of resources or to create new resources are explored. Furthermore, as highlighted in Chapter 5, the study of relations between CLEs resulted in individual evolutionary pathways, which were then aggregated in typical pathways based on patterns in the configurations of resources across time.

1.2 Motivation for the study and research questions

Business start-ups and entrepreneurial activities have been granted the role of catalysts of economic growth for creating jobs, generating income, driving innovation and speeding up structural economic changes (e.g., Kelley, Bosma et al. 2010, Lalkaka, Shaffer 1999, UNDP 2004, Praag 1999, OECD 2010). They contribute to productivity and national competitiveness by introducing new competition (Kelley, Bosma et al. 2010, Acs, Audretsch 2003). Despite extensive literature on entrepreneurship and organizational studies, the internal processes of business start-ups and their role in development have, for long, been empirically under-investigated (e.g., Malecki 1993, Imasato 2005). In fact, theories and empirical studies about internal processes of firms have focused on big businesses and hierarchical organizations (e.g., Thompson, Frances et al. 1991), with some justification based on the lack of good data about these entrepreneurial ventures (Kelley, Bosma et al. 2010).

Nevertheless, it is accepted that the first years of operation are the most critical for survival, after which the majority of the starters are left behind (e.g., Casson, Yeung et al. 2006). This critical period may range from two (e.g., SEBRAE 2007, Casson, Yeung et al. 2006) to five years (e.g., Kelley, Bosma et al. 2010). National statistics show that the rate of survival for business start-ups in the second year was around 70% in Finland, Italy and Portugal, and around 85% in Australia in 2005 (SEBRAE 2007). Brazilian indices indicate a 78% survival-rate for business start-ups (irrespective of whether they were linked or not to business development services) in the second year[2], a percentage comparable to countries like England (82%) and Singapore (75%)[3]. This report also shows that 64% survived the fourth year. A recent report by SEBRAE, using a census methodology in partnership with the Brazilian Secretariat of Internal Revenue Service, examined the survival rate to the second year between 2005 and 2009 (SEBRAE 2011)[4]. It indicates a growing tendency, with 72% of the start-ups started in 2005 surviving the second year, against 73% of those started in 2006.

This favourable environment for business is associated to Brazil's economic growth, with reduced and controlled inflation, the gradual reduction of interest rates, increased personal credit, increased consumption mainly by the lower social strata (SEBRAE 2007), and better legislation for SMEs (SEBRAE 2011). Also, higher rates of survival are shown

by enterprises in the manufacturing sector (75%, attributed to higher entry barriers and lower competition compared to other sectors), and by those located in the Southeast (76% overall survival rate; 78% in Minas Gerais and 77% in São Paulo, representing the 4th and 5th national top positions) (SEBRAE 2011). These data confirm the importance of structural factors in creating a munificent environment for entrepreneurship with higher probabilities of success (Malecki 1993). In addition, entrepreneurs were shown to be more qualified, with about 79% of them with higher education, and 51% with previous work experience in the private sector (SEBRAE 2007). These entrepreneurs were also more concerned with the internal conditions of the business than with the economic situation of the country, with 71% of them focussed on planning (against 24% in 2002), 54% on the enterprise organization (against 17% in 2002), 47% on marketing and sales (7% in 2002), 36% were working on the financial analysis of their business (7% in 2002), and 38% on the human relations in the business (only 3% in 2002). Moreover, the percentage of pull-entrepreneurs, who identified a market opportunity to start a business increased from 15% in 2002 to 43% in 2005 (SEBRAE 2007). In sum, these statistics highlighted the existence of a favourable scenario for private sector development that combines entrepreneurial capabilities with economic stability over time. It also suggests that, with better structural conditions, entrepreneurs can focus on building up intra-firm competences, i.e., planning, enterprise organization, marketing and sales, and human relations.

Beyond this optimistic scenario, there are indicators of regional inequality and bureaucratic barriers. At the regional level, SEBRAE's data show that the survival rates of business start-ups in Northern Brazil in 2000 was 47% and increased to 70% in 2005; whereas in the Southeast these rates were 39% in 2000, increased to 84% in 2005 (with Minas Gerais at the highest end, with 86% of survivors) (SEBRAE 2007). Statistics for 2006, from the SEBRAE census methodology (2011), were estimated at 73% of overall survival in the Southeast, up to 80% in the manufacturing sector, these percentages being above the national average. These promising statistical indices augment the interest in explaining how business start-ups in these resource-rich states evolve in the first three to five years. A comprehensive understanding of how entrepreneurs deploy resources in this favourable environment can potentially inform analyses and interventions in less favourable regions, as is discussed in Chapter 6.

In addition to these developmental issues, studying business start-ups may contribute theoretically to a theory of the firm that considers the dynamics of resources and evolutionary processes in small entrepreneurial businesses. It is reasonable to assume that the agency of entrepreneurs is more directly and strongly powerful to create and reshape organizational routines in business start-ups than in departmental organizations. Therefore, linkages between individual learning processes and intra-organizational use of resources are more easily identifiable. Furthermore, since the business start-ups here are linked to business incubators, it is possible to investigate this type of business development service as a learning setting for entrepreneurs.

The main research question that follows is: **How do learning-based pathways explain the evolution of business start-ups?** This is unfolded in five sub-questions:

1. *What types of critical learning episodes characterize evolutionary pathways in business start-ups?*
2. *Are there typical pathways that could describe this evolutionary process for groups of businesses?*
3. *What is the role of structural, agency and temporal factors in these evolutionary pathways?*
4. *What are the characteristic networking dynamics that, beyond learning episodes, contribute to the evolution of business start-ups?*
5. *How can business development services (i.e., business incubators) provide a learning setting for entrepreneurs?*

In order to empirically investigate these questions, the research was limited to the two most developed states in Brazil: São Paulo and Minas Gerais (IBGE, Directory of Research, Coordination of Industry 2008). They were selected for their comparatively higher local and regional availability of resources, representing fertile ground for the formation and growth of small enterprises. The selection of these two regions guaranteed, to a certain extent, that market opportunities, support institutions, funding and credit, skilled labour, technological expertise, suppliers, and other sources of resources exist.

Moreover, these states are stepping into the innovation-driven economic group defined by Global Entrepreneurship Monitor GEM (Kelley, Bosma et al. 2010), together with the efficiency-driven group in

which Brazil as a country is classified. Therefore, these states have a higher chance of producing outputs in line with the current economic development level and with a future innovation-driven development level. Both the innovation-driven and the efficiency-driven groups are associated to different development focuses and to different institutional dynamics for entrepreneurship (Kelley, Bosma et al. 2010).

Local and regional availability of resources

The Southeast of Brazil, despite the increasing interiorization of economic activities across the country and increments above the average national GDP in less developed regions, still holds 55,5% of all SMEs in Brazil, and 71% of all bank credit (IBGE, Directory of Research, Coordination of Services and Commerce 2003). This region produces 55% of the national GDP (IBGE 2008), contains 42,6% of the Brazilian population, has access to the most skilled labour, better urban infrastructure and better developed markets (IBGE, Directory of Research, Coordination of Services and Commerce 2003). In terms of industrial activity, 52,6% of all industrial units are in the Southeast, producing 62,2% of the industrial transformation value[5] (IBGE, Directory of Research, Coordination of Industry 2008).

Out of the four States that compose the region, São Paulo contributes 30,9% of the national GDP and Minas Gerais 9,4%. These two States are on top in the national balance of imports and exports (+23,4% in Minas Gerais and +19,2% in São Paulo), and their markets are dominated by big enterprises whose supply chains create opportunities for SMEs (Kelley, Bosma et al. 2010). In this regard, the Brazilian Institute of Geography and Statistics (IBGE, Directory of Research, Coordination of Industry 2008) shows that the top three industrial activities in these states are the following:

- São Paulo: manufacture of motor vehicles, trailers and semi-trailers; manufacture of coke and refined petroleum products; and manufacture of food products, representing 37% of all industrial activities in the State;
- Minas Gerais: manufacture of basic metals; extractive industries; and manufacture of motor vehicles, trailers and semi-trailers, representing 51% of all industrial activities in the State.

Moreover, they are leaders in research and development. Some statistics illustrating the participation of the region and of these two States in the national economy in terms of R&D and innovation activities is presented in Table 1.1 (IBGE, Directory of Research, Coordination of Industry 2010). The table cells in soft grey highlight outstanding values, predominantly found in the São Paulo State. Expenses in innovative activities and in internal R&D activities correspond to 55% of the national figures: in Minas Gerais, in second overall place, these figures are 9% and 6% respectively. The two states together spend 90% of the regional expenditure on innovative activities and 82% of the regional expenditure on internal R&D activities

Another important datum is that São Paulo State contains more than 50% of the enterprises creating new products and more than 45% of the enterprises creating new processes at national and international levels. In both states the ratio between net revenues of sales and expenses in innovation activities is above the national average. Table 1.1 also shows differences between these states in terms of sources of finance and the ratio between number of employees dedicated to R&D and total number of employees. Enterprises in Minas Gerais invest below the national average of own resources in R&D and other activities. They rely more on governmental grants and have a ratio below the national figures of employees dedicated to R&D (cells in black).

The selection of business incubators was based on, among other criteria, the largest geographical coverage possible, within each state. This methodological choice increased generalization of results to the state level, in addition to providing data on local level dynamics. The methodology is described in Chapter 3.

Table 1.1
R&D indices for São Paulo and Minas Gerais in the regional and national contexts

Indicators	Brazil	Southeast	São Paulo	Proportion (SP)	Minas Gerais	Proportion (MG)
Implementation of innovation of product and/or process (n) (2003-2005)	30377	16040	10734	0.353	3203	0.105
Expenses in innovative activities* (22005)	34405980	25811206	19085504	**0.555**	3080678	0.090
Internal R&D activities* (2005)	7112928	5768759	4112386	**0.578**	456218	0.064
New product for the enterprise but existent in the national market (n)	14875	7661	5039	0.339	1547	0.104
New product for the national market but existent in the international market (n)	2734	1790	1395	**0.510**	159	0.058
New product for the international market (n)	175	109	91	**0.520**	7	0.040
New process for the enterprise but existent in the national market (n)	23080	11709	7627	0.330	2473	0.107
New process for the national market but existent in the international market (n)	1321	804	615	**0.466**	104	0.079
New process for the international market (n)	103	83	72	**0.699**	6	0.058
Net revenues of sales/ Total of expenses in innovation activities*	0.028	0.030	0.035		0.030	
Sources of finance for R&D: own resources (%)	93	93	96		70	
Sources of finance for other activities: own resources (%)	84	86	86		82	
Sources of finance for other activities: public funds (%)	10	8	8		13	
Expenses with continuous R&D activities*	6670499	5477910	3874677	0.581	432913	0.065
Expenses with occasional R&D activities*	442430	285988	236684	0.535	23085	0.052
N employees dedicated to R&D/ N employees	0.008	0.010	0.011		0.005	
Enterprises that received fiscal incentives for innovation (R&D, Law of Informatics) (n)	531	310	218	0.411	56	0.105
Enterprises that received loans for innovation (partnerships with research centres and acquisition of machinery) (n)	4135	2067	1473	0.356	403	0.097

*In 1000 reais. (n) number of enterprises

Source: IBGE 2010

Other motivations

Discourses about the need for interdisciplinary approaches to better describe complex phenomena have been widely spread across several disciplines, including psychology and economics (e.g., Borman, Ilgen et al. 2003, Chandler, Hagstrom-Jr. et al. 1998, Dopfer 2004). However, the use of interdisciplinary approaches in one piece of work has been a challenging and contested task (e.g., Greckhamer, Koro-Ljungberg et al. 2008). One aspect is, for instance, the ontological position that different disciplines attribute to the same phenomenon. An illustration of how interdisciplinary approaches can be contentious, which is inherent to this research, is organizational learning. In psychology literature, learning is a phenomenon of the individual and, therefore, cannot be attributed to organizations (Abbad, Borges-Andrade 2004). Differently, a sociological approach would defend the ontological position of learning organizations, based on the assumption of organizations as cultural rather than cognitive entities (Cook, Yanow 1993)[6].

Nevertheless, interdisciplinary research applied to more comprehensive explanations of phenomena such as the evolution of business start-ups is a powerful theoretical and analytical approach. This is one of the contributions of this thesis. It brings together psychological learning processes with the formation of organizational routines at the level of the firm. The theoretical intertwine between agency and structure in the analytical framework is explained in Chapter 2 and further elaborated, based on the empirical results of Chapters 4 and 5, in Chapter 6.

Evolutionary economics, resource-based theory of the firm, and social cognitive learning theories are complementary to each other in order to shed light on the black box acknowledged by each discipline (e.g., Kraaijenbrink, Spender et al. 2010). From the economics perspective, learning is highly recognized as a necessary process for innovation (Best 1990), growth (Penrose 1980 [1959]) and evolution (Nelson, Winter 1982). The basal claims of these approaches assume a critical, if not central, role of learning processes.

On the other hand, learning processes in organizations have been extensively theorised about, including the multilevel effects of learning beyond the individual, with impacts on teamwork and organizational performance (Pantoja, Borges-Andrade 2004, Klein, Kozlowski 2000). The gap in this literature is the result of a scarcity of empirical studies (Rous-

seau 1997), for example in measuring impacts of learning on organizational effectiveness (Kozlowski, Bell 2003). Two types of learning processes are distinguished: formal learning, commonly achieved through training programmes, and natural learning, in which the learner controls the learning process. A series of studies have investigated on-the-job impacts of the former (e.g., Kraiger 2003), but little is known about the effects of the latter on individual performance and organizational effectiveness. Therefore, by investigating entrepreneurs' learning processes as they take place, this thesis contributes to studies about natural learning in organizations. At the institutional level, business incubators are redefined as learning settings that combine formal training through pre-set consultancies, and natural learning through formal and informal networking between groups of entrepreneurs and entrepreneurs and other actors (see Chapters 3 and 6).

The possibility to explore these complementary black boxes, explaining learning processes in organizations and their impacts on the organizational functioning, configures the theoretical motivation of this research. This is a bold task, even when the scope of the study is delimited to business start-ups. This delimitation allowed for the examination of the dynamics of formation, transformation and replacement of routines through intricate relationships between individual and organizational levels. Hence, there are three levels of analysis: individual (learning processes), organizational (critical learning episodes), and pathways (typical pathways that aggregate individual start-ups).

1.3 Theoretical positioning

Foss (1999) organizes the history of the theory of the firm in three phases. The first corresponds to the neglect of the firm for the predominance of price theory. The second, from the late 1930s until the beginning of the 1950s, refers to the few first studies tackling issues such as the reasons why firms exist, the boundaries of firms (forces determining the size of firms), and the internal organization of firms (returns to management). These became classic studies but were followed by little development until the 1970s, since economic theory was dominated by the neoclassical model. Nevertheless, these studies in the 1950s and 1960s provided important foundations regarding transaction costs and incentive properties making it possible to understand economic organization beyond the price mechanism. Some of the studies in this phase refer to the

social choice theory, the comparative institutionalist approach (transaction costs and property rights), industrial organization, managerial and behavioural theories of the firm (incentive conflicts), welfare economics and information economics (market failures and information asymmetries). In the third phase of the history of the theory of the firm, developments leading on from this earlier conceptual basis generated independent streams in the literature in modern theories of the firm.

Despite independent developments, all these theoretical attempts share three key questions: the boundaries of the firm (or the scope), the internal structure of firms and the relations between firms and market (Garrouste, Saussier 2005). Debates about these questions were still abundant in the 1990s (Foss 1999), much driven by the first critiques to the partiality of these approaches and initial advances towards combining internal firm capabilities and an external environment that can be conducive or constraining to change (Chandler, Hagstrom-Jr. et al. 1998). These questions are addressed in this study in different levels:

- Boundaries of the firm: these are defined by the formation of organizational routines that establish the internal control over resources and the firm's relationships with the external environment. They are not static, but rather in constant change as a result of opportunities or threats. Endogenous and exogenous factors contribute to the definition and adaptation of firm boundaries.
- Internal structure of firms: the focus of this study, which analyses learning processes of business start-ups in-depth. The internal structure, which is zero at the beginning of a new idea, evolves through critical learning episodes. New resources are acquired or created and become integrated into the existing configurations of resources, or substitute existing resources if these strengthen the firm's structure. Configurations of resources regularly applied to the firm's functioning constitute organizational routines. These, when organized in a system, correspond to the firm's structure. An important assumption is that these changes do not necessarily correspond to growth in terms of revenues or number of employees. Moreover, the evolution of the internal structure of business start-ups cannot be represented, for most cases, in an ascending curve. Ups and downs are an inherent characteristic of firms and these changes over time are, here, examined through a longitudinal perspective[7].

- Relations between firm and markets: this thesis does not examine the condition under which firm organizations are preferred to market organizations. However, the study of critical learning episodes in the storyline of start-ups disclosed interactions and mutual influences between the internal organization of firms and markets. These interactions appear as the most prevalent of all events in pathways of business start-ups.

From these theoretical developments, Foss (1999) distinguishes between the incentive conflict theories and definitions of the firm as an information processor and as knowledge-bearer. The latter two theories "focus on the costs of storing, using, producing and transmitting information and knowledge" (Foss 1999, 20). From the knowledge-bearer approach, two theories provide the foundations for this thesis: evolutionary economics and resource-based theory. They share the following assumptions: a) learning and rule-guided behaviour are central to understanding firms, and b) knowledge and capabilities constitute the critical and distinctive resources of firms. Firms are superior to markets to develop knowledge because:

> First, knowledge is the result of learning and experience. Second, since it is the result of learning, it is context (local) and path-dependent (historical). Finally, it is partly tacit, and the organization is partly unaware of its existence because it is embedded in organizational routines and individual skills (Nelson and Winter, 1982; Cohen et al., 1996). For this reason, knowledge can be transferred only to a third party who has some absorptive capacity, that is, someone who has already accumulated the required knowledge to understand and integrate the transferred knowledge. […] Firms are therefore viewed as a governance structure that possesses advantages in generating firm-specific language and routines that yield valuable capabilities. (Garrouste, Saussier 2005, 185)

The knowledge-based view is on the intersection between economics and business administration, with parts of its' developments stemming from either discipline. From an economic perspective, this approach adopts the firm as an economic organization, distinct from the market organization due to its specific mechanisms to allocate resources to productive activities. From a business administration perspective, it sees the firm as a managerial organization, characterized by its internal organization and how it deals with knowledge and control. Control over different knowledge assets will lead to different efficiencies, and thus to dif-

ferent lengths of rents. Learning processes are emphasized at the level of the management team, responsible for creating routines and using excess resources as stepping stones for diversification. The knowledge-based view explains firm heterogeneity by evolution in industry dynamics (discussed at length in Chapter 2) or population dynamics (briefly discussed below).

This approach, therefore, emphasizes the role of internal firm processes in generating knowledge that shapes the distinctiveness of firms in relation to the market and between firms. Consequences of this differentiation impact on competitiveness, innovation and diffusion of innovation through imperfect communication channels. The assumption of bounded rationality underlies most theories in this perspective, but instead of building an argument of opportunism, bounded rationality may refer to the portion of knowledge that remains tacit, independent from opportunistic drivers (e.g., Conner, Prahalad 1996). Firms become more efficient in the codification of explicit knowledge and internalisation of human-specific investments in the form of routines (e.g., Zollo, Winter 2002, Eisenhardt, Martin 2000), reducing internal knowledge transaction costs.

In relation to the second question in theories of the firm, the internal organization of firms, Foss (1999) argues that this has not been a strong concern of economic theory; much of the literature stems from business management studies. Dynamic perspectives on the internal organization of firms focus on relations between learning and promotion (Garrouste, Saussier 2005). Issues of risk, uncertainty, types of knowledge and decision rights have also been studied, but no reference to learning assets in the evolution of firms in general or start-ups in particular was found in the literature reviews. Moreover, the focus on big businesses leaves business start-ups out. A possible explanation is the ill-fit of these businesses to the assumptions of these theories, given the narrower scope of these firms in relation to hierarchical levels and knowledge systems, scarcity of internal resources in the number of employees, organizational departments, complexity and divisions of tasks and activities, power in the market, internal structure, etc.

Despite these differences between business start-ups and big firms, this thesis claims that business start-ups are very dynamic firms. They count on less assets and resources, so their internal dynamics are remarkably dependent on knowledge acquisition and exchanges with external

sources to acquire resources. Furthermore, business start-ups in general are more susceptible to uncertainties. They are driven by the agency of entrepreneurs to assess and cope with these uncertainties, making room for processes of a cognitive and entrepreneurial nature to be incorporated into the theory of the firm (Xu 2011, Casson 2005). In this thesis, firms often do not rely on employees and it is common that internal contractual relations refer to scholarships to undergraduate students. Moreover, cases of firms with some hierarchy have no managerial tier, since entrepreneurs are simultaneously owners and decision-makers on the use of assets and the hierarchical structure is very shallow – with two or eventually three levels. As one of the entrepreneurs stated, the organizational culture of start-ups is of a network nature, based on horizontal relations between entrepreneurs and collaborators, who may, in some cases, easily become part of the team of associates for their innovative contributions. Therefore, the logic of social relationships inside business start-ups challenges the foundations of theories of the firm based on hierarchy and the superior knowledge of managers.

In sum, the following gaps in the literature on the internal organization of firms justify the design pursued in this thesis:

- Theorizations about the internal organization of big firms do not easily apply to the peculiar characteristics of business start-ups;
- Hierarchy inside firm organization does not necessarily imply more knowledge-specificity by managers in relation to subordinates/ employees/interns;
- Costs of knowledge transfer are lower in business start-ups because of their relatively horizontal internal organization. A probable related hypothesis is that communication flows more easily in business start-ups, reducing these costs and refuting the general normative claim that hierarchies are the best arrangement for efficient communication in firms;
- The entrepreneur needs to be acknowledged as rule breaker, decision maker, and learner agent. Cognitions and behaviours need to be placed at the bottom of firm formation, influencing a firm's boundaries and internal organization;
- Discussions about innovation as one of the outcomes of knowledge-based theories of the firm[8] are scarce. Hence, the novelties generated by learning are not accounted for at multiple dimensions; i.e., the re-

shaping of internal routines as innovation in process, the creation of a new product as innovation in product, and so forth;

- Being ahead of competitors is a concern but not the main drive of business start-ups. At this stage, establishing initial internal dynamics corresponds to establishing the boundaries and basic capabilities of the firm.

These gaps are investigated here through empirical research with entrepreneurs, who define what events were or still are critical to their start-ups. For each of these events, entrepreneurs report on the resources and actors involved, strategies used to learn new cognitions and behaviours, and the outcomes at different levels that shape the internal dynamics in their firms (organizational routines). These narratives also described the relationships between start-up and environment, which is composed by a broad range of organizations and institutions specific to on each start-up.

The following sections summarize the main assumptions, developments and critiques to theories from the broad knowledge-based approach to the firm. These theories are the resource-based theory of the firm, dynamic capabilities, resource dependence theory, and population ecology.

Resource-based theory of the firm

The resource-based view[9] of the firm developed as a reaction against the industrial organization literature, which claimed that the performance of firms is exogenously determined by the industry's structure. Instead, the resource-based view "explicitly looks for the internal sources of SCA[10] and aims to explain why firms in the same industry might differ in performance" (Kraaijenbrink, Spender et al. 2010, 350). The central proposition of resource-based theory is that "if a firm is to achieve a state of SCA, it must acquire and control valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities, plus have the organization (O) in place that can absorb and apply them". Fundamental assumptions of the traditional elaborations of this theory are:

- Firms are profit-maximizers;
- Managers are rationally bounded;
- Markets are reasonably predictable and move towards equilibrium;

- Information about the future value of a resource is asymmetrically distributed.

A key resource in this theory is knowledge. Knowledge has been operationalized in different ways. For instance, Conner and Prahalad (1996) examined knowledge dynamics between managers and employees in two organizational modes: firm and market. These authors provide an argument of knowledge-based transaction costs in contrast with the opportunism-based view of the firm. Following Penrose's assumptions, they highlight the importance of managerial competences for learning and firm growth. Hence, firms are "distinguished from markets based on an authority (employer-employee) relationship in the former, as compared to autonomous parties contracting in the latter" (Conner, Prahalad 1996, 478). Managers are assumed to have superior knowledge above employees and the transfer of knowledge, especially of specific knowledge that renders competitive advantage, is favoured under the firm organizational mode.

Knowledge is a resource that works in opposition to the predictions of declining returns to scale (Wernerfelt 1984). Wernerfelt (1984) claims that a broader perspective on resources, such as the one elaborated by Penrose, has received little formal attention because of the challenges it imposes on economic theory or factor demand. Kraaijenbrink et al. (2010) define knowledge as a type of resource that is intangible and non-rival, that is, the more deployed, the more knowledge results. Hence, co-operation and co-development between firms may result in strategically significant knowledge. Kraaijenbrink et al. (2010) claim that, to examine these resource dynamics, the Penrosian distinction between resources and services is a useful conceptual tool.

In relation to knowledge transfer, bounded rationality plays a role, since individuals are cognitively limited to possess identical stocks of knowledge (Conner, Prahalad 1996). Bounded rationality, however, is insufficient to explain why stocks of knowledge differ. It is necessary to consider that other factors, such as knowledge from past experiences, individual backgrounds (human capital) and information currently available, strongly affect the current perception and judgment about knowledge. These will affect decisions to cope with environmental changes and to proactively promote change. Therefore, cognitive structures function jointly with the individual's history, the information available, and the current environmental conditions. These, in turn, will feedback the cog-

nitive structures (Kraaijenbrink, Spender et al. 2010, Xu 2011). Since much of this knowledge is tacit, its entire transfer is not a reasonable assumption. Hence, individual cognitive structures will always differ to some extent and will shape differently the way in which information is sought, perceived, acquired, processed, stored and retrieved to cope with or to trigger changes.

This view on the asymmetry of information and stocks of knowledge adds a degree of interpretation and sense-making of ambiguous environmental cues to cognitive processes in organizations (Hodgkinson, Healey 2008). It rejects the assumption of hierarchy in the value of knowledge (managerial knowledge superior to employee's), in favour of an argument of complementarity between sources and types of knowledge. In the context of business start-ups, in which entrepreneurs-founders perform, without mastering them, several functions in the first years of the business, there is a clear need for complementary expertise to establish the first routines that compose the boundaries of the firm. These, once coordinated in systems of routines, will fulfil the main condition for the firm's existence. Through these systems, resources are combined and used in multiple ways for firm functioning such as managerial competences, inter-firm cooperation, technological development, marketing strategies, financial management and new interpretations of alternative ways to use resources within the firm structure.

Many resources, especially in the small scope of business start-ups, need to be acquired through networking. Thus, exchanges with the external environment are essential to a resource-based theory of the firm (Kraaijenbrink, Spender et al. 2010, Teece, Pisano 1994, Eisenhardt, Martin 2000, Zollo, Winter 2002, Aramand, Valliere 2012). Networking activities are linked to creativity to endogenously generate value to resources, to facilitate radical innovation, to learn the dysfunctional parts of routines, to promote social exchange of information, to foster technological innovation, to multiply the knowledge sources outside the firm, to produce knowledge, to generate variation, to identify resourceful actors and interact with them.

One of the first in-depth examinations of the resource-based theory is found in Wernerfelt (1984), who discusses the differences between resource position and product-market. Resources at a given time are defined as "those (tangible and intangible) assets which are tied semi-permanently to the firm" (Wernerfelt 1984, 172). The key point is that

resources will be attractive to firms if they can support a resource position barrier to competitors under the following conditions: no one else holds such a resource position; there are chances to be one of the few occupying that position. Yet, at that time, the definition of resources was too broad and based only on its functionality.

A challenge pointed out by Wenerfelt (1984) is the difficulty of identifying resources and the processes of setting up a structure and systems to execute firm strategies in comparison to the easiness of identifying products. The identification of resources is investigated in this thesis through a qualitative methodology based on the narratives of entrepreneurs. This method of investigation is consistent with a theory of the firm that recognises the role of the agent's perceptions and judgments about the firm's needs, criticality of resources, and the possible uses of these resources. As detailed in Chapter 2, learning processes are at the core of the formation of an internal structure and systems of routines. It is important to emphasize that, here, the notion of structure has an adaptive and changing dimension, which is challenged and reshaped through critical learning episodes.

A recent literature review of the resource-based view by Kraaijenbrink et al. (2010) pointed out the strengths and weaknesses of this theoretical approach in relation to eight categories; key arguments of the critique are summarized in the table below. It includes the counter-argument from the literature review and the position of this thesis in relation to each of these arguments. The first five points are arguably defensible by the authors, whereas the last three appear to be more problematic.

One of the theoretical attempts to develop the resource-based view into a theory of sustainable competitive advantage, reacting directly to points 1, 5 and 6 in Figure 1.1, is dynamic capabilities. Since this approach has been developed closely with evolutionary economics concepts, its main contributions to this study are summarized next.

Figure 1.1
Critiques and answers to the resource-based theory of the firm

Argument of the critique	Counter-argument in Kraaijenbrink et al. (2010)	Thesis
1) There is an illusion of managerial total control over resources, and capacity to predict their future value.	Not all theories have direct managerial implications.	No centrality is attributed to managerial roles; the entrepreneur is seen as someone in search of resources believed to be needed by the firm, with uncertainty about the outcomes they will provide.
2) Second-order capabilities (development of structures that better innovate products) are more valued than first-order capabilities (product innovation), leading firms to an endless search for higher order capabilities.	Critique applicable to mathematical models; not to interactions between levels of capabilities	The concept of capabilities, especially sustainable competitive advantage, is not discussed in this work. The context, scope, and configurations of resources in business start-ups differ from the structure of firms assumed in this critique.
3) Limited applicability of the theory at three levels: • Uniqueness of resources • Application to firms with market power • Implicit path dependence	There are degrees of resource uniqueness. Small firms, once they aim for SCA, can also be examined by this theory for their intangible resources – managers' aspirations and intentions. The inclusion of entrepreneurial capabilities opens the possibility of path breaking	Resources acquired from outside are not unique per se. Their use by the firm makes the services they provide unique to the start-up. Resources developed by the firm, for their potential added value, may carry a higher degree of uniqueness, but this is effectuated through their use. Business start-ups bring together the applicability of RBV to small firms and the entrepreneurial role to path breaking activities.
4) Non-achievability of SCA, for the static nature of the bundle of resources that composes a firm	Firms are not passive and SCA requires dynamism in the form of dynamic capabilities and learning (*ex post* sources of SCA).	Although not examining SCA, this study focusses on dynamic processes of learning and resource configurations that promote adaptation to change.
5) RBV is not a theory of the firm, despite recent interest in knowledge as a strategic resource.	Indeed, it does not sufficiently explain why firms exist. It should develop as a theory of SCA and leave the existence of firms to transaction cost economics.	RBV is a good starting point to investigate the internal organization of business start-ups, in which knowledge and networks seem to be more important than ownership of assets. However, other theoretical approaches need to be incorporated to a more integrative theory of the firm. For instance, evolutionary economics contributes, here, to define the boundaries of firms in terms of routines and the internal organization as systems of routines.

6) VRIN/O is neither necessary nor sufficient for SCA, since the literature has pointed out factors such as the ability to deploy these resources, for which the RBV does not offer a theoretical explication. RBV focusses on individual static resources. The literature also refers to uncertainty, resource specificity, and firm-level innovation as conditions for profit.	Indeed, RBV does not consider synergy among resources as a source of SCA; it neither considers judgment and mental models of individuals to create and assess value.	Linked to other points above, a dynamic perspective on acquisition and use of resources by entrepreneurs is adopted here. It highlights the role of agency in the formation of firms and path breaking activities, as well as the reconfigurations of resources across critical learning episodes. It offers some insights on capability deployment, although this is examined within critical learning episodes.
7) Indeterminacy and indefinite notion of value of resources, tautological definition of SCA (efficiency and effectiveness).	Need of a more subjective and creative notion of value; i.e., perceived, monetary, and exchange value. Value of resources can appear *a priori*, but value of capabilities is post hoc, after resource deployment. Debate: is the value of resource determined endogenously or exogenously? A time lag between acquiring VRIN and gaining a SCA may solve tautology, but would establish RBV as a theory of path dependence or "constraint over strategic resource allocation" (p.358).	The value of resources is not discussed or measured. Instead, the focus on critical learning episodes brings together two key aspects: • The role of agency to define what resource is critical, and, therefore, more subjectively valued; • *Explanans* and *explanandum* are distinguished in a contingent way in the phases of a critical learning episode. Lacking a valuable resource explains the occurrence of a CLE, and the creation of services to the firm through configurations of these resources is the *explanandum*.
8) Unworkable definition of resource. Anything strategically useful to the firm is a resource. There is a need to distinguish between resources (inputs to the firm) and capabilities (that enable selection, deployment and organization of these inputs). All types of resources are treated the same way.	"RBV could improve substantially if its basic logic were refined by explicitly recognizing differences among types of resources – static, dynamic; tangible, intangible; financial, human, technological; deployed, in reserve; perishable, non-perishable; and so on – and among types of resource ownership." (p.359).	The all-inclusive definition of resources is also here. The focus is not on creating a taxonomy of resources but on examining the dynamics of resource use, i.e., creation. Possession vs. integration of resources is not yet a dichotomy in business start-ups, because of the initial lack of firm structure, scarcity of resources, and considerable adaptations in the possessed resources.

Dynamic capabilities

The dynamic capabilities approach originated from the resource-based theory of the firm. The aim was to include a dynamic element in the competitive use of resources, in contrast to the firm as a static bundle of resources (Aramand, Valliere 2012). Teece and Pisano (1994), in their

seminal paper on the dynamic capabilities approach, lay out the following two pillars:

- Environment changes. Rapid changes will favour those industries developing high technology in a timely and flexible manner;
- Strategic management has a key role in coordinating and redeploying internal and external resources to guarantee the competitive advantage of firms. This requires high performance routines, which are embedded in a firm's processes and conditioned by the firm's history.

The dynamic capabilities approach has a prescriptive purpose directed to managers in relation to innovative strategies to deal with rapidly changing environments. It coalesces with the Penrosian resource-based theory for the exploitation of internal and external firm-specific resources and the exploration of new resources. This framework converges with the literature on innovation, for the distinction between explorative *versus* exploitative search activities (e.g., Xu 2011).

Teece and Pisano (1994) claim that, since firms are a more favourable arrangement for learning and internal knowledge transfer than markets, competences and capabilities are built rather than bought[11]. This makes replication less obvious or easy, since these capabilities are embedded in the firm's path (Teece, Pisano 1994). These authors describe two categories of paths towards competitive advantage: path dependence and technological opportunities. Path dependence refers to future prospects depending on the current position, paths ahead, and the path behind. This path behind does not exist for most start-ups or, for serial entrepreneurs, it corresponds to their personal entrepreneurial history. Technological opportunities, the counterpoint of path dependence, belong to the path ahead. They can be exogenous **or** result from a firm's engagement with basic research (network) **or** from endogenous R&D. Networks with research institutions and endogenous R&D make technological opportunities firm-specific.

Note that the main difference between Teece and Pisano's (1994) concept of paths of and the one used in this thesis is that, here, the path behind may have little to do with strategic decisions. Learning-based pathways concern critical events rather than only the results of managerial decisions. Therefore, the concept of pathways here is potentially more powerful as a source of predictions to the evolution of firms than it is in Teece and Pisano's concept, since it encompasses configurations

of resources beyond managerial competences, such as networking dynamics, learning processes, technological innovation, social capital, etc.

A detailed examination of the linkages between the dynamic capabilities approach and the resource-based view is found in Eisenhardt and Martin (2000, 1106). These authors advance common theorizations for distinguishing different functions of dynamic capabilities according to the speed of market dynamics. Dynamic capabilities have "greater equifinality, homogeneity, and substitutability across firms than traditional RBV thinking implies". Their specific function is changing the resource-base of firms. In moderately dynamic markets, this function resembles routines and refers to enhancing the current resource configurations for long-term competitiveness. In high-velocity markets, dynamic capabilities are unstable processes of adaptation with unpredictable outcomes, since they build new resource configurations to tackle an opportunity. Learning appears as the path-dependent mechanism through which dynamic capabilities evolve (Eisenhardt, Martin 2000). It involves three strategies: repetition, codification, and small errors. These strategies, and others, are empirically discussed in Chapter 4, in terms of the results gained from various types of learning strategies in critical learning episodes.

An important contribution by Eisenhardt and Martin (2000, 1106) is challenging the VRIN resources assumption, tackling arguments 3, 6 and 8 of Figure 1.1. These authors state that "since dynamic capabilities can be duplicated across firms, their value for competitive advantage lies in the resource configurations that they create, not in the capabilities themselves". Resource dynamics are the bottom line of the analytical framework (Chapter 2) and are explored at length in the empirical chapters. For instance, a finding that supports this statement is the creation of secondary products or services, out of reconfigurations of the available resources (Chapter 5).

Other studies brought the dynamic capabilities approach closer to evolutionary economics, such as Zollo and Winter (2002). These authors extend the dynamic capabilities approach to more environments. A dynamic capability is redefined as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (Zollo, Winter 2002, 340). Three key differences appear in relation to the original formulation by Teece and Pisano (1994): a) the notion of collec-

tive activity replacing the managerial role; b) the focus on routines rather than selection of paths ahead; and c) the emphasis on effectiveness rather than competitiveness. This revised conceptualisation also makes clear that dynamic capabilities are structured and persistent.

Since dynamic capabilities are those activities that change operating routines, they correspond to a specific type of learning mechanism, or learning routine. Ultimately, dynamic capabilities are constituted by search routines. Learning in dynamic capabilities result from learning by doing (or passive experiential learning), and from deliberate cognitive processes of articulation of collective knowledge (reflection upon past experiences that is articulated into new knowledge). The similarities between Zollo and Winter (2002) and this thesis are:

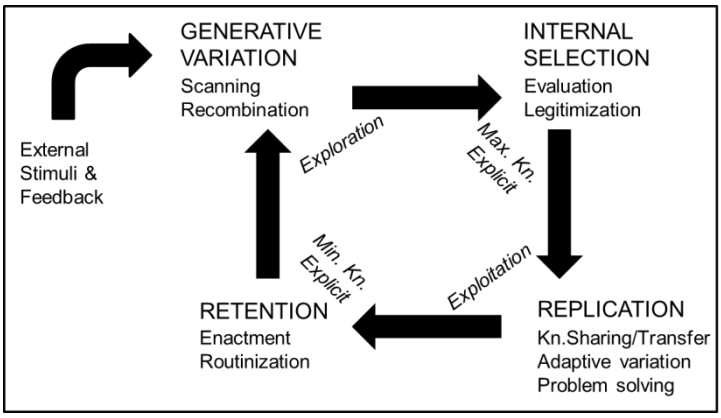
- Routines are shaped by learning processes through search;
- Behavioural and cognitive approaches are combined to achieve organizational learning;
- The external environment is a potential trigger to internal reflections and routine change.

Nevertheless, there are differences between the two studies. Zollo and Winter (2002) assume that learning mechanisms shape routines either through dynamic capabilities (search routines) or directly. This is a reasonable assumption for those types of learning mechanisms they focus on: experience accumulation, knowledge articulation, and knowledge codification. In this regard, the present study shows that individual learning does not directly change organizational routines. Chapter 4 provides empirical evidence that the effectuation of routines and the assessment of their effectiveness through entrepreneurial judgment are necessary steps for learning processes to shape routines.

Zollo and Winter (2002) propose a model for the cyclical evolution of knowledge in organizations (Figure 1.2) that is anchored in four evolutionary concepts: variation, selection, replication and retention. The first two concepts refer to the exploration and explicitness of knowledge; whilst the last two refer to exploitation and the embedding of knowledge in behaviour with declining abstraction and increasing explicitness. As in this thesis, Zollo and Winter's (2002) knowledge evolution cycle emphasizes events that trigger change, the combination of external stimuli and internal information, the internal selection of those ideas that improve existing routines or form new ones, and the feedback loop from the ap-

plication of new knowledge/routines to a new cycle. Within this model, this thesis focusses on variation and selection (the upper part of Figure 1.2).

Figure 1.2
The knowledge evolution cycle



Source: Zollo and Winter (2002, 343)

The main differences between Zollo and Winter (2002) and this study are:

- Stimuli are triggers to critical events and can be exogenous or endogenous. For the latter, triggers can also result from the agency of entrepreneurs in taking decisions to change,[12]
- Variation is generated through networks with external resourceful actors, not exclusively from members of the firm as maintained by Zollo and Winter (2002);
- Selection emphasizes most of all entrepreneurial judgments, since other factors are less prevalent in business start-ups, such as shared understandings of prior experience, power structures and legitimized processes;
- Replication is partly restricted to the repeated use of the routine by a small group of agents, given the limited scope of business start-ups. There is little room for codification as advocated by Zollo and Winter (2002).

Other, recent, developments in the dynamic capabilities approach started looking at entrepreneurial firms, bringing this theory closer to the field studied for this thesis. Aramand and Valliere (2012, 145), for instance, define entrepreneurial firms as those that effectively identify opportunities in the environment and exploit them, "either by acquiring ownership and control over the resources or by developing a new product or method of production"[13]. Resources portfolios are broadened mainly through networking, which permit the identification of resourceful actors and interactions to influence them to use those resources to the benefit of the firm.

Aramand and Valliere (2012) combine the concepts of dynamic capabilities and entrepreneurial capabilities to case studies in three Canadian entrepreneurial firms in the information and communication sector. These authors use the definition of dynamic capabilities from Teece and Pisano (1994). Entrepreneurial capabilities, in turn, refer to finding opportunities and exploiting them through the creation of goods and services; they characterize firms with high growth potential. This distinction between capabilities represents a step forward in the theoretical balance between path dependence and path-breaking, or, simply stated, between the reactive and the proactive roles of agents. These authors associate entrepreneurial capabilities with the short term exploitation of opportunities; and dynamic capabilities with long term competitiveness through the protection of existing competences and resources, and the deployment of new ones.

Resource dependence theory

The resource dependence theory combines elements of the information processing and the knowledge-based views of the firm. From the former, it considers the extent to which members of a firm devote attention to a limited set of environmental information, how this information is imperfectly incorporated to organizational information systems and how it impacts the relations between firm and environment. From the latter, it includes inter-organizational cooperation as a governance strategy to reduce uncertainty and transaction costs. It also highlights the role of managers in reading and reacting to the environment, seeking adjustment or control over critical resources. The bridge between information processing and knowledge-based decisions appears in the dependence on past experiences for learning what to read in the environment and how

(Pfeffer, Salancik 1978). The central point of this theory is to demonstrate that the environment matters more than endogenous processes.

Other concepts that are central in this theory are uncertainty in relation to access to resources, interdependence between organizations to cope with uncertainty, and power forces that shape inter-organizational relationships. Uncertainty in accessing resources creates instability and increases demands upon organizational actions. These depend on the environment and are constrained by it. The environment is enacted by the individual; it is created by the authority of the agent and, by it, is recreated. As a consequence, the attribution of meaning to the environment is retrospective to experience, shaped by specific events in the present time, and inherent to human information processing. Therefore, this theory acknowledges the role of agency in relation to reading and interpreting the environment (see Xu 2011 for an application of this approach to innovation studies). Through a combination of information about the present situation coupled with past experiences, managers use several inter-organizational strategies to manage interdependence and reduce uncertainty from interdependence (Pfeffer, Salancik 1978). Some of these strategies have been explored by further studies (e.g., Casciaro, Piskorski 2005), such as the establishment of joint ventures (which discussion is resumed in Chapters 5 and 6).

A theoretical assessment of this theory to explain organizational behaviour is provided by Nienhüser (2008). This author emphasizes the power dimension in interdependence relations and how it relates to the uncertainty caused by scarcity and concentration of resources. There is an objective dimension in this process of control over resources by some actors and the criticality of these resources for other actors. It refers to the actual amount of resources available. The other dimension, subjecttive, refers to the interpretations of managers about the distribution of these resources (Nienhüser 2008). Once more, the argument favours the role of perceptions and interpretations of exchanges with multiple actors to guide decisions. These perceptions and interpretations by managers are socially constructed and strongly influenced by information systems that filter information and, ultimately, influence the attribution of meaning to it. This resonates with the interpretive dimension of cognitions (e.g., Hodgkinson, Healey 2008).

A review of the resource dependence theory by Hillman et al. (2009), examines five enactment strategies used by organizations to manage en-

vironmental interdependence: mergers, joint ventures, boards of directors, political action and executive succession. A conclusion of this literature review is that, across strategies, a diversity of other theoretical approaches has been integrated to the resource dependence theory in search of better predictions. Nevertheless, comprehensive integration remains a gap in the literature, since so far empirical evidence only points out that resource dependence alone is not a good predictor.

One of these integrative efforts combines resource dependence theory with resource-based theory (Hillman, Withers et al. 2009, Nienhüser 2008). Since both approaches are complementary to the focus on resources, such integration would help explain organizational resource endowments and competitive advantage for obtaining unique resources from the environment. However, one of the conceptual problems with both approaches, pointed out by Eisenhardt and Martin (2000), is the reified notion of resources. This view of resources does not include changes in the configurations of resources nor give room for the creation of resources or innovation. An expanded conceptualisation is provided by Nienhüser (2008). This author refers to symbolic resources: these are cognitive representations of material resources, resource alternatives, and actors' interests and values. All these resources are socially constructed and their value is difficult to estimate, although they also influence power relationships.

Nienhüser (2008) claims the need for a dynamic perspective on resource dependence theory. He states that "it is not environment or resources that determine how organizational core groups decide or act, but cognitively and socially constructed environment. […] Rather RDT assumes that organizations create their environment too, change, disprove resistance etc." (Nienhüser 2008, 29).

Population ecology

The population ecology approach to organizations is marked by the studies of Hannan and Freeman in the late 1970s. The main assumptions of this approach are:

- Organizational change at the population level occurs through organizational births and deaths;
- Inertial pressures prevail. This theory attributes higher reliability and accountability to higher inertia.

The level of analysis is populations of organizations and how their prevalence is influenced by environmental pressures (Hannan, Freeman 1977). These authors, although recognising that adaptation and selection are coupled processes, focus on selection alone. They rely on models of competition and niche theory to in argue in favour of the impacts of environmental forces upon populations of organizations. The principle of rational selection of optimal combinations by organizations is at the basis of the theory and the attribute of rationality belongs to natural selection processes, so that the environment (market) selects out profit maximizers.

A key point in the argument of the population ecology of organizations is the non-reducibility of events at the population level to individual events. These are interdependent classes of events, but one does not carry all the characteristics of the other. For instance, the distinction between adaptive learning and adaptation of populations is that the former refers to the "selection among behavioural responses" (Hannan, Freeman 1977, 929), whilst the latter refers to "selection among types of members". Therefore, organizations do not necessarily disappear through an adaptive process. Populations with a given set of characteristics, instead, are selected to the disadvantage of populations with other sets of characteristics.

Recent studies on population ecology have explored the linkages between population ecology and evolutionary economics, based on the shared assumption of the core position of competition dynamics in environmental selection processes. One example is Bataglia and Meirelles (2009), who applied the concepts of variation, selection and retention. Variation is the number of components of an economic system; it can be increased by the introduction of new sectors or by the enhanced productivity of existing sectors. Selection and retention are the result of competition processes. Profit is defined as an expression of selection and source of constant adaptation. While selection refers to the survival of the fittest organizations, adaptation refers to change in the less-adapted organizations to improve adjustment to the environmental selective system.

Adaptation processes require strategic management to search and select adaptive routines[14]. The role of routines is to reduce uncertainty in complex decision-making processes. In addition to this, change can become part of organizational routines. These change routines, also dis-

cussed by Miner at al. (2008), correspond to routines of learning, in which past changes have dynamic effects on new changes (Bataglia, Meirelles 2009), in terms of learning outcomes and how to learn. One of the conclusions of this discussion is that evolution is partly deterministic and partly stochastic (Bataglia, Meirelles 2009). The selection of routines will lead to the better performance of some firms. As a consequence, their relative importance in the population increases, explaining the retention of the fittest firms.

Bataglia and Meirelles (2009) also point out the weaknesses of each theory. They claim that the weakness of population ecology is its structuralist stand, in which the environment has a deterministic role, and agency and organizational adaptation are left out (see also Salimath, Jones III 2011). Conversely, the weakness of evolutionary economics is the traditional neglect of non-technological innovation (the institutional processes for competitive and cooperative relationships). Nevertheless, evolutionary economics has the advantage of including the firm, the technological environment, and institutional aspects of innovative processes at the national, regional and sectoral innovation system levels.

These advantageous points justify the use of evolutionary economics concepts in the analytical framework of this thesis. In addition to this, the sample of firms used includes low R&D-intensive start-ups. This inclusion was facilitated by the empirical starting point of individual firms' critical learning episodes. Several of these episodes certainly affect most businesses, independent of their level of technological innovation.

Other critiques of the population ecology theory are found in Salimath and Jones III (2011). These authors point out the lack of clarity in the definition of constructs, issues in relation to the application and methodology to investigate theoretical claims such as selection mechanisms, the near absence of adaptation and organizational change, the reification of the environment, and the density dependence that omits the competitive advantage of big organizations within a population.

A deeper critique, from a philosophy of science perspective, argues that population ecology lacks a concept of selection in the evolutionary sense (Reydon, Scholz 2009, 411). "Evolution, simply speaking, is the change of genotype frequencies within organismal populations because of the differential reproduction of organisms with different genotypes. Such processes, however, require populations to exhibit at least minimal levels of closure and isolation from other populations". This is not the

case in organization populations, since: a) membership of a population is defined by what would be the phenotypes (shared organizational form); b) members show degrees of membership to more than one population; c) entirely new organizational forms would be placed out of a given population, preventing the emergence of "evolutionary significant variation in populations" (Reydon, Scholz 2009, 423); and d) populations of organizations lack the property of genetic continuity, which is the basis of replication and reproduction, through which variation/mutation is transmitted from parents to offspring.

The critique is ontological, for organizational populations are not sufficiently similar to biological entities. Hence, "talk of 'evolution' in the organizational realm is nothing but a metaphor and that metaphors can cause confusion as easily as they can yield illumination" (Reydon, Scholz 2009, 435). Despite these ontological and epistemological critiques, the population ecology approach contributed to alert organizational studies and management practitioners to the importance of environmental pressures and inertial factors in organizations. One of the implications of this is that adaptation to environmental changes is more complex than theoretical predictions would assume (Reydon, Scholz 2009).

This approach is not applicable to this study for the following reasons:

- Level of analysis: this thesis examines dynamics at the firm and entrepreneurial levels irrespective of the organizational population to which the start-up belongs;
- Prominent role of the environment: environmental influences are neither neglected in this thesis, nor placed at the forefront of the evolution of business start-ups;
- This approach rules out the role of agency;
- Specialisation *versus* diversification: the costs of these choices may be less critical to business start-ups than big enterprises. The former, because of the low level of their resources and looseness of their systems of routines, may benefit from flexibility for adaptation;
- Exchanges of resources between organizations involve diverse organizational forms. Since this thesis recognises these diverse exchanges as a form of social capital for learning, the assumption that "in equilibrium, only that organizational form optimally adapted to the de-

mands of the environment" (Hannan, Freeman 1977, 939) will endure does not apply.

Entrepreneurship literature and the theory of the firm

The sub-sections above have shown that, despite some different degrees of acknowledgement of the role of agents and their cognitive processes to understand firm dynamics, theories of the firm still lack a clear framework to integrate agency and, more specifically, to describe learning and knowledge processes within firms. In their assessment of the critiques to the resource-based view, Kraaijenbrink et al. (2010) state that the main underlying factor of these critiques is the neoclassical economic rationality that underlies this approach's assumptions and concepts. There is a need to recognise the role of human imagination and explorative action, since "the practical assessment and evaluation of resources involve subjectivism, knowledge creation, and entrepreneurial judgment" (Kraaijenbrink, Spender et al. 2010, 364).

In relation to entrepreneurship, and despite recent theoretical advances towards more comprehensive and integrative approaches, theories of the firm remain quite unconnected to entrepreneurship literature. An explanation for this gap is given by Casson (2005), who refers to the parallel developments of entrepreneurship studies in economic theories and in management literature. Another explanation claims that traditional theories of the firm fail to resolve the problem of the dynamic nature of entrepreneurship as a source of change and innovation, as opposed to the firm-organization as an environment of stability, control, and predictability of functions and outcomes (Jelinek, Litterer 1995).

Casson (2005) adopts an institutional approach to information costs for his proposed synthetic theory of the firm. The entrepreneur is defined in terms of "specialisation in judgemental decision making" (Casson 2005, 329). This definition implies:

- Improvisation in addition to reliance on routines to take decisions;
- Availability of public information;
- Availability of private information accessible to only a few;
- Risk and uncertainty;
- Subjectivity in the perception of risk.

One important implication of Casson's (2005) elaboration is that the establishment of new routines depends on the entrepreneur's judgmental decisions. Investment decisions will be driven by the types of volatility or shocks.[15] For long-term volatility, decisions will be improvised, since there are no routines to rely on. In this case the experience of the entrepreneur and the resources he/she can gather from his/her networks will count the most. For short-term volatility, however, there can be routines to monitor the environment and undergo internal adaptations. These are the routines that compose a firm. These two types of investment decisions work complementarily inside the firm.

Introducing entrepreneurship in the theory of the firm implies a radical change in the core of these theorisations, since it redefines the concept of the firm, the internal dynamics of firms (e.g., Jelinek, Litterer 1995) and the relationships between entrepreneur and market relations (e.g., Kraaijenbrink, Spender et al. 2010, Casson 2005). One of the main outcomes of the entrepreneurial synthesis of information is the identification of market-making opportunities, through the development of a new product or the refinement of an existing one (e.g., Casson 2005, Jelinek, Litterer 1995). This ultimately converges to the Schumpeterian contribution by including the entrepreneurial role of breaking economic stagnation through the creation of new markets (Alcouffe, Khun 2004).

An interesting aspect of Casson's analysis of entrepreneurship examines the issue of optimism, one of the individual characteristics of the entrepreneur. The entrepreneurial optimist influences others through information sharing, so that new ideas can be accepted – the 'buy-in' process (Jelinek, Litterer 1995). Factors affecting acceptance are the reputation of the entrepreneur (Casson 2005) and asymmetry of information between the originator of an idea and other parties (Conner, Prahalad 1996). Trust and agreement take time and effort to be built.

Factors related to the human capital of entrepreneurs are also accounted for in an integrative theory of the firm. Entrepreneurial characteristics highlighted by Casson (2005) are low risk aversion, self-confidence, social networking, subjective probabilities in assessing risk (optimism *vs.* pessimism), and the potential social influence of entrepreneurs upon others, such as customers, suppliers, financers, etc., to obtain support for the entrepreneurial idea. Other authors highlight educational level, educational specialization, work experience, entrepreneurial experience, technological experience (e.g., Gruber, MacMillan et al. 2012,

Kenworthy, McMullan 2010, Madsen, Neergaard et al. 2003, Bosma, Praag et al. 2002), personality, age and gender (e.g., Madsen, Neergaard et al. 2003).

Networks with diverse external actors are important in influencing imaginative and creative capabilities, and facilitating radical innovation and a dynamic view of the endogenous creation of value to resources (Kraaijenbrink, Spender et al. 2010).

Closing remarks about the theoretical position of this study

This thesis is delimited to the formation of the firm and its evolution in the first three to five years. Since entrepreneurial businesses in general and business start-ups in particular, are only marginally considered in most theories of the firm, this study contributes by investigating this gap.

It was discussed in previous sections that evolution involves variation, selection, replication and retention (e.g., Reydon, Scholz 2009, Zollo, Winter 2002); therefore, evolution is change. Theoretical approaches to change in economic units, such as firms, have tackled different parts of the puzzle to explain why and how these changes happen, and to predict their impacts on the firm and its environment. As the review of recent literature showed, there have been efforts to identify convergence points between these theories to facilitate the elaboration of integrative approaches. Inspired by these efforts, the analytical framework of this study integrates concepts of individual learning in organizations (Warr, Downing 2000), resource-based theory of the firm (Penrose 1980 [1959]), and evolutionary economics (Nelson, Winter 1982). This framework is detailed in Chapter 2.

This thesis follows neither the extreme position of attributing the internal organization of the firm to the environment (e.g., Pfeffer, Salancik 1978) nor to the dual relationships between managers and employees (e.g., Conner, Prahalad 1996). Instead, it draws on the change in the axiomatic base of the resource-based view that rephrases it under the Austrian framework by incorporating time and uncertainty. A consequence of this axiomatic change is defining resource and value in terms of the context, "implying there cannot be a single, universal way of categorizing resources" (Kraaijenbrink, Spender et al. 2010, 362).

Penrose's (1980 [1959]) concepts of resource and services of are embedded in the relative determinacy of endogenous and exogenous fac-

tors, which trigger critical learning episodes. During each episode, this study examines how resources are acquired, created, transformed and incorporated into organizational routines. This process involves cognitive (learning new interpretations), social (changing networks configurations), and practical (developing new methods) dimensions. As routines are implemented, legitimized and coordinated with other routines, the boundaries and internal organization of the firm are constituted. In the storyline of business start-ups, these critical learning episodes and the new routines are landmarks of firms' individual pathways. At an aggregated level, similarities between these pathways form typical evolutionary pathways that cluster start-ups together. Therefore, this study places learning at the centre of firms' evolutionary processes. It seeks to understand discontinuous learning episodes (which often involve path-breaking activities) for the development of new capabilities and routines, so that business start-ups can survive the valley of death (Cressy 2008 [2006]). The summarized narratives of two cases illustrate these points.

1.4 Objectives and method

The main objective of this research is to explain the evolution of business start-ups in the first three to five years of operation, through learning-based pathways. Pathways are obtained from the storyline of the business, starting with the formulation of a business idea. The literature labels this stage nascent entrepreneurship (Kelley, Bosma et al. 2010, Gelderen, Thurik et al. 2006) or pre-venture (Lichtenstein, Lyons 2006). Studies can be specific to the point of discerning phases of development of an intention to start a business, followed by a phase of recognition of opportunities and conceptualization of the idea, and concluding with the assembly of resources and the creation of the business (Gelderen, Thurik et al. 2006). In the present research this initial stage is characterized as the birth of the idea, the initial resources, and the initial network of entrepreneurs.

Once the idea is conceived and the business is somehow structured, the first years of operation are described in terms of critical learning episodes (see a brief definition of critical learning episodes and other key terms in Section 1.5). It is noteworthy that these episodes are not predefined by the researcher. Instead, they reflect the narratives of entrepreneurs about critical events that led to the creation, redesign, or replacement of organizational routines. Successful learning outcomes are

incorporated into the start-up's routines and become a protocol for action under similar circumstances.

Dynamics involving understanding organizational routines, search processes, learning, and, more specifically, critical learning episodes, allow for the examination of evolutionary paths and the role played by structure, agency and temporal factors. To contextualize the main objective, it is important to state that this research does not describe the relatively stable 'status of operating routines' emphasized by Nelson and Winter (1982). Instead, it examines processes that generate this status. Organizational routine is one of the key concepts developed by Nelson and Winter (1982) and by far the most explored in the literature on evolutionary economics (Feldman 2000). For example, the Journal of Institutional Economics recently launched a special issue about business routines (issue 7, number 2, 2011). However, most of these discussions are about the ontology of routines and their functioning, with little attention to the process that originates and changes routines: search. Moreover, when changes are examined, they are commonly attributed to exogenous factors such as crisis and external shocks.

Among the authors that claim the role of agency in changing processes in routines, most attention is given to continuous changes performed by employees (Feldman 2000, Lazaric 2008). Here, however, the subject is a process of search characterized by discontinuous change performed by entrepreneurs. The distinctive feature of a critical learning episode in comparison to continuous learning is the depth and extent of the changes it implies. Whilst small adjustments do not necessarily change the overall routine, a critical learning episode will take the business to a new stage in its evolution. For instance, changing suppliers to reduce production costs adjusts a routine of cost reduction; whereas accessing new production inputs that increase quality at affordable prices implies changing understandings about cost-benefit analysis, reshaping the production line to accommodate these new inputs, and possibly expanding the network of suppliers and buyers.

Search in entrepreneurial contexts corresponds to the acquisition of needed resources. These needs appear as triggers for CLEs and these resources are often knowledge-based, i.e., managerial competences, technology development, business partnerships, etc. Search processes for combining cognitive and behavioural activities for the acquisition, adaptation, retention, recollection and use of knowledge in organizational con-

texts, are strongly characterized as learning processes (Abbad, Borges-Andrade 2004).

An important ontological point is the nature of a CLE. As asserted earlier, an episode is considered critical according to the entrepreneur's perception of its (potential) effects upon the firm, so critical learning episodes are subjectively defined. As illustrated by the case studies in the beginning of this chapter, the same event can be experienced by different entrepreneurs in different ways. A common event for one entrepreneur may be critical for another. Perceived criticality can change with time, the pool of resources available to the firm, and the organizational services to deal with the event. At later stages, the perception of criticality can be replaced by an increased perception of control (similar to claims from the resource dependence theory).[16] Since the content of CLEs varies according to the perception of the entrepreneur, types of CLEs may increase exponentially. Therefore, one complementary objective of this research is to identify categories of CLEs (described in Chapter 4).

In addition to content, CLEs can vary in terms of duration. They can be as short as weeks (i.e., issues related to the formalization of the business) or as long as years (i.e., development of sustainable cash flows). Time, therefore, plays an important theoretical and methodological role. Since the effects of individual learning at the organizational level are a bottom-up process, they are likely to require more time to generate observable outcomes than top-down processes (Pantoja, Borges-Andrade 2004). This is a constraint for longitudinal studies, unless a retrospective perspective is adopted. Thus, the extensive use in this thesis of individual retrospective interviews (Flick 2007), in which entrepreneurs narrated the critical events in the trajectory of the business.

Collections of narratives are the predominant input material in studies of process (Langley 1999). The advantage of using narratives is that they can be bracketed in phases bounded by temporal break points. In this research, these boundaries corresponded to critical learning episodes. From the demarcation of these boundaries, sequences of CLEs and their internal dynamics were identified. As will be discussed in Chapters 4 and 6, this method was appropriate as a way to grasp the contents of these events, overlaps and exchanges between them, and networking dynamics within and beyond critical learning episodes. General methodological steps to conduct the research are presented in this chapter, but detailed

procedures to investigate CLEs and pathways are found in Chapters 4 and 5, respectively.

Data collection strategies

The first step for data collection was mapping business incubators in both states. A list of business incubators with their location, type of business attended, services provided, contact persons, time in operation, etc., was obtained from online databases, mostly from SEBRAE's (The Brazilian Service of Support for Micro and Small Enterprises), ANPROTEC's (The Brazilian Association of Science Parks and Business Incubators) and RMI's (Minas Gerais Incubators' Network) websites. The selection of incubators was based on two criteria. They should be either traditional or technological incubators, and should have been operating for at least 5 years. These criteria guaranteed that the structure of services was established and at least one cycle of incubation had been completed.

The selected incubators were contacted by phone with follow-up information by e-mail, and a logistic arrangement was put in place to sequence the interviews per geographical location. This procedure optimized the data collection process within each sub-region. The aim of these first exchanges of information was to enter the incubation system and identify eligible business start-ups for the research. The next step was to select and contact the entrepreneurs. They should be near or recent graduates from a business incubator – preferably within the past two years. This criterion aimed at a) increase the probability that all start-ups would have started in the same period, and b) reduce memory bias in relation to the events occurred in the first years of the start-up. Starting in the same period would increase the chances that these start-ups experienced similar macroeconomic and institutional contexts.

Face-to-face interviews with managers, incubatees and graduates followed. Whenever possible, interviews linked to a specific incubator were set up on the same or the next day. Indications of non-incubation comparative cases, when existent, were provided by the entrepreneur at the end of the interview. From this procedure, it was found that there were few or no comparative cases for the majority of the start-ups. This is especially true for high R&D-intensive businesses, given the degree of innovation of the product or service. The few competitors for this type of start-up were international or multinational companies, represented by

offices in Brazil. For those who reported comparative cases, access to most of them was very difficult or even impossible, despite successive attempts. The lack of a matching to sample group is a weakness of this study that compromises generalizing the results to businesses out of the incubation system. Implications of this weakness are discussed in Chapter 6.

Complementary secondary information about the selected business incubators and start-ups was collected in-between interviews. This information referred to the objectives, mission and vision of the incubator, selection process, services offered and support institutions. For start-ups, some websites provided information about the characteristics of the product, history of the business and other data that complemented the content of the interviews. Furthermore, information provided by support institutions (i.e., SEBRAE, FINEP, FAPEMIG) contributed to understanding the institutional context.

Overview of data treatment and analysis

The research primary material consists of recorded interviews (n=72), non-recorded interviews (n=5), pictures of the start-ups and business incubators, and the researcher's field notes. Field notes were based on observations of the facilities and the spontaneous dynamics (i.e., a visit of an alderman to the incubator), and on informal conversations with entrepreneurs, business incubator managers and support staff.

Interviews were submitted to the following steps for analysis:

- Brief summary based on fieldwork notes, carried out during the fieldwork period. Summaries for the interviews with incubators' managers, included: type of business incubator, services provided, selection criteria, profile of the entrepreneurs, critical episodes for start-ups based on their experience, and drop-outs. For the interviews with entrepreneurs, summaries reported the beginning of the idea, educational and professional backgrounds, critical learning episodes, learning strategies, networking dynamics, growth perspectives, sector-specific issues, role played by the business incubator in the evolution of the business, exit of the incubator, and competition issues. These summaries informed further stages of data collection through improvements in the semi-structured interview (Appendix A) and identification of other potential interviewees, i.e., matched cases, support institutions, etc.

- After fieldwork, the recorded interviews were transcribed and codified using Atlas.Ti (version 5.0.66) for coding, memo writing, and reorganizing the data according to the research questions. The main codes were the entrepreneur's background, learning episodes, networking dynamics, the role of the business incubator, and sector-specific dynamics. Fieldwork notes were also organized in electronic files and, when convenient, they were incorporated into memos linked to the correspondent interviews. Priority of analysis was given to the interviews with entrepreneurs. Codes for critical learning episodes resulted in a first classification of types of CLEs (see Chapter 4 for detailed methodological procedures).
- Two databases with all components of CLEs were constructed, one in Excel, focussing on the qualitative content of each episode, and one in SPSS (version. 16.0) for codified information about the characteristics of the business start-ups and entrepreneurs, components of CLEs and some other factors. Another database in SPSS was aggregated per start-up. These databases were used complementarily and results are shown in Chapters 3 to 5.
- Two main strategies were used to generate the results. The first was a cross-cut analysis describing types and distribution of CLEs. Chapter 4 presents and discusses these findings. The identification of CLEs and their characterization constitute the building blocks of a theoretical explanation of the evolutionary pathways of business start-ups.
- The second strategy focussed on pathways as a unit of analysis, in two stages. The first stage was characterized by quantitative analysis of patterns per sets of variables; the second was characterized by a qualitative comparative analysis between CLEs, following grounded theory principles. Details of the analytical procedures and the results yielded are in Chapter 5.

1.5 Outline of the thesis

This chapter reviewed the main theories under the umbrella of knowledge-based theories of the firm, and defined the theoretical position of this study. It laid out the research questions, motivations to undertake the study, research objectives and methodological main steps.

Chapter 2 describes how concepts from evolutionary economics, resource-based theory of the firm, social networks, and psychological theo-

ries of learning are articulated in the analytical framework. This framework is presented in two parts. First, it defines the concept of pathways and shows how they result from arrangements of critical learning episodes. Second, the concept and constituent elements of critical learning episodes are presented. Each element and its inter-relationships are detailed.

Chapter 3 characterizes business incubation programmes in general and the institutional setting of the business start-ups in terms of sources of funding, geographical distribution of resources, actors and the supportive roles these actors play. It then details those business incubators studied here in relation to packages of services, selection criteria, types of partnerships for resources, the profile of incubators' managers, etc. The chapter characterizes the start-ups, i.e., degree of R&D-intensity, configuration of initial networks and other factors, and the entrepreneurs, i.e., education, professional background, etc.

Chapter 4, the first empirical chapter, describes the method of identifying critical learning episodes and corresponding findings. The sequence of the chapter presents cross-sectional features of the five main types of CLEs, and explores each element of a CLE, combining qualitative and quantitative analyses. The chapter includes issues of resource use and networking dynamics, as well as illustrative cases. The role of entrepreneurial agency and structural factors to explain patterns of CLEs, issues of path-dependence *versus* path-breaking in learning processes and the advantages and risks of embeddedness in business incubators' networks are also discussed.

Chapter 5 describes the methodology to explore relationships between CLEs through time and the results in terms of evolutionary pathways. It explores the quantitative and qualitative analyses to identify aggregating typical pathways. Typical pathways' dynamics are discussed in relation to contextual conditions and endogenous factors, entrepreneurial characteristics, learning strategies and types of resource use.

The last chapter concludes the thesis by discussing the answers to each research question. It explores the theoretical, methodological, and empirical contributions of this study to explain the evolution of business start-ups. It draws initial arguments to improve the knowledge and resource-based theory of the firm that in fact places learning processes at its core. Search processes are unpacked using agency, structure and temporal factors, having critical learning episodes as the basic unit of analy-

sis. Issues of path-dependence and path-creation are revisited in light of the potentially dual role of embeddedness to facilitate survival and hold innovation back. Moreover, this chapter concludes previous discussions about the articulation between different levels of analysis regarding the development of entrepreneurial learning into organizational routines. Furthermore, the conclusion about pathways highlights aspects of entrepreneurial and firm characteristics, networking dynamics and institutional aspects that influence different pathways. A specific section is dedicated to the role of business incubators in providing operational, strategic and 'invisible' services, which are crucial in the proposed learning-based approach to the evolution of start-ups. The final section summarizes key contributions to development studies and presents a research agenda.

1.6 Key terms

Terms defined here are fundamental to grasping the argument of this thesis. The terms related to the analytical framework are detailed in Chapter 2, but for now it is important to briefly introduce them.

- **Business start-ups:** are entrepreneurial initiatives that aim to survive and grow in the market (Altenburg, Eckhardt 2006). They are dynamic organizations commonly characterized by limited assets and resources, thus making them strongly dependent on networking with external actors to acquire and create resources. Due to the scarcity of resources and looseness of systems of organizational routines, they are more susceptible to uncertainties, but also more flexible to innovate and diversify. Their internal organization is more horizontal and based on social relationships between members. Entrepreneurs tend to be multi-task, especially in the first years. They are characterised by high rates of failure in the first years, due to either the lack of access to needed resources (e.g., Mead, Liedholm 1998) or mal-management of available resources (e.g., SEBRAE 2007).
- **Triggers:** endogenous or exogenous events that start a search process. A trigger is the starting point of a critical learning episode, in the sense that, for the sake of business survival, it cannot be ignored. Example are the need for a financial management system for the business start-up (endogenous trigger); or important clients in default (exogenous trigger).

- **Resources:** tangible and intangible inputs into the firm. Penrose (1980 [1959]) states that resources result from changes or increases in knowledge as a result of experience. This notion in expanded here to include path-breaking activities that create new resources through innovation. Resources can be acquired from outside, such as machinery or training, created inside the firm, such as technology, or created in partnership with other actors, such as innovative products. The three main dimensions of resources in this thesis are cognitive (interpretations), social (networks), and practical (working methods).
- **Search:** is a variety of intentional or unintentional learning processes, through which organizational routines change. It is triggered by endogenous or exogenous triggers, and encompasses learning strategies and learning outcomes. Effective learning outcomes that solve the trigger are incorporated into organizational routines and conclude the search process.
- **Routine:** relatively stable configuration of resources applied to the regular functioning of the firm. Routines are the way start-ups systematically do things internally and in interaction with the environment. They do not work in isolation; rather, routines are organized systems of configurations of resources framed in general organizational rules of action. Examples of routines are application for R&D grants and financial management.
- **Learning strategies:** individual activities of information-processing used by the entrepreneurs to codify critical information that can help solve a trigger. These strategies optimize learning processes by facilitating the acquisition, storage and further recovery of learnt information (Abbad, Borges-Andrade 2004). Strategies can be cognitive, behavioural or self-regulatory.
- **Critical learning episodes (CLE):** critical events in the business start-up evolution, composed of triggers, learning strategies, resourceful actors, learning outcomes, and changes in organizational routines. They are turning points in the evolution of business start-ups, for the depth in which they change the internal organization of these firms. They are delimited by when the episode started, how long it lasted and when it finished.
- **Pathway:** arrangement of critical learning episodes that compose the storyline of a start-up. In a pathway, critical learning episodes can be

concomitant, sequential, independent from each other, or interrelated through exchanges of resources, interdependent or independent from each other. All this variation makes each pathway unique, but common features based on the focus of the business clusters start-ups in typical pathways.

- **Typical pathway:** typical pathways provide a comprehensive description of the evolution of groups of business start-ups, by considering the effects of the characteristics of the start-up, entrepreneurs, institutions, and learning through time. The most typical pathway, representing the classical evolutionary path, is defined by the direct production of the core product or service.

Notes

[1] Note that in the flow of the conversation with the entrepreneur, the question would be rephrased differently. Here, the central idea is presented.

[2] Survey conducted by SEBRAE with a representative sample of 14.181 business start-ups formalized in 2003-2004-2005 in all Brazilian States. They were in the industrial, commercial and services sectors.

[3] This is an improvement in relation to 2002, when 51% of Brazilian start-ups survived the second year (SEBRAE 2007).

[4] This new methodology applied to the Brazilian context is comparable to the methodology used by the OECD (2010), except for the inclusion of zero employee enterprises in the Brazilian statistics. This may lower the Brazilian estimations in relation to international indices, since enterprises with employees tend to be more stable.

[5] Industrial transformation value = gross value of production – costs of the industrial operations.

[6] A deeper discussion about the concept of learning and its dimensions is found in Chapter 2.

[7] Evolution is understood here as a discontinuous process, happening through critical learning episodes, due to the processes of generation of variation and selection of components to the structure of the firm. Non-critical and continuous activities and processes are acknowledged as part of the internal functioning of firms, but are not examined in this study.

[8] A clear exception is evolutionary economics, which examines research and development (R&D) dynamics for technological innovation at the industry level.

[9] The term resource-based view is used here in line with most of the literature reviewed. It refers to the initial developments of this approach. The term resource-based theory, found in more recent publications and applied to the other chapters of this study, reflects the current status of this approach, the most influential in the history of management theorizing (Kraaijenbrink, Spender et al. 2010).

[10] SCA: sustainable competitive advantage.

[11] A paradoxical elaboration of this theory is that dynamic capabilities are built through learning (by individuals), but the environment is what counts, as stated by Teece and Pisano (1994, p. 548): "A shift in the environment is a far more serious threat to the firm than is the loss of key individuals, as individuals can be replaced more readily than organizations can be transformed."

[12] Recent developments in the dynamic capabilities approach already include this argument. For instance, Aramand and Valliere (2012) claim that sources of dynamic capabilities can be endogenous, for changes in substantive capabilities, or exogenous, for changes in the environment.

[13] Note that entrepreneurial firms are not synonymous with start-ups.

[14] Note that Bataglia and Meirelles (2009) adopt the concept of routine as genotype, that is, the core competences (technical and administrative) to coordinate activities and learning in complex changing environments. This is a limiting definition of routines, as discussed in the thesis.

[15] The types of short-term shocks do not vary much but they are frequent, of small impact, with transitory effects and are reversible. Long-term shocks, on the other hand, are more diverse, occasional, have a large impact, and show persistent and irreversible effects (Casson 2005). It is noteworthy that this ex ante definition of the impacts and effects of these episodes contradicts the central assumption about the role of uncertainty in environmental change. It paradoxically seems not to rely on the firm's internal configurations of resources to change the impacts and outcomes of these shocks.

[16] Note that cases of misperception of critical events driven by entrepreneurs' overconfidence are not examined here (e.g., Luthans, Youssef et al. 2007).

2 Theoretical foundations

> *Economists have, of course, always recognized the dominant role that increasing knowledge plays in economic processes but have, for the most part, found the whole subject of knowledge too slippery to handle with even a moderate degree of precision, and have made little attempt to analyse the effect of changes in the traditional economic variables upon changes in knowledge.* (Penrose, 1980 [1959], 76-77)

This quote summarizes the status of learning processes in economic theory and research in the 1980s and indicates that advances towards describing the micro-foundations of economic dynamics are recent achievements. The current status of learning in economic theory claims that "Economic evolution is a growth of knowledge process" (Dopfer, Foster et al. 2004, 265). It is upon this perspective that the theoretical foundations of this thesis are laid out. This chapter presents how theories and concepts, developed mostly in economics and psychology, compose the analytical framework of learning and evolution of business start-ups.

The chapter first describes the relationships between concepts of evolutionary economics, learning processes, and networking. Next, each set of concepts is elaborated upon. The chapter starts with concepts of evolutionary economics, including the place of business start-ups in this approach. Then, specific aspects of learning are explored. Learning is examined in the resource-based theory of the firm, in social and organizational psychology theories. Networking activities are conceptualized in light of the literature on social capital and evolutionary economics. The following section describes the concept of critical learning episodes. Final remarks summarize the main points of the theoretical argument.

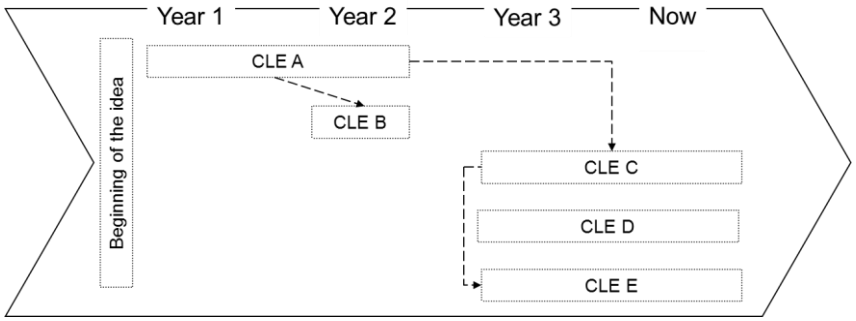
2.1 Analytical framework

The analytical framework is composed of two parts: pathways (Figure 2.1a) and critical learning episodes (Figure 2.1b). An individual firm's pathway is an arrangement of critical learning episodes (CLEs) in the story of the business start-up. This concept emerged from the qualitative analysis of dynamics of resources within and between CLEs. The primary condition for a pathway is the occurrence of at least two critical learning episodes. Pathways could not be defined a priori in the research design because even categories of CLEs were unknown and investigated in a very exploratory fashion. Hence, these individual pathways were compared in advanced analyses and showed patterns that were called typical pathways, for aggregating groups of start-ups. Pathways and typical pathways are the subject of Chapter 5.

Figure 2.1a has the following elements: a timeline indicating when each CLE started in relation to the beginning of the business. The duration of each CLE is indicated by the length of the box and relationships between CLEs are shown by the arrows. The following characteristics of arrangements of CLEs in a start-up's pathway are illustrated:

- CLEs can be concomitant (A and B) or sequential (B and C);
- CLEs can be independent (D) or inter-related (A and B);
- Resources can be exchanged across CLEs, independent of sequence or simultaneity (resources in A are used in B and C). These exchanges can be unidirectional or bidirectional (in simultaneous episodes);
- Dynamics within individual pathways, for the relationships between CLEs, can potentially disclose systems of organizational routines. This would require that, instead of referring to exchanges or resources, the arrows in Figure 2.1a indicate linkages between organizational routines. This property of pathways is not examined in this thesis, since for most start-ups these systems of routines were very loose if existent at all.

Figure 2.1a
Analytical framework – Business start-up pathway



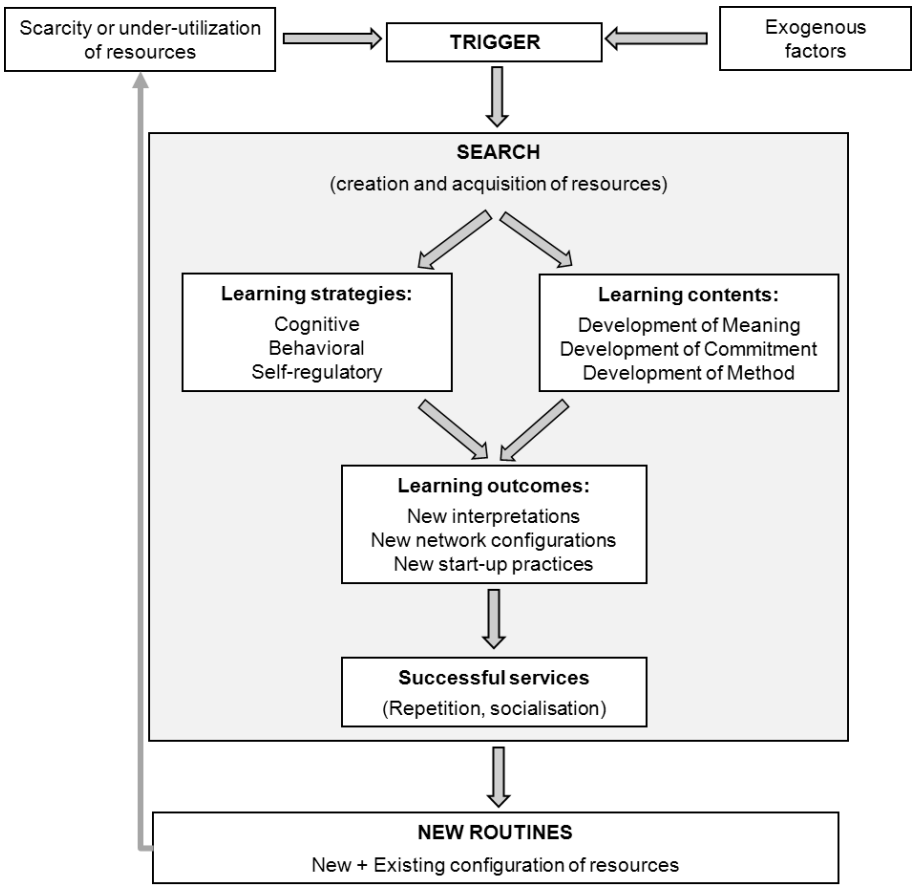
The concept of critical learning episodes, the second part of the analytical framework, is informed by three theoretical approaches. The most macro is evolutionary economics (Nelson, Winter 1982), with the concepts of search and routine. Next is the resource-based theory (Penrose 1980 [1959]), that defines the acquisition and transformation of resources into organizational services as key factors for firm growth. At the most micro level is the social cognitive theory of learning, which contributes with the concept of individual learning strategies (Warr, Downing 2000).

These three approaches are represented in Figure 2.1b. Relations between concepts across approaches are indicated by the arrows. The chain of steps in a critical learning episode starts with triggers to a search process. Events can only trigger a CLE to the extent that they require the development of new routines through mechanisms of search. These triggers can be endogenous or exogenous. Endogenous triggers, according to Penrose (1980 [1959]), refer to scarcity or under-utilization of resources inside the firm. Exogenous triggers (Nelson, Winter 1982), in turn, stem from the institutional setting of the business start-up, through market actors, support institutions, regulatory frameworks, etc. Note that the Penrosian process of acquisition and transformation of resources into services to the firm is also applicable to exogenous triggers, for the demands for new resources that they entail.

If the business start-up does not have the necessary resources or does not utilise them effectively, a process of search to acquire or create resources[1] is started. Search ends when new configurations of resources

solve the trigger. In order to be successful, these new services are incorporated into the organizational routines, at the bottom of the figure, changing the internal organization of the firm.

Figure 2.1b
Analytical framework – Critical learning episodes



The knowledge gap that this study investigates is ***how*** search processes change organizational routines. The part of the framework to tackle this process question is highlighted in the box between triggers and routines. It unfolds the search process in terms of learning strategies, contents, and outcomes. These are the elements of individual learning processes researched here. This whole articulation of concepts in Figure

2.1b configures a critical learning episode. A practical example of a CLE is a start-up that needs an expert in marketing to commercialize a new technology. This trigger can be solved through cognitive or behavioural learning strategies, for instance, by developing marketing competences internally or hiring an expert from outside. These new competences, once applied to the firm, will bring in services that were so far absent. If these services improve the functioning of the business, they will change current routines of product commercialization. As a spillover, improvements in this routine may affect the commercialization routines for other products produced by the firm. These new services can also affect the operating system of routines, impacting related routines, such as negotiation with clients, price formation, advertising etc.

This framework expands on Penrose's conceptualization of resource use in two ways. First, it considers any resource a firm needs to function, beyond just management, and includes technological expertise, financial resources, infrastructural facilities, and so forth. Second, it expands the possible types of resource use. The original concepts of acquisition and under-utilization of resources are expanded to include the dynamics of the creation and loss of resources. These four conditions are examined at the level of triggers, indicating the type of resource dynamic at the start of each CLE. These resource dynamics are detailed in Chapter 4.

Search is, thus, central in this thesis. It is defined as the process of acquisition or creation of resources through learning processes for the establishment of, or for change in, organizational routines. Search processes may range from the acquisition of managerial competences to the development of a new machine for the production line. It is noteworthy that several learning outcomes can result from a single search process; these are applied as services to the start-up. Those services that are considered useful are re-used on other occasions and become incorporated into the working organizational routines. This implies that not all resources will render useful services – at least not immediately – and that not all services will change the mix of working routines. These dynamics are empirically demonstrated in Chapter 4 and further discussed in Chapter 6.

The definition of search in terms of learning processes brings in two sets of concepts. One is the concept of learning strategies, defined by psychological theories of learning (e.g., Warr, Downing 2000). The other is composed of learning contents and learning outcomes from theoriza-

tions about network learning (Knight, Pye 2004, Knight, Pye 2007). These concepts will describe learning dynamics through which search can change current rules. The application of learning strategies is the first step in a search process. These strategies, the categories of which are detailed further, represent different activities involved in acquiring and processing information. They are used by entrepreneurs to achieve different learning contents. Learning contents are the focal topic of a learning episode as perceived by the entrepreneur and they express the needed resources to solve the trigger. For instance, in the example of needing marketing expertise, the learning content is bringing into the firm specific knowledge and, for that to happen, entrepreneurs may use strategies such as networking with resourceful actors to find this expert, or enrolling in a course to develop these competences themselves. Different categories of learning contents and their implications explaining search processes are discussed in Section 2.6.

Pursuing these contents accounts for most of the search process and, once they are achieved, learning outcomes are identifiable. These outcomes cover a wide variety of services for the business start-up and their types are described in Section 2.6. An important characteristic of learning outcomes is that they carry some degree of uncertainty, since there is a chance that the outcome will not provide a useful service. This would be the case, for instance, with an expansion in the network of buyers that results in episodes of default. Thus, only those outcomes proven to be effective are incorporated into working organizational routines, while others may remain as cognitions about how to (or not to) perform certain activities. Following the example, new understandings about reasons for default will become part of the organizational knowledge, but will not be identifiable in the organizational practices.

Hence, learning outcomes are different from organizational routines. The former are contingent to a critical learning episode and are the final part of an individual learning process. The linkage between them and the organizational routines is determined by the usefulness of the services provided by the resource acquired or created in these outcomes. Organizational routines, on the other hand, are located at the firm or inter-firm level, are more complex than learning outcomes, and more stable over time. Moreover, as routines become more complex and coordinated in a system, outcomes from CLEs will tend to affect more than one routine, or outcomes from more than one CLE will converge towards one single

routine. Nevertheless, in business start-ups, it is more difficult to differentiate learning outcomes from the initial organizational routines, because of the dynamic changes and adjustments in the latter. However, as these routines are established, socialized and legitimized, they become less subject to change by new learning outcomes. Empirical evidence of the dynamism of organizational routines is provided in Chapter 4.

The following sections will develop these main concepts. They are organized per body of literature, starting with evolutionary economics and moving onto the conceptualizations of learning in different theories. At the end, a section on critical learning episodes is elaborated and some final remarks are presented.

2.2 Evolutionary economics

Concepts of evolutionary economics (Nelson, Winter 1982) are included in the analytical framework of this study for their focus on explaining economic change. Although it is concerned with industry behaviour, evolutionary economics recognizes that individual firms play an essential role. This role relates to the creation and change of organizational knowledge. This change can be brought about by deliberate choice (endogenous factors) or by non-chosen and unwelcome processes (exogenous factors) (Nelson, Winter 1982). Deliberate choice relates to a search for knowledge "in a source known to contain the answer, or an extended search for a problem solution that may not exist" (Nelson, Winter 1982, p.64). This thesis adopts the distinction between endogenous and exogenous triggers to change, but it does not support the match between endogenous-welcome and exogenous-unwelcome. Both sources of change can lead to positive or negative outcomes. For instance, when a competitor fails to provide a promised service (exogenous factor), market opportunities are opened up to business start-ups (welcome process). Other examples are discussed in Chapter 4. Evolutionary economic theory is based on three main concepts: routine, search and selection (Nelson, Winter 1982). As discussed above, search and routine are the two concepts redefined here at the firm level to explain the evolution of business start-ups.

Search

Search is "a rubric for the variety of processes, mostly intentional but some not, by which rule changes take place" (Nelson, Winter 1982, 171). In the analytical framework developed in this thesis, this variety of processes is narrowed down to those intentional or unintentional learning processes that are critical for the survival of the business. They keep the same characteristics of search elaborated by Nelson and Winter (1982):

- *Irreversibility*: relates to the acquisition of knowledge. Retention and use of new knowledge usually incurs less costs than its acquisition or production. In business incubation settings, however, the costs (in terms of finance, time, trust etc.) of acquisition and production of new knowledge are expected to be minimized by the incubator's facilities (e.g., infrastructure, research laboratories, networks), constituting one of the reasons why entrepreneurs opt for taking part in these programmes;
- *Uncertainty*: among many alternatives, the decision-maker (entrepreneur) can rarely count on clear information on what the best choice is. "The process of exploring perceived alternatives, or exogenous events, may bring to light other alternatives not even contemplated [by the firm] in the original assessments" (Nelson, Winter 1982, 171). Here, again, the set of available alternatives might be widened by being in the institutional setting of a business incubator, through access to resourceful actors. Moreover, the embeddedness in this network contributes to capturing inputs to choose among these alternatives. Both the range of alternatives and the inputs from which to choose are expected to lower the perception of risk and to increase the sense of control over the environment;
- *Contingent character*: the success of search processes depends on solutions that are potentially available in a given context. The local dimension of search is fundamental to explain and to understand the agglomeration of business start-ups – and of business development services too – in certain regions. Capital cities and other resource-rich centres are expected to improve chances for small enterprises due to the presence of externalities such as suppliers, labour, and technological spillovers. These are critical sources of solutions for start-ups' needs, as shown in Chapters 4 and 5. At the opposite end, start-ups in poorer areas lack access to market actors, skilled labour, etc. The

availability of local and regional resources is elaborated in Chapter 3, in relation to the availability of funding and the geographical distribution of business incubators in São Paulo and Minas Gerais.

The link between intentionality and outcomes deserves some attention here. This study investigates search processes that are triggered by both deliberate and non-deliberate factors. Entrepreneurs engage in search processes to achieve those learning contents they judge will provide the solution to the trigger. However, during a search process, unexpected outcomes also appear. For example, if the entrepreneur deliberately aims to increase sales through expanding the portfolio of buyers, he or she will engage in a search process to access new buyers, to establish a business model with sales representatives and final consumers, and so on. If new buyers default on the payment agreements, unintentional outcomes will lead to a change in the sales routines accordingly, possibly leading to a redesign of the sales strategy. Hence, intentional and unintentional search processes may result in both expected and unexpected outcomes.

Search and learning

Literature is scarce in describing how search processes work (Lazaric 2011). Originally, Nelson and Winter (1982) remarkably associate search to R&D and describe some decision rules for the allocation of effort put into R&D. They describe two search processes. The first assumes a regular and constant topography of technological alternatives, a process triggered by insufficient target returns in which search would have no particular direction, with a high probability of developing something close to the current technology. Market conditions would affect the engagement with search activities and the likelihood of profit. The second process assumes more complex strategies and topographies in a general model. This is the case of not yet created technologies, of which the economic attributes are unknown and some of the technological attributes are known. The search strategy, then, is setting up decision rules for the research activities and the direction of search, facilitating the learning of technological details and the development of the technology for practical application, combining economic and technological attributes. This is clearly a R&D perspective of search processes.

Alternatively, this thesis includes any resource, including but not restricted to R&D, which demands a search process. Here, entrepreneurial

judgment about what resource is needed and cognitive factors, such as the beliefs by knowledge-holders on what can be advanced through search, are taken on-board. The role of agency in search is illustrated by narratives on joint venture breakdowns. If one of the associates is against engaging in search to increase the organizational complexity, it is common that he or she leaves the business. Therefore, these shared cognitive frameworks, based on knowledge, social values and goals, are necessary to enable processes of intrinsic motivation and conscious commitment to learning. In turn, the outcomes of this process will reflect back onto both the individual and organization, in the form of new interpretations, network configurations, work methods, and routines. In a paper that reclaims the two-way causation between individuals and organizations, Lazaric (2011, 153) states that

> The emergence of mechanisms of change stemming from individuals, but which have an impact on the organization ('upward causation'), and the changes within organizations that radically affect individuals ('reconstitutive downward causation') (Hodgson, 2007:108) are worthy of investigation.

A concept that complements this relation between individuals and environment for search is distributed agency. Distributed agency reflects the idea that different resources are in the hands of different actors, so that routine change can only take place when there is an exchange of resources and coordination between these actors (e.g., Garud, Karnoe 2003, Garud, Kumaraswamy et al. 2010). Therefore, networking is a critical activity in search processes. Another central concept from this relational ontology is path creation. It assumes that it is impossible for the entrepreneur to promote change by his or herself and that there is therefore a need for a network of other actors to create new rules and legitimate them (Garud, Hardy et al. 2007). Although this literature does not discuss routines specifically, the underlying rationale of distributed agency and creation of new paths is well-aligned with current conceptualizations about changes in organizational routines.

Moreover, the three characteristics of search (irreversibility, uncertainty and contingent character) provide the basis for those processes involved in search, presented in the analytical framework (Figure 2.1b). First, individual learning strategies aim at fulfilling specific learning contents and are clearly irreversible, uncertain and context dependent. The

choice for a private investor instead of a public grant, for instance, will first of all depend on the local availability of both types of financial sources. If the business has never counted on either type, choosing implies in higher uncertainty about the outcomes of that choice. Although the choice itself may not be irreversible, in the sense that changing or combining sources of finance may be possible, the learning acquired from either choice remains for future decision-making. Therefore, learning contents about what an angel investor is, what the requirements to access these funds are, the involvement an investor can have in the firm, the efforts to elaborate a proposal for investment etc., irreversibly become part of the organizational pool of knowledge. Consequently, outcomes such as the ability to elaborate a funding proposal, the establishment of new networks with private investors and a new mind-set to weigh the advantages of private investment in relation to public funding become resources available to the firm. Again, these outcomes are irreversible, uncertain and context contingent. Here, the contingent character includes also endogenous factors such as the start-up capacity to deal with different sources of investment.

At the closing of a search process, two factors will influence how these learning outcomes will impact on the firm's functioning. First, there is the entrepreneurial assessment of the effectiveness of the outcomes, once they are incorporated into the firm. Second, there are the internal conditions of the start-up to implement change. Yet, once change is implemented, another type of uncertainty arises. Even under favourable conditions, the impacts of new resources on the existing configurations of resources organized in routines are uncertain. The magnitude of the impact of these changes will depend on the complexity and interweave of the current system of routines and on the strength of environmental demands. Knowledge about this intricate combination of factors also remains as an asset to the firm. This description of search process shows that its key characteristics are present at different stages of the process, from the individual strategies to deal with triggers to the impacts on organizational routines.

Routine

Nelson and Winter (1982, 125) define routine as the skills of hierarchical industrial organizations.

> Routines are the skills of an organization. The performance of an organizational routine involves the effective integration of a number of component subroutines (themselves further reducible), and is ordinarily accomplished without 'conscious awareness' – that is, without requiring the attention of top management. [...] A routine may involve extensive direct interactions with the organization's environment and the making of numerous 'choices' that are contingent both upon the state of the environment and the state of the organization itself, but these choices involve no process of deliberation by top management.

These hierarchical organizations are characterized by the provision of the same type of goods and services over extended periods of time and by a top management level for decision-making. It is noteworthy that the power to change organizational routines lies in the hands of top managers,[2] even under demands from exogenous factors. This brings Nelson and Winter's (1982) elaboration closer to Penrose's theory.

Recent discussions on the ontology of routines have tried to overcome the metaphorical character of the original formulation by postulating that routines are continuously being reinvented, reshaped and readapted by ongoing performance (e.g., Feldman 2000). These authors (e.g., Lazaric 2011) claim that individual actions (agency) are embedded in and influenced by the abstraction of routine (structure). In Lazaric's (2011, 150) words "[r]outines evolve according to various internal or external pressures and create focal points around which organization members agree to organize their work or activities". This claim, however, does not answer the question *how* these pressures, or triggers as defined here, change working routines. Another definition claims that routines are "repetitive recognizable patterns of interdependent actions, carried out by multiple actors" (Feldman, Pentland 2003, 95). These theoretical developments emphasize the dependence of routines on what individuals and organizations do within a given environment and explicitly recognise multiple agencies in processes of routine formation and change. This is observed in business start-ups, with the strong influence of the local availability of resources on entrepreneurial decisions about which resources to choose from and about strategies to create resources that are inexistent or inaccessible in their environment. These new resources, for the new configurations of resources and innovation they generate, feedback into the internal and external environments of the firm.

Routines in this study

Routines are relatively stable configurations of resources applied to the regular functioning of the firm. They are organized as a system framed in general organizational rules of action. This definition includes recognizable patterns of interaction between individuals and the environment, and the role of multiple actors in continuously reshaping routines as they are performed. An important aspect of this definition is the importance of shared cognitive frameworks and the motivation to build these patterns of interactions (Witt 2000, Lazaric 2011). Cognitions and motivation are, by definition, individual (e.g., Witt 2000, Bastos, Gondim et al. 2004). Once socialized, they emerge to the organizational level of analysis, ontologically linking individual competences to firm's routines (e.g., Vromen 2011). In addition to the cognitive aspect, there is the interactional nature of routines. The latter has been conceptually treated as being separate from the former (e.g., van der Steen 2009), with implications for a more comprehensive concept of routines.

Therefore, the inter-organizational dimension of some routines, supported by empirical data here, expands the *locus* of routines from inside the firm towards inter-organizational borders. One example is the creation of spin-offs in partnership with other start-ups and the development of parallel administrative structures for the spin-off. This type of arrangement implies network routines involving entrepreneurs of the two first start-ups to run a third business, corroborating a scenario of industrial networks of cooperation, in which

> We distinguish technical, planning, knowledge, socioeconomic and legal bonds. These bonds can be exemplified by, respectively, product and process adjustments, logistical coordination, knowledge about the counterpart, personal confidence and liking, special credit agreements, and long-term contracts" (Johanson, Mattson 1991, 257).

Already at earlier stages of firm development, entrepreneurs develop routines that are essentially inter-organizational in order to access and deploy resources that do not exist internally. Therefore, these are important routines to cope with the scarcity of intra-firm resources and to reduce the costs of developing a whole set of resources internally. As discussed in Chapter 5, a specific pathway develops out of this strategy, through the creation of spin-offs for the secondary product. This expansion of the *locus* of routines (Lazaric 2011, Feldman, Pentland 2003)

strengthens advanced arguments about the necessary individual-environment interactions to understand routines. These arguments were originally developed in reaction to earlier unbalanced claims favouring structural exogenous factors. Here, the comparative simplicity of business start-ups in terms of mix of routines pointed out the great number of inter-organizational exchanges in accessing inputs for routine formation and change. This suggests that inter-organizational routines gradually convert into internal routines, as more resources are acquired or created and the boundaries of the firm are delineated by its systems of routines. As a consequence, this research is in agreement with the literature that advocates multilevel research to investigate routines (e.g., Vromen 2011).

In sum, this thesis supports the tripartite basis of the concept of routines: the operational (e.g., Nelson, Winter 1982), the cognitive (e.g., Witt 2000), and the interactional (e.g., van der Steen 2009). This concludes the conceptualization of routines as closings of search processes. Nevertheless, as indicated by the arrow from routines to endogenous triggers in Figure 2.1b, routines can also trigger critical learning episodes. This theoretical assumption is analysed empirically in Chapter 4 and discussed in Chapter 6.

Since the concepts used in evolutionary economics were developed for hierarchical industrial organizations, many issues arise from their application to business start-ups. Hence, an overview of the evolution of business start-ups is provided to situate the analytical framework in this literature.

Evolution of business start-ups

A good theoretical starting point to discuss developments of evolutionary economics towards simpler organizational units such as business start-ups is provided by Dopfer (2004). This author discusses the microfoundations of economic theory, bringing the autonomy of individual agents to the centre of the dynamics of the firm.

Dopfer (2004) claims that "The explanatory core of an evolutionary theory of the firm or any other micro unit must be a behavioral model that links with both the subjective cognitive dimension of rules[3] and the objective blueprint dimension[4]" (Dopfer 2004, 182). The cognitive dimension, here, is represented by the entrepreneur's knowledge, business-related exchanges in the firm's networks, and operational practices.

These correspond to the three dimensions of outcomes of critical learning episodes. The entrepreneur, therefore, plays a central role as cognoscente agent (Dopfer 2004):

> The evolutionary microeconomic agent, in this sense, has internal and external structure: internal structure is built upon cognitive and imaginative capabilities (the agent has a mind) and external structure is built from specific interactions with other agents (the agent has a society). From the evolutionary perspective, each agent is continually engaged in problem-solving that results in the construction and maintenance of complex systems of rules. The role of micro as an analytical domain, then, is in relation to a 'micro trajectory', which is the process that describes how an agent originates, adopts, adapts and retains a novel generic rule (p.269).

Within Dopfer's theoretical perspective, this thesis sits at the micro level of an economic system, the one in which rules are subjected to the agency of entrepreneurs (Dopfer 2004, 2005). Instead of applying the concept of rules, however, the analytical framework of this thesis adopts the concept of resources. There is no assumption that resources and rules are interchangeable. The argument is that, while Dopfer (2004) focusses on rules, this thesis focusses on dynamics of resources. The underlying common process is the agency of the entrepreneur for creation and change at the micro level.

In terms of scope, Dopfer's micro perspective, however, does not define the firm in terms of size or stage of development. Similarly, the entrepreneur can be located outside or inside an organization, whether as founder or employee. This thesis, however, is delimited to business start-ups and founder-entrepreneurs. The entrepreneur takes central stage as the agent that develops new ideas for the formation of a new firm and is the one involved in problem-solving activities for its evolution.

Learning in evolutionary economics

Part of the literature on evolutionary economics has looked at the relationships between routines and learning, providing a body of research that connects these two central concepts in this thesis. A good analysis of this literature is presented by Miner et al (2008), who claim that the introduction of learning in evolutionary studies challenges those models that strictly parallel social and biological systems, for the recognition of

the cognitive dimension of organizational processes. These authors distinguish four types of relationships between routines and learning.

The first relationship presents routines as organizational memory, highlighting the role of routines in encoding prior experience, providing codes for action, and containing procedural and/or declarative knowledge. Two noteworthy points are a) that the existence of routines does not assure enactment and b) some routines can be more fully incorporated into the daily functioning of the business than others. This type of relationship appears in Chapter 4, when working routines a reused to cope with CLEs.

The second type of relationship between routines and learning refers to the changes in the mix of stable routines. It involves a learning cycle composed of three phases: creation of variation in the routines available, selection among these routines for future enactment, and retention of a new mix of routines. This is the relationship focussed on in this thesis, narrowed down to variations caused by critical learning episodes. This thesis also includes an element highlighted by these authors as a research gap: the need to investigate the origin of new routines that do not necessarily result from recombinations of existing ones, but from imaginative actions based on prior experience applied to real-time experiences. This scenario is typical of business start-ups' dynamics. Miner et al. (2008) characterize the key processes of variation, selection and retention according to two sets of sub-processes that generate systematic change in the nature and mix of routines: internal/external (here, endogenous and exogenous triggers) and deliberate/emergent (here, the focus is on deliberate processes).

Moreover, environmental conditions will impact which of these processes will be stronger. "Dynamic environments challenge the system to find balances between retention and variability that sustain the value of prior learning while avoiding obsolescence" (Miner, Ciuchta et al. 2008, 175).

The third relationship between routines and learning is adaptation through the transformation of routines. This relationship explores partial changes for refinement of the same higher-level routine, which may take place in either its interpretive or performative dimensions (Feldman, Pentland 2003); or in sub-routines of organizational action. One example is the impact of new rules that, if not changing the existing routines, at least will impact on the interpretation of old rules. This happens, for in-

stance, to PhD entrepreneurs who re-evaluate the advantages of public R&D grants once they are confronted with the costs of time and effort that are incompatible with business dynamics. Although these start-ups continue depending on this type of grant, the interpretation about its importance and advantages is deeply changed. Indications of this process of routine change appear in the qualitative analysis CLEs, but they are not followed up, since this study does not focus on changes in specific routines over time.

The fourth and last relationship described by Miner et al. (2008) refers to a specific type of routine: routines for learning. The main role to these routines is to generate systematic change in the organization's knowledge. They imply the routinization of search activities and establish some degree of standardization of ways to interpret experience and encode diffuse experience in new routines. This relationship between learning and routines is beyond the scope of this study, despite some empirical evidence of the formation of this type of routine in the narratives of entrepreneurs.

These relationships between routines and learning provide a conceptual framework that accommodates the concept of critical learning episodes, and the creation and reshaping of routines. However, these relationships only touch on search processes, which are crucial to generate variation in the first place, and do not yet explain how learning processes take place.

2.3 Learning in the resource-based theory of the firm

Chapter 1 introduced general arguments about the resource-based theory of the firm and learning. For instance, Teece and Pisano (1994) argue that learning can be developed through repetition or experimentation, which are included in two of the learning strategies described later in Section 2.4. Moreover, learning is a social and collective process that requires common codes of communication and coordinated search. It only has value to the organization when applied; hence the distinction between learning by individual entrepreneurs and its impacts on organizational routines in this thesis' analytical framework. In addition to this, these authors claim that new knowledge results from search and resides in new routines. Aligned with the discussion about routines and networking activities, the resource-based theory recognises that networking

activities are part of learning for the identification of dysfunctional routines and the promotion of the social exchange of information.

Here, the objective is to narrow down this discussion in relation to Penrose's contributions, recognised in the literature as relevant and under-researched (e.g., Wernerfelt 1984, Kraaijenbrink, Spender et al. 2010). Penrose (1980 [1959]) claims that it is through learning that firms acquire resources and transform them into services for enterprise growth. However, Penrose (1980 [1959]) rarely explicitly associates the process of acquisition and transformation of resources to a 'learning process'. Instead, Penrose (1980 [1959]) distinguishes explicit and tacit knowledge and emphasizes 'changes' or 'increases' in 'knowledge' that results from 'experience'. A step further in explicating the role of learning is found in Best (1990). This author states that continuous improvement "demands an organization in which a persistence to detail operates at every activity level. The persistence to detail is about incorporating learning from doing into improved ways of doing" (Best 1990, 13).

Best (1990) clearly neglects the role of discontinuous events in learning. Likewise, for Penrose, the transformation of resources into services characterizes a process of learning by doing and suggests that learning is a process of knowledge accumulation. As described in Section 2.6, discontinuous events also play an important role in triggering learning and impacting on the evolution of business start-ups. Nevertheless, underlying processes apply to both continuous and discontinuous learning. One of them is the interaction between individual and environmental factors to transform resources into services. Penrose states that: "The services that resources will yield depend on the capacities of the men using them, but the development of the capacities of men is partly shaped by the resources men deal with" (1980 [1959], 78). Examples of this interaction between environmental and individual factors are reported by the entrepreneurs as follows:

> I've talked to many entrepreneurs in this incubator who are in the same situation. What is it? We start doing everything. We are the cleaner, we are the programmer, we are the project maker, we are the manager, we are… we have to break into a thousand (Firm16, §050).

> And, if you say one day 'Ouch, I need to think of a product. I will not go to work'. Sometimes there is this, you have a creation moment and you say 'Oh, I need to think about this thing.' And next you say 'Oh, I need to drop by, to solve an issue with the bank and it is there in Barra Funda

> [neighbourhood]'. But you are the one who has to go there and solve it. Then you are like 'But am I going to go out now? No, I will not work.' In the beginning I had a lot of this (Firm23, §064).

These quotations indicate that entrepreneurs have to develop multiple competences in the face of scarce resources. Since resources are a prerequisite to establishing the business, this situation of high multiple demands can turn into a source of variation in ideas, flexibility to create alternatives, and an easier adaptability to critical events. The agency of the entrepreneur, then, determines how the external environment is perceived and which responses will be given to it. In this regard, knowledge about this external environment, i.e., markets, consumer preferences, technologies available, is also part of the firm's stock of knowledge and represents important resources to deal with demands.

Penrose (1980 [1959]) describes a dynamic process of increased knowledge influencing the amount of resources available, the employment of previously unused resources and the obsolescence of previously used resources. Business start-ups benefit from this dynamism by having a less costly structure for changes, in which the 'heterogeneity in the services available' (Penrose 1980 [1959]) can be deployed more easily to develop alternative pathways[5]. This provides the baseline argument to explain the typical pathways in Chapter 5. A central point for this creation of multiple uses for the same resources is the knowledge of the entrepreneur, so that increased knowledge is likely to increase the amount of services from any resource. This argument is complementary to the previous one, about learning by doing. The mutual feedback between cognitive knowledge and enactment of practices is schematically represented in Figure 2.2.

Furthermore, there is a qualitative change in ways of using resources towards more profitable products. "Consequently, there is a close connection between the type of knowledge possessed by the personnel of the firm and the services obtainable from its material resources" (Penrose 1980 [1959], 76).

Further elaborations in the literature point out the importance of prior knowledge (e.g., Cooke, Morgan 1998). In the case of start-ups, this is the entrepreneur's knowledge (or human capital, e.g., Gruber, MacMillan et al. 2012), which may originate from his or her educational and profes-

sional background, previous entrepreneurial experience, available competences, and initial networks.

Figure 2.2
Heterogeneity of services by Penrose (1980 [1959])

> Learning is what helps the firm to strike a balance between routines and creativity and the capacity to learn depends in no small way on its absorptive capacity: that is to say the firm's ability to recognize, assimilate and exploit knowledge, from within and without, is largely function of the level of prior-related knowledge (Cooke, Morgan 1998, 16).

For Best (1990, 3), the entrepreneurial firm is the one pursuing "continuous improvement in methods, products and processes". Learning is conceived as a social process, in which actors from inside, such as the entrepreneur and workers, and from outside, i.e., consumers and suppliers, can contribute with ideas or improvements. In addition to this, learning is correlated with innovation, which also "involves the interaction of people engaged in functionally distinct activities" (Best 1990, 13). A similar argument, based on the diversity of human capital in teams of entrepreneurs-managers, claims that individual perceptions of market opportunities are combined in permutations, resulting in multiplicative rather than additive perceptions (Gruber, MacMillan et al. 2012). Entrepreneurial firms, therefore, strongly depend on networking for learning and innovation, as elaborated later in this chapter.

2.4 Learning in organizational psychology

Learning in organizations is the process of knowledge acquisition, processing, retention, recollection and application to the organizational context (Pantoja, Borges-Andrade 2004). This is a cognitive-behavioural definition that emphasizes the cognitive processing of information by individuals inside organizations (Hager 2011). This section defines learning processes and aligns the cognitive-behavioural approach with the concepts described in the previous sections.

Learning is "a behavioural and attitudinal change which involves the affective, motor and cognitive realms" (Bastos, Gondim et al. 2004, 221). It does not result from maturation, but from an active process of changes in attitudes (cognition, affect and behavioural intention) and behaviours that occur at the individual level (Pantoja, Borges-Andrade 2004, Moraes, Borges-Andrade 2010). It is a process affected by intra and inter-psychological factors, such as the degree of anxiety and the environmental context (e.g., Bastos, Gondim et al. 2004), including the social context.

Individual characteristics that affect learning processes in the workplace are the level of anxiety, degree of self-efficacy, motivation to learn, individual values, learning strategies and previous experience. In addition to these, the contextual characteristics that affect learning are, amongst others, psycho-social support and material support to apply the learnt content to actual performance (e.g., Pantoja 2004, Warr, Downing 2000).

A key point from the psychology literature is that these individual characteristics are not deterministic of learning processes or outcomes. Similar individuals, under the same environmental conditions, will differ in their learning processes and related performance. It is noteworthy that individual characteristics, beyond the scope of learning processes, have been subject to much research in the entrepreneurship and management literature, especially in the initial developments of entrepreneurship literature in the 1980s (e.g., Landstrom 2008). Some of these characteristics have been grouped under the label of human capital, in an effort to distinguish individual characteristics that can be subject to policies from personality and other intrinsically psychological traits (e.g., Madsen, Neergaard et al. 2003). The two key variables explored in human capital literature are formal education and work experience (e.g., Gruber, MacMillan et al. 2012, Madsen, Neergaard et al. 2003, Kenworthy, McMullan

2010). These are also examined in Chapters 3 to 5, together with other individual, relational and structural variables.

In relation to contextual characteristics that influence learning processes, the psychology literature has traditionally emphasized induced learning events, that is training and development (T&D) programmes. These are confined to the intra-firm context, and are characterized by planned instructional objectives, methods and performance goals. This approach to learning is strongly influenced by the notion of economic development through skilled labour and productivity, under the control of an employer organization that seeks a return over investments (Cairns, Malloch 2011). Here, the contribution to the literature on learning in organizations tackles the context of business start-ups and entrepreneurs. In this context, the role of agency is stronger than in traditional T&D programmes because the learner himself or herself can trigger learning events (Moraes, Borges-Andrade 2010). Furthermore, in business incubation settings, even formal learning is closer to natural learning as it is more problem-oriented than rigidly structured.

Studying learning in entrepreneurial contexts requires, most of all, an investigation of informal exchanges of information and knowledge in a broad institutional environment: an environment composed of local actors, support institutions, legal frameworks, etc. (e.g., Eraut 2004). This outer environment provides inputs to learning and influences the nature of the learning that takes place (e.g., Warr, Downing 2000, Hager 2011). Informal learning, or natural learning processes, results from holding a certain job or career or from contact with people or information from other groups or organizations. It differs from the induced (formal) learning as the learner is the one in control of the learning process, which takes place in non-structured ways (Pantoja 2004, Moraes, Borges-Andrade 2010).

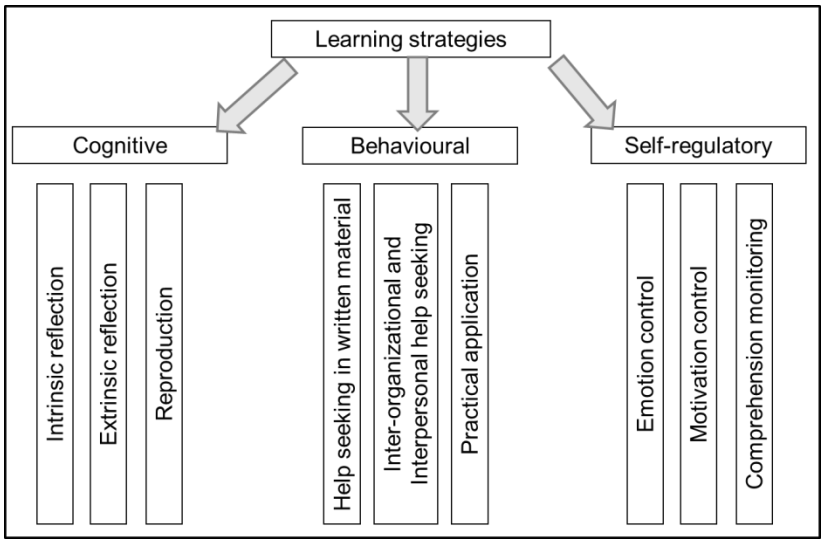
This distinction between formal and informal learning, although useful to highlight the role of agency in learning processes in organizations, has been criticized in the literature (e.g., Cairns, Malloch 2011, Moraes, Borges-Andrade 2010), since the attribute of formality is context specific (Moraes, Borges-Andrade 2010) and, in complex working settings, both formal and informal dynamics are in place (Eraut 2004). To investigate learning contextualized within critical learning episodes, this study combines individual, social and operational dynamics (Hager 2011, Eraut 2004). This more inclusive nature of learning processes (Cairns, Malloch

2011) is represented here by the concept of learning strategies, because it combines the cognitive, behavioural, and emotional dimensions of learning and it is contingent to the context.

Learning strategies

Learning strategies are individual activities of information processing used by entrepreneurs to codify information and generate new meanings, expand business-related networks, and develop new methods of work. They are adaptable to contextual and individual characteristics and will vary according to the task to be performed (Riding, Rayner 1998). These strategies optimize learning processes by facilitating the acquisition, storage and further recovery of learnt information (Abbad, Borges-Andrade 2004). Entrepreneurs make use of learning strategies whenever they need to acquire tangible or intangible resources, ranging from the development of a new machine to the acquisition of managerial competences. Learning strategies can be cognitive and self-regulatory (both at the individual level), and behavioural (at the interpersonal level) (Warr, Downing 2000). Each of these categories has sub-categories with specific contents. Figure 2.3 shows how these concepts are structured.

Figure 2.3
Classification of learning strategies



The first category, cognitive learning strategies, refers to the cognitive processing of information gathered from the environment by the learner (Warr, Downing 2000). This can refer to *intrinsic reflection* if the analytical thinking is about a single concept or process - for instance, when the entrepreneur acquires competences such as understanding cash flow; to *extrinsic reflection* if there is relational thinking - for instance when the entrepreneur connects information from different sources such as clients' demands and the internal capacities to attend them; and to *reproducing practices* gained from former job experiences or advisers' recommendations (e.g., Pantoja 2004, Eraut 2004).

The second category, behavioural learning strategies, refers to seeking help in *written material* such as manuals and legislation; to *interpersonal and inter-organizational help seeking* through networks with resourceful actors; and to *learning by doing* through experiments and trial-and-error efforts (e.g., Abbad, Borges-Andrade 2004, Eraut 2004). The behavioural strategy crosses levels, ranging from application of standard procedures for start-up routines (i.e., following instructions from a manual) to engagement with social contexts (i.e., exchanges with other incubatees). More implications of the social dimension are discussed in Section 2.5.

The last category, self-regulatory strategies, represents metacognitions applied by the entrepreneur to monitor and control his or her own learning process. These strategies are reflected in *emotion control, motivation control and comprehension monitoring* of learning activities (e.g., Abbad, Borges-Andrade 2004). Metacognitions gain in importance when there is time to reflect upon the learning process: entrepreneurs can think about the "the deliberative process itself and how it is being handled, searching for relevant knowledge, introducing value considerations, and so on" (Eraut 2004, 261). Being metacognitions, these learning strategies are less-easily self-identified and reported on by entrepreneurs, yet they were mentioned in critical events such as unfair competition or in the face of the imminent risk of business close down. Furthermore, these strategies are more likely to oversee different moments rather than being specific to one individual learning episode.

An important distinction between the literature on organizational learning and this study is that here the cognitive dimension is not strongly associated to higher level learning; likewise, the behavioural or practical dimension is not associated to lower level learning (Cope 2003, Ar-

gyris, Schon 1978, Fiol, Lyles 1985). This distinction is defined *ex-post* and does not take processes into consideration. Conversely, this study claims that these two dimensions of learning processes are "interdependent and mutually supporting" (Kraaijenbrink, Spender et al. 2010, 352). Likewise, there is no pre-assumed association between categories of learning strategies and types of outcomes. It is expected that, since the use of learning strategies is associated with critical learning episodes, a) learning strategies can be combined; and b) interpretive and practical outcomes are intertwined.

Moreover, the entrepreneur is closer to the 'strategic learner', who plans how to achieve a learning goal (here, learning content), selects specific strategies to do so, monitors the progress, modifies the plan, the methods and the original goal if necessary, and evaluates the outcome for decisions about future learning (Riding, Rayner 1998, Eraut 2004).

2.5 Networking

Networking is one of the most important behavioural learning strategies used by entrepreneurs, due to the scarcity of internal resources in business star-ups to cope with triggers and develop solutions to CLEs. To the extent that these resources add value to the firm through trust, cooperation, collective action and reduction of costs, networks and networking activities become a source of social capital (Hormiga, Batista-Canino et al. 2011, Lall 2002). Networks as social capital impact on the stability and evolution of business start-ups beyond learning.

Networks are characterized by actors and the ties between them. Through these ties, a wide range of contents is transacted, which can be material (such as equipment) or immaterial (such as trust) (Wasserman, Faust 2006). Here, these contents are specified as those resources that are accessed or developed through social interactions. A network is a snapshot of entrepreneurs' on-going networking activities at a particular moment in time. There is substantial research about the properties of social network structures, looking at actors' attributes and the dynamics of the ties between them. This type of analysis follows a structuralist approach to networks and is useful in identifying the position of some actors in relation to others, i.e., the centrality of a business incubator in relation to its incubatees; and in comparing the configuration of networks in different points in time, i.e., networks of entrepreneurs at the begin-

ning of the business and after a few years of a firm's operation. The results of this structural analysis are presented in Chapter 4.

Another approach is the connectionist, which focusses on relational processes and dynamics of networks by examining the content of ties (e.g., Gössling 2007). It facilitates the analysis of networks in a multilevel perspective, i.e., entrepreneur, enterprise, institutional setting of incubation, etc. The connectionist approach is discussed in the sub-section about networking and evolutionary processes.

Networking and embeddedness

Networks can be formal or informal. Informal networks provide psychosocial support to entrepreneurial initiatives and decision-making, as well as being sources of financial support to entrepreneurs, especially at the very beginning of the business (e.g., Hormiga, Batista-Canino et al. 2011). On a more professional level, informal networks with experts and other entrepreneurs provide business-related advice to new entrepreneurs. It is common to find family members, friends, colleagues, and acquaintances who share their expertise. These exchanges are sporadic, non-structured and are rapidly replaced or reduced in importance when formal networks with professionals are established. These formal networks tend to be more regular, focussed, and committed to the success of the business, such as the linkages between entrepreneurs and monthly consultants in the business incubation programme.

The literature on social capital and business start-ups highlights their very limited social capital, since relationships with the environment are in formation (e.g., Hormiga, Batista-Canino et al. 2011). As pointed out above, these relational resources provide critical intangible assets to the firm. However, simply acquiring these resources is not enough. Entrepreneurs need to develop strategies to transform them into services to the start-up, so that they can render their estimated value. Hormiga et al. (2011) recognize that the success of the start-up (measured by the founder's subjective appreciation), depends on entrepreneurs' choices in selecting resources during the start-up phase. In addition to entrepreneurial agency, these authors emphasize the importance of a diversity of network actors to enable the entrepreneur to access critical, tangible and intangible resources.

Informal networks remain crucial across the evolution of business start-ups. However, they are not static: when these informal dynamics take place, for example trust building and embeddedness, they can become partly formalized in the form of business partnerships or trade contracts. Moreover, these dynamics are associated with innovation, in which cognitive processes are central to decision-making. Agents self-select strategies to acquire resources and decide how to make use of them in more or less innovative ways (Xu 2011). The association of cognition with social capital for innovation is explained by Xu (2011, 14) as follows: "Innovation is a dynamic social learning process; actors continuously assimilate information and knowledge from those they interact with. […] Actors with more training and experience diversity will create ideas with greater novelty than those with access to a narrower range of knowledge." This literature highlights three types of embeddedness: structural, relational and resource-based.

Structural embeddedness is "the structure of the overall network of relations" (Xu 2011, 13). This is investigated in Chapter 4 by looking at a quantitative comparison of networks structures at two points in time. Relational embeddedness is "the extent to which the quality of an actor's personal relations affects economic actions" (Xu 2011, 13). This aspect is examined in Chapter 5, which shows that, as start-ups engage in market relations, their networks remarkably present more resourceful actors that are critical for trade and production. Resource embeddedness is "the degree to which network contacts possess valuable resources" (Xu 2011, 13). This is especially the case of (bio)technology-based start-ups, which remain closely linked to universities and research centres. This last dimension of embeddedness was observed in the content of individual critical learning episodes, but is not highlighted specifically in the empirical chapters.

Successful exchanges with resourceful actors contribute to building trust and share critical information, increasing all three types of embeddedness. With more frequent exchanges and the formation of multiple ties with other actors in the network (i.e., friendship and trade relations with other entrepreneurs), more resources become available to more members of the network. Another aspect is that the diversity of actors tends to bring in multiple institutional settings, such as market actors, support institutions, research centres, and so forth. This implies embeddedness in multiple networks if one examines the institutions to which

individual actors belong. This process of network expansion impacts on the sustainability of the business by signalling access to diverse types of resources.

Different network configurations influence the likelihood of innovation. Xu (2011) claims that diversity in a network of business partners benefits exploratory search, due to the increased possibilities to exchange new knowledge and to recombine this knowledge in new ways. Conversely, networks focussed on buyers' demands, despite reducing risks, are characteristic of exploitative search and may imply modest productivity gains. Empirical evidence in Chapters 5 partially confirms this statement.

Networking and evolutionary processes

The analytical framework described above, referred to networks as one of the learning strategies, as one of the possible outcomes of a critical learning episode, and as part of the resulting routines. As discussed above, networks can also become a source of social capital. Here, the three first functions of networks are differentiated in the evolutionary framework.

As a learning strategy, networking is a way of generating variation of ideas (resources) to create a solution to the trigger of an episode. Although most of the time this is a deliberate process (in a line with Xu 2011), since the entrepreneur is reacting to a critical learning episode, there is also the possibility that this variation emerges from informal exchanges with other entrepreneurs (e.g., Hormiga, Batista-Canino et al. 2011). The latter is largely reported in relation to outcomes of corridor talks (e.g., Giuliani 2007).

Networks are also one of the possible outcomes of a critical learning episode. The issue then is no longer networking as an ongoing activity, but the configuration of the entrepreneur's and the start-up's network. It is the result of selection from amongst options of types of relationships with other actors at the end of a CLE. And finally, networks and networking can be part of the new mix of routines. This corresponds to the retention of the selected variation and is mostly a result of a deliberate decision. As part of the system of working routines (i.e., regular consultations with buyers), networks can trigger new critical learning episodes.

These multiple roles for networks fit in with the connectionist approach. Two aspects of this approach are relevant when examining the evolution of business start-ups: networks as institutional settings and embeddedness.

The social structure of networks constitutes the institutional setting of firms to the extent that a) actors are under implicit or explicit rules and sanctions with regard to their behaviour, b) trust relationships are built, and c) the conditions for interaction between these actors are formally or informally established (e.g., Gössling 2007). The association between networks and institutions has been explored in studies about inter-organizational relations (e.g., Gössling, Oerlemans et al. 2007), including different levels of analysis (i.e., individual, organizational, inter-organizational) (e.g., Provan, Fish et al. 2007).

In inter-organizational relationships, each organization has its own institutional setting when informal institutions are looked at – even within the same formal institutional setting. For instance, business incubators are the formal hub in business start-ups' networks. Within its formal setting, however, entrepreneurs are gradually embedded in informal relationships with other incubatees and consultants, the incubator's manager, and other actors. This informal setting may include rules of mutual cooperation, for instance. It is noteworthy that the entrepreneur has an active role in this institutional setting, being able, as trust relationships evolve, to influence other actors in the incubation system. Therefore, formal and informal institutional settings shape the configuration of the entrepreneur's networks and are shaped by the agency of entrepreneurs upon their social interactions.

This process of embeddedness in the business incubation setting is helpful in including the start-up in the market, whilst at the same time it carries the risk of surrounding the business with strong ties that may hinder innovation by narrowing the range of variation in new ideas. Business start-ups show a gradual embedding process, from arm's length relationships[6] towards embedded networks[7]. The diversity of relationships start-ups establish with other actors shows how economic relations are supported by different types of social ties.

Embeddedness can be measured by three criteria: duration of the relationship, multiplexity, and the size and density of the network (UNIDO, Leuven Centre for Global Governance Studies 2011). Longer term relationships tend to be more embedded, as is the case of those

start-ups which have participated in a business incubation programme for over two years. Over time, bonds of trust are built and exchanges of information are facilitated. Multiplexity refers to the multiplicity of types of ties between actors. This is an "indicator of the strength and durability of an organization's links because they enable the connection between an organization and its linkage partner to be sustained even if one type of link dissolves" (Provan, Fish et al. 2007, 484). This measure reflects the diversity of resources exchanged between actors; i.e., two incubatees that share the incubation facilities and become also business partners in a spin-off. Last, size and density refer to the number of ties in the network. Large networks with low densities are characteristic of arm-length networks; whilst large or smaller networks with high densities are indicative of more embedded networks. This configuration impacts on the types and diversity of resources that are available to the start-up. Duration, size and density of the start-ups' networks in this study are described in Chapter 4; multiplexity and other aspects related to the type and variety of resources exchanged are discussed qualitatively in Chapter 5.

Embeddedness in market networks belongs to the micro dimension of economic systems defined by Dopfer et al. (2004) and is the underlying process that links micro to meso for the formation of a population of firms that are subject to relationships of trust, competition, flow of resources, etc. Embedded networks, for the longer-term relationships and more intense exchange of resources over time, make room for the emergence of institutions for the adoption and retention of new rules. For instance, entrepreneurs who graduated from a big university created a large informal virtual network through which they regularly exchange information about their businesses, funding opportunities, calls for suppliers and buyers within the network, etc. This example is interesting for its high level of overall informality, high speed and large spread of information flow, and low hierarchical relationships. Of course, this meso-structure facilitates a scenario in which actors more connected than others might form sub-networks with the typical characteristics of embeddedness.

2.6 Critical learning episodes

The concept of critical learning episodes was originally conceived at the network level, referring to long-term changes in network practices, struc-

tures and interpretations (Knight, Pye 2007) and allowing comparative analysis across networks in different sectors (Knight, Pye 2004). In this thesis, the theoretical and methodological tools developed by authors in that field are theoretically adjusted to the level of the individual and the firm. The conceptualization of a critical learning episode relates to the notion that, although learning experiences can be discrete or continuous, discrete learning episodes are the ones that become meaningful because they require reflection and the development of new meanings and significances (Eraut 2004).

Critical learning episodes are defined as bracketed and punctuated events in the continuum of a start-up storyline, with temporal and structural boundaries. As Knight and Pye (2004, 481) state, "[t]hese actions and interactions are not evenly distributed in time or among actors, but can be seen as coalescing into a number of 'sub-plots' that are critical components of the episode storyline. Sub-plots can be compared across episodes". These sub-plots reflect the development of new meanings, commitments and methods.

The development of new meanings reflects attitudinal changes in entrepreneurs' values and culture: what would elsewhere be referred to as higher level learning or double-loop learning (Cope 2003, Argyris, Schon 1978, Fiol, Lyles 1985). In evolutionary terms, developing new meanings corresponds to generating a variation of ideas, grounded in entrepreneurs' cognitive capacities (Dopfer 2004). The cognitive process through which variation is generated involves understanding the demands of a CLE, recognizing what knowledge and skills are relevant, adapting new information to the demands of the CLE, and integrating new and existing knowledge to think and act upon the CLE (Eraut 2004).

The development of new commitments signals reconfigurations in the role played by actors in the start-up's institutional setting in relation to the start-up demands. It entails all the networking dynamics described above. The development of new methods reflects changes in behavioural patterns, observable by the way of doing things, such as the organization of the production. It eventually implies new operational routines.

The concept of critical learning episodes combines different levels of analysis by connecting exogenous and endogenous factors (Nelson, Winter 1982, Feldman, Pentland 2003) to dynamics at the individual (Dopfer 2004, Abbad, Borges-Andrade 2004), network (Granovetter 1983), organizational (Penrose 1980 [1959], Miner, Ciuchta et al. 2008) and inter-

organizational levels (Cooke, Morgan 1998, Best 1990, Gössling 2007). These episodes vary in terms of properties such as: type and duration of the episode, combination of learning strategies (Riding, Rayner 1998, Warr, Downing 2000) to achieve a certain learning content, types of resource use (Penrose 1980 [1959]), types of learning outcomes (Moraes, Borges-Andrade 2010) and the content of the changed organizational routines (Nelson, Winter 1982, Feldman 2000, Lazaric 2011). Moreover, and essential for an evolutionary study, the components of CLEs provide parameters for comparisons of episodes between start-ups and across time, so that learning-based evolutionary processes can be empirically investigated. In short, critical learning episodes are the smallest unit of analysis of the evolutionary processes in firms.

In the original formulation, Knight and Pye (2004, 481) define three narrative elements: context, content and process. Here, the context is redefined as the institutional environment of the start-up, including specific business-related networks and actors beyond that, such as research centres, regulatory agencies, governments etc. Content is the focus of a CLE, to which learning strategies are directed. Learning outcomes are reconceptualized as a phase in an episode rather than as part of the content. This facilitates identifying the nature of these outcomes and relating them to organizational routines.

A summary of the concepts involved in each sub-plot is shown in Figure 2.4 (adapted from Knight, Pye 2004, 2007). Despite the apparent linearity from one column to the next, there is no one-to-one correspondence between the three sub-plots of learning contents and the three categories of learning outcomes (Knight, Pye 2007).

As defined here, critical learning episodes fit in the literature of learning through 'discontinuous events' (e.g., Cope 2003), focus on 'change over stability' (e.g., Knight, Pye 2007), and rule change triggered by endogenous or exogenous factors (Nelson, Winter 1982). It is assumed here that evolutionary processes occur in jumps rather than as a cumulative process. Therefore, these episodes account for major jumps in the evolution of start-ups.

Figure 2.4
Learning sub-plots, content and outcomes

Sub-plots	Example	Learning content	Learning outcomes
Processes developing meaning	From employee to entrepreneur mind-set	Changes in values and culture	Changes in interpretations
Processes developing commitment	Building of business-related network	Contributions by different actors shape change	Changes in network structures
Processes developing method	Creation of a new machine	Application of change in operational activities	Changes in practices

It is noteworthy that this approach does not deny the importance of continuous learning. In fact, learning strategies and networking dynamics unrelated to specific episodes support interpretations of the results in Chapters 4 and 5. This implies that continuous learning and critical learning episodes are not independent in practice. In fact, the distinction between the two is not defined *a priori;* instead, the distinction is based on the entrepreneur's perception of the criticality of a learning event. The advantages of focussing on CLEs are:

- the conceptualization of critical learning episodes allows bracketing the search process for analytical and theoretical purposes;
- in retrospective interviews critical events are more easily recollected than smooth continuous processes are;
- assuming that evolution happens in jumps, comparisons between firms' pathways are more likely to be based on critical events than on continuous learning processes.

2.7 Final remarks

This chapter theoretically situates critical learning episodes at the core of business start-ups' evolution. The loop trigger-search-routine and the search sequence of learning strategies, learning contents, and learning outcomes contribute to a) operationalizing different components of search in a learning cycle defined by critical learning episodes that are delimited in time and use of resources, b) recognizing the intertwined role of agency and structure that connects the individual and the organi-

zational levels of analysis, and c) combining exogenous and endogenous factors and dynamics at the individual, network, organizational and inter-organizational levels. One important contribution is demonstrating the tripartite nature of these processes: the cognitive, social and working methods dimensions of learning and evolution.

It is noteworthy that the new or modified organizational routines will vaguely resemble the processes at their origin (Nelson, Winter 1982). This happens for a number of reasons. First, learning episodes entail so many transformations of resources between the trigger and the resulting routine that there is no necessary direct link between resources in the former and in the latter. Second, because interpretive learnt content (Feldman, Pentland 2003) may not be immediately identifiable at the performative dimension. Third, there are learning outcomes about what not to do for the survival of the firm (Miner, Ciuchta et al. 2008). These non-selected outcomes remain as organizational memory or are forgotten. Although this is an interesting research topic, it is out of the scope of this thesis to examine it in depth.

This chapter also defined the focus of the research at the micro level, represented by business start-ups and entrepreneurs' learning processes. At this level, it is important to highlight the more prominent role of search compared to routines. This is different to most of the literature on evolutionary economics.

From a perspective of economic change, the focus of this thesis is on how entrepreneurs combine capabilities with resources from the institutional setting to create a new business. The analytical framework to investigate this combines complementary theoretical contributions to a more comprehensive explanation of the evolution of business start-ups. In their own realms, these contributions describe a process in which the firm identifies needs, searches for resources to fulfil them, and transforms these resources into services that are incorporated into the functioning of the enterprise. These resources include finances, technology, managerial competences, social networks, etc.

Notes

[1] Knowledge about how to use resources more effectively is considered a type of resource to be acquired or created.

[2] Despite this common point, these two theorizations differ in terms of the role played by endogenous or exogenous factors in the evolution of the firm. While Penrose (1980 [1959]) focuses on top management decisions for the firm's growth, Nelson and Winter (1982) also emphasize the role of factors such as technology and the industrial structure as drivers of change at the firm level.

[3] Rules are "emergent properties of a rule adoption process occurring in a group" (Dopfer, 2004, 189). Note that this definition implies a social nature of rules.

[4] The blueprint dimension refers to physical objects, layouts, and artefacts.

[5] A note on the downside of this initial stage of development is that start-ups are also more fragile to the criticality of these same events by having fewer and less stable routines, or a smaller scope of heterogeneity, in which efforts are spread instead of concentrated on strong points.

[6] "[C]haracterized by lean and sporadic transactions and function without any prolonged human or social contact between parties who need not enter into recurrent or continuing relations" (UNIDO, Leuven Centre for Global Governance Studies 2011, 49).

[7] "[C]haracterized by their strength, repetitiveness, transmission of tacit, thick and additional information and their grounding in norms of trust and reciprocity" (UNIDO, Leuven Centre for Global Governance Studies 2011, 49).

3 Business incubators, start-ups and entrepreneurs

This chapter defines business incubation programmes and describes business incubators in the Brazilian context. It then characterizes those business incubators that participated in this study, the business start-ups, and the entrepreneurs interviewed. The chapter draws up a definition of business incubators as learning settings that combine both formal and informal learning opportunities for entrepreneurs.

3.1 Business incubation programmes

A business incubation programme is a business development service (BDS) for small and medium enterprises, designed for individual businesses or entrepreneurs (Altenburg, Stamm 2004, DCED 2001). Business incubation strategies are recommended when qualitative and quantitative "changes in the capacity of the entrepreneur and the enterprise are required" (Lichtenstein, Lyons 2006, 383). For this, operational and strategic services are provided. Operational services are those that attend to daily needs and they function on three levels: basic (i.e., telephone), legally required (i.e., accounting) and advanced (i.e., specialized services or tools) (Altenburg, Stamm 2004). Strategic services aim at enhancing "the long-term capacity of an enterprise to compete", by the provision of services such as training, consultancy, research and development and technology development (Altenburg, Stamm 2004, 13). Business incubators are one type of BDS that act as deliverers or at least mediators of access to such services. Strategic services are more costly than operational services as they require a higher degree of customization to deal with specific needs.

Some authors claim that the current incubation system as a whole is a rational proposal for the use of natural, technical, financial, and human

resources to transform ideas and technology into products and jobs. Therefore, main societal actors such as universities/research centres, entrepreneurs and public government, can count on the work of incubators to improve regional development (Hernández, Estrada 2006). In the tipple helix analytical framework (Etzkowitz, Mello et al. 2005), business incubators are hybrid organizations that focus on the triad university-industry-government. This framework concerns the institutional integration of science and technology, dealing with four levels of transformation: intra-institutional, mutual influence between institutions, creation of new structures based on the interaction of the three helixes, and the impacts on social institutions (Almeida 2005). However, a limitation of this approach is that it assumes rather fixed roles for each actor, i.e., government as regulator, university as source of knowledge and technology, etc. In contrast, this research introduces a dynamic perspective on the roles of each actor that is based on the resources exchanged between them. For instance, local governments that are also service providers, universities become buyers, etc.

Another approach that provides useful analytical tools is the innovation framework (OECD, Eurostat 2005). Here, business incubators are placed in a network of relationships between various actors, facilitating the three types of linkages described in the OECD guidelines: open information sources, acquisition of knowledge and technology, and innovation cooperation. The innovation framework matches SEBRAE's main requirement for innovation to applications. It applies a broader concept of innovation that includes the institutional dimension of innovation processes; it brings learning and networks to the centre of the discussion on knowledge access, production and flow.

In this thesis, business incubators are conceptualised as learning settings, because they incorporate a set of specific strategic services. Those strategic services that are acknowledged as learning are the formal consultations, which provide training within general guidelines. Examples of topics covered are break-even point, cash flow, marketing strategies etc. Beyond these broadly recognised strategic services for learning, there is also a high degree of informal exchanges and initiatives between the entrepreneurs themselves. Firm08 reports that the main contents of these exchanges are finances, market, competitors, market position, and general issues. This entrepreneur states that, when he left the incubator,

> in the first months here, I felt odd. Because I would step out and say 'With whom will I talk today?' […] I missed it. But one has to continue, right? [...] We sometimes still meet, talk, but it is not the same. Why? Because sometimes one has to…we are apart now. I won't leave here to go there and chat. Sometimes there are things to talk about… [but] it is not like leaving for two or five minutes and talk for a bit. (§255-263).

Several actors figure amongst those with whom entrepreneurs learn on a daily basis. The most cited actors are other incubatees, frequently followed by the business incubator manager. These learning processes were often 'externalities' of the concentration of entrepreneurs in one place – the cafeteria effect (e.g., Giuliani 2007). However, this is not always the case, since some business incubators organize business meetings with graduate entrepreneurs, and nurture a cooperative environment of corridor talks and shared kitchen facilities in which entrepreneurs can 'hang out' and share their experiences over a cup of coffee. Business fairs also played a small role, but less than one would expect. These seem to work more for benchmarking through observation of competitors' products than to networking.

Critiques on the role of business incubators suggest that the institutional settings provided by them can result in barriers to the development of start-ups and in a relationship of dependence with the incubator (e.g., McAdam, Marlow 2007). Some research findings show, for instance, that "as a firm grows, the relevance of the incubator adding credibility declines" (McAdam, Marlow 2007, 370) due to the increasing need of presenting an established image to clients. Findings here suggest that this may vary per sector, since in technological fields being associated to a university via a business incubator is seen positively by the market.

For incubatees, the incubator can also represent a threat to secrecy as potential competitors are also incubated. Episodes of this type of competition, although rare, were reported by some entrepreneurs. If secrecy reaches high levels, networking activities between entrepreneurs may be hindered (McAdam, Marlow 2007). In terms of the programme, business incubators require a significant investment of time and resources combined with skilled staff to run activities related to entrepreneurial development and support to enterprises for further levels of development (e.g., Lichtenstein, Lyons 2006).

Business incubators in Brazil

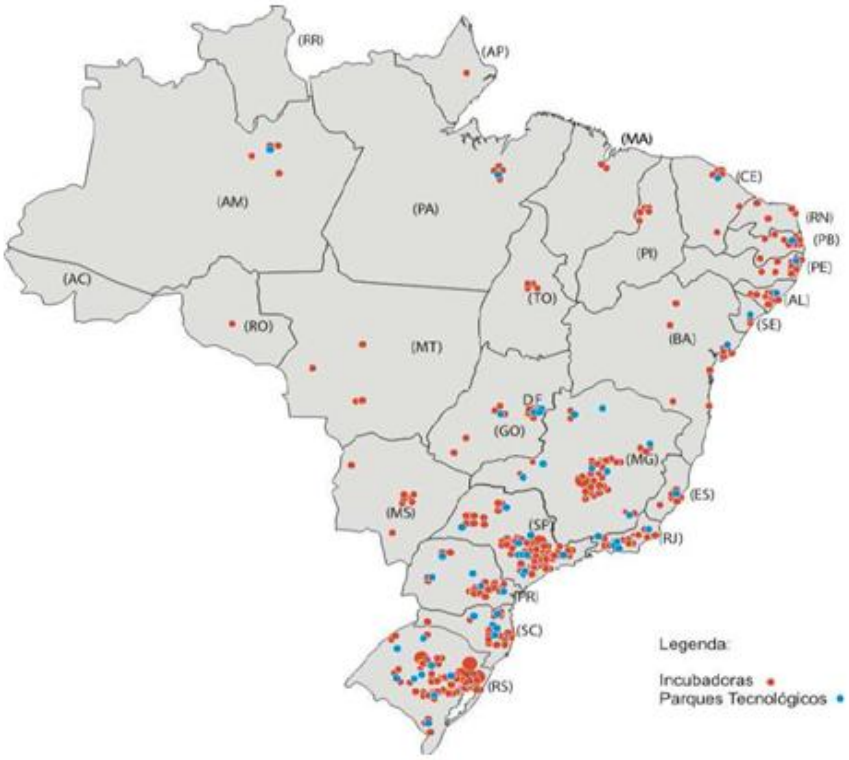
Brazil pioneered the implementation of business incubation programmes in Latin America in the early 1980s. In 1984, Brazil created five technological foundations for the transfer of technology from universities to the productive sector. However, the first Brazilian incubators consolidated only in 1987, in the International Seminar for Science Parks, in Rio de Janeiro. Also in 1987, in October, the Brazilian Association of Science Parks and Business Incubators (ANPROTEC) was created (Aranha 2008) and has been actively engaged in the business incubation movement in Brazil (ANPROTEC 2007) since then.

Annual reports published by ANPROTEC (ANPROTEC 2003, 2004, 2005, 2006, 2007)[1] show that the number of incubators in Brazil has increased 20% on average every year, particularly in the two less developed regions in the country, the North and the Northeast, with 55,6% and 51,4% respectively more incubators from 2004 to 2005 (ANPROTEC 2005). Map 3.1 shows the distribution of incubators per federative unit. It is noteworthy that incubators are predominantly located in the most developed states and, within each state, concentrated in metropolitan areas. In Roraima (RR) and Acre (AC) there are no incubators[2]. The geographical distribution of incubators and science parks found in Brazil corroborates the tendency of business services to be located in resource-rich areas, usually urban centres or areas not far from airports (Walker 2000).

Annual reports present descriptive statistics for several features of business incubation programmes; however, longitudinal comparisons are hindered by the availability of only aggregated data, using different ranges of values and variable labels. Nevertheless, updated data shows that in 2009 Brazil had 400 operating incubators (Franco, Pereira et al. 2009). In its 2005 annual report, ANPROTEC shows that the main objectives of business incubators were entrepreneurship incentive (97%), regional economic development (88%), job creation (84%), and technological development (72%). Although the same incubator can work with enterprises in diverse economic sectors, they tend to concentrate on Information and Communication Technology (18%), Agribusiness (11%), Electro-electronics (11%), Mechanics/Biotechnology (8%), Services (15%), and others (37%). These areas correspond to the priority segments in the national policy for development (Brasil 2003). In 2007, approximately 4300

enterprises were either incubated or graduated from business incubation programmes.

Map 3.1
Distribution of incubators (in red) and science parks (in blue) in all federative units in Brazil



Source: ANPROTEC (2008)

On average, incubated start-ups invoice approximately €55.000/year, which corresponds to 12,06 Brazilian minimum wages at 2007[3] values. Graduated firms invoice, on average, approximately €410.000/year, or 89,91 minimum wages. National figures show that, in 2007, 36% of all SMEs had a gross income up to 60.000 reais/year; followed by a second group of 23% of SMEs with a gross income between 60-120.000 reais/ year (SEBRAE, 2007).

An important remark about these values is that they hide huge variety within groups. The start-ups still in incubation tend to be more homogeneous in terms of scale, scope, and revenues, but for the group of graduated start-ups these positive figures are misleading. For instance, a different calculation was provided by an incubator's manager, showing values based on the 20 years of the business incubation movement in Brazil. He states that, amongst the graduated firms, total invoicing is estimated at about 1.6 billion reais (approx. 604,77 million euros) by ANPROTEC (2007), but the top three firms – operating for over a decade – invoice, together about 1.4 billion reais.[4] This manager believes that these numbers are inflated, but nevertheless they indicate that the incubation movement in Brazil is not doing well in terms of income generation.

This variation within the group of graduated start-ups can be attributed to several factors. The first is time in operation. It is expected that firms that survive the critical first years without merging or being acquired by others will have grown in scale and scope in comparison to recently graduated start-ups. The second factor is the type of economic activity. Firms developing high R&D-intensive activities that survive by themselves have greater potential to achieve higher revenues than small firms in low R&D-intensive activities that service local or regional markets. Both can be in operation for long periods of time, but the gap between their contributions to economic development will gradually increase during their maturity phase[5].

The third factor is the geo-political location of the business. Installing a business in a resource-rich area, one with market structures and a favourable institutional environment rather than in a poorer region, is key to fostering growth. For example, many start-ups located in small cities, where higher education institutions or technical schools are absent, reported that a shortage of skilled labour posed one of the most challenging problems for quality production, innovation and growth. On-the-job training becomes a common strategy, but it is time- and resource-consuming, slowing down the overall pace of performance and the formation of routines of production. At the political level, the implementation of training courses and other facilities (i.e., an adequate building for the incubator, an industrial district area for graduate start-ups etc.) depends on political perceptions about the importance of the business incubator for local development, job creation, attraction of investments, and so forth, combined with a willingness to implement change.

This study looked at these points by focussing on incubated and recently graduated start-ups (preferably graduated less than four years previously). Thus, the start-ups here are similar in terms of time in operation, revenue, and stage of development. They are involved in both low and high R&D-intensive activities. Their geographical location reflects the intra-state variation in the degree of development (Section 3.3).

Official statistics show that an incredible 80% of enterprises participating in an incubation programme survive in the market for an average of four years (ANPROTEC 2007). Although this figure is questionable, as it is provided by a non-independent source and the calculation on which it is based is not available, this is the only data available in Brazil about the survival rate of start-ups after a business incubation programme. Assuming that this figure may be somewhat misleading (i.e., by not considering drop-outs or other failure indicators), nevertheless it indicates some degree of effectiveness of business incubation programmes in terms of new firm survival rates.

In most incubation contracts an incubation programme lasts for two years, extendable for one extra year. The incubation period is dedicated to the implementation of the business plan, the development of managerial competences, the development of the product or service, and in introducing this to the market (Aranha 2008). At the end of these two or three years the start-up is expected to be able to survive in the market by itself, no longer depending on the support of the business incubator. In fact, some exceptions were found, in which the start-up was incubated for longer than three years. This is typical, but not exclusively so, of biotechnology businesses, which invest heavily in building infrastructure inside the business incubator and depend on governmental licenses for their functioning and production. Since regulatory procedures, such as the licensing of installations and the registration of a product by ANVISA (the Brazilian National Health Surveillance Agency), can take three years or longer, these businesses are locked inside the incubator. This is so because if they change address, the registration procedures start again from the beginning and the previous years of investment are under-utilised or lost.

In relation to packages of services, data from ANPROTEC's annual reports indicates that these range from facilities, such as meeting rooms and specialized laboratories, to intangible services, such as entrepreneurial orientation and consultation in finance. Other common services are

secretarial, provision of a showroom, library or auditorium, support for cooperation with a university or research centre, juridical assistance, support to intellectual property, and support for exportation, each of these being present in more than 35% of the incubators (ANPROTEC 2005). It is noteworthy that ANPROTEC's surveys did not collect data on the networking activities promoted by business incubators. As was theoretically discussed in Chapter 2 and will be demonstrated in Chapters 4 and 5, networking is one of the most strategic services that business incubators can provide. The implications of this 'invisibility' of networking activities for the business incubation programmes are discussed in Chapter 6.

One factor that may distinguish different packages of services is the model of incubation. The two most common configurations in the literature and in the Brazilian statistics are technological and traditional incubators (e.g., Chandra 2007, Lalkaka, Shaffer 1999). In addition to these, Brazil has reported other alternative models of incubation, such as cooperatives, cultural, agro-industrial, social and services incubators, which are sector-oriented types of incubators (Aranha 2008, ANPROTEC 2004, ANPROTEC 2005). Each configuration or model "has its own dynamics regarding potential customers, the incubator's internal practices, the network of institutions with which it relates and the possibility of accessing funding sources" (Almeida 2005, 268). Different configurations, therefore, are associated to different packages of services, i.e., technological incubators depend more on links with universities and research centres; whereas traditional incubators rely more on networks with local governments and market actors. Amongst all these categories, data shows that 40% of Brazilian incubators are technological (focus on high R&D-intensive activities), 18% are traditional (focus on low R&D-intensive activities) and 23% are mixed (focus on both types of start-ups) (Franco, Pereira et al. 2009, ANPROTEC 2005). These are the types selected for this study.[6]

3.2 The institutional environment of the business incubators in this study

Fieldwork was conducted in the two most resource-rich states in Brazil: São Paulo and Minas Gerais. Chapter 1 pointed out similarities between them in terms of R&D activities and briefly mentioned that they differ in terms of enterprise investment in these activities, with São Paulo repre-

senting a ratio above the national average and Minas Gerais below it. The role of the government in sponsoring R&D activities in firms in Minas Gerais is higher than in São Paulo and this implies an entire set of factors that are arranged differently to support business start-ups.

Whereas in the São Paulo State 45% of all incubators are traditional,[7] in Minas Gerais this category is absent. Actually, fieldwork information shows that even mixed incubators in that state support predominantly technology-based start-ups. This difference was explained by the administrative manager of the Incubation Network of Minas Gerais. He states that for the last three years there has been lack of interest by the Minas Gerais State Secretariat of Science and Technology in setting up incubators for low R&D-intensive start-ups. Instead, there is a similar, although less structured, programme that provides training in digital inclusion and some guidance to entrepreneurs, in partnership with SEBRAE. Therefore, in general, the availability of economic and financial incentives determines the type of incubation model at the state level. In addition to the availability of funding, the location of business incubators is influenced by their proximity to critical resources, such as market actors, regional economic dynamism, and the relative strength of local and regional support institutions.

From the demand side, a survey by SEBRAE showed that 55% of the entrepreneurs looked for some type of assistance in managing their business, their accountant proving to be the most important actor (65%), followed by SEBRAE (19%). The policies which are indicated as being the most necessary for SMEs are a differentiated tax regime (68%), preferential credit (interests and timeframe) (63%), and programmes for personnel training (39%) (SEBRAE 2007).

Legal framework

A landmark in the national legislation that substantially facilitated the formation and continuity of start-ups in Brazil is the *general law of the micro and small enterprise,*[8] introduced in 2006 (Brasil 2006). This federal law reduced taxes for opening a new business, instituted a simplified fiscal system for small businesses (the *Simples Nacional*), reduced the bureaucracy needed to formalize a new business, facilitated direct and indirect (through partnership with bigger enterprises) access to governmental contracts and reversed auctions, stimulated associative activities that improve competitiveness and insertion in domestic and international mar-

kets, and made credit more accessible through the provision of credit lines specifically for SMEs and credit cooperatives.

This law evolved from some seed initiatives laid down in previous laws that referred to various features of SMEs in the bigger context of technological innovation, i.e., Law 11.196/2005 (Brasil 2005), which briefly mentions support to SMEs in relation to their investments in R&D for technological innovation; and Decree 5.563/2005 (Brasil 2005) that regulates Law 10.973/2004 on incentives to innovation and to scientific and technological research in productive environments. Further developments of Complementary Law 123/2006 are found in Complementary Law 128/2008 (Brasil 2008), which advances the definition and regulation of individual micro-enterprises, details some fiscal aspects of the *Simples Nacional* system, creates the National Network for Simplified Registration and Legalization of Enterprises and Businesses, and establishes the role of the Agent for Development who guarantees that this law is implemented in accordance with local specificities.

The main advances in the legal framework of Law 123/2006 (Brasil 2006) that impact the evolution of business start-ups are:

- Differentiated treatment of SMEs allowing them to participate in governmental contracts, thus enhancing local and regional economic and social development, the broadening of the efficiency of public policies and incentivizing technological innovation (Art. 47);
- Emphasis on orientation rather than punitive inspection, providing guidance on labour rights, metrics, sanitation, environmental impacts and security, followed by a follow-up visit and, if necessary, the application of sanctions (Art. 55);
- Coordination between financial and support institutions to promote training programmes, managerial development and technological capacity building of small entrepreneurs (Art. 59);
- A concept of innovation that, despite the underlying focus on technological innovation, includes added value by introducing new functionalities or product characteristics that increase competitiveness;
- Enumeration of key actors in the national system of innovation: support agencies for the promotion and development of science, technology and innovation; science and technology institutions that perform basic and applied research; nuclei of technological innovation to manage the innovation policy of one or more of these science and

technology institutions; and support institutions that sponsor research, teaching, extension, and institutional, scientific and technological development projects;

- Design of a specific system of support for innovation in SMEs, through multi-actor programmes maintained at all governmental levels and the institutions listed in the previous item, explicitly including start-ups in business incubators. One financial impact of this system is that at least 20% of the resources allocated to the development of innovation should target SMEs; another is the possibility of reduction down to zero the level of taxes on imported products and related transactions for the acquisition of equipment, machines, instruments, accessories and tools by SMEs dedicated to technological innovation. The Ministry of Science and Technology is the central actor of control and monitoring of the system.

This new legal framework tackles the main difficulty reported by successful entrepreneurs in a study about the reasons for the success and failure of Brazilian start-ups (SEBRAE 2007). Positive direct impacts of this national framework on specific calls for proposals were largely reported by entrepreneurs developing high R&D-intensive products, especially in relation to the PRIME (presented below), the announcement of the results of which happened to coincide with the fieldwork period.

Formal sources of funding

Central and state governments are the two main sources of funding to incubated start-ups through their research support foundations. This sub-section presents only the main sources of funding as reported by entrepreneurs during fieldwork. It is noticeable that all the research funding programmes are directed at innovative projects, mostly R&D research, leaving out the low R&D-intensive initiatives. This is discussed in the sub-section about actors in the institutional environment of business start-ups and in the conclusion. Note that many smaller programmes in terms of scale or importance, as perceived by the entrepreneurs, are not reported here. Additional information about the main funding sources comes from documentary research on institutional websites and other documents obtained in the field.

A recent programme which had national coverage, PRIME (First Innovative Enterprise), is briefly described here for its great importance for

many of the technology-based start-ups interviewed in this study[9]. PRIME was set up in the beginning of 2009 and is still managed by FINEP (Financier of Studies and Projects), aiming at providing subventions to high added-value nascent enterprises. The programme benefited 5.000 firms across the country and counts on decentralized institutional partnerships for its implementation (FINEP 2012). Eligible applicants are nascent enterprises, up to 24 months in operation, which include a high level of innovation in their products or services. These start-ups' business plans have to demonstrate potential for growth and a set of viable challenges and goals. In addition to this, once selected, entrepreneurs have to participate in a special course on entrepreneurship and business management.

It was stated by beneficiaries-entrepreneurs and business incubators' managers that this programme filled the subvention gap in the web of governmental support to SMEs: a grant with rubric to hire expert consultants in management and other specific areas. In fact, the package includes economic subvention of 120.000 reais specifically for qualified human resources and services specialized in market studies, legal, financial, certification and costs services, amongst others, for a period of one year. Successful enterprises are entitled to apply for a programme of loans at zero interest rates, as well as to other FINEP programmes (i.e., to access seed capital). This programme therefore goes a step further than to common models of R&D grants, which are limited to the acquisition of capital goods and technological inputs for product development, and to scholarships exclusively to R&D researchers (master and doctoral levels).

At the state level, the strongest institutions providing financial resources are the foundations for support to scientific and technological research: FAPESP (São Paulo Research Foundation) and FAPEMIG (Minas Gerais Research Foundation). In São Paulo State, PIPE (Innovative Research in Small Enterprises) is a programme initiated in 1997 that is managed by FAPESP and has supported over 1.000 research projects in the state[10] (FAPESP 2012). It is a funding programme that aims at a) supporting R&D as a tool to develop technological innovation, promoting entrepreneurial development, and increasing the competitiveness of small enterprises; b) creating the right conditions to improve research contributions to social and economic development; c) inducing the increase of private investment in technological research; d) facilitating

partnerships between small enterprises and researchers in research projects for technological innovation; and e) contributing to form nuclei for technological development in small enterprises and to insert researchers in the entrepreneurial market.

The programme is structured in three phases: a) analysis of techno-scientific viability (up to six months); b) development of the research proposal (up to 24 months); and c) application of the results aimed at the commercialization of the product or process created in phases a) and b). FAPESP provides funding for the first two phases, although the third phase is mandatory for approval of the grant. There are several conditions to receiving a grant from the programme, but the most important ones here are that the researcher in charge of the project has to be linked to the small enterprise and be available for at least 24 hours per week to work on the project; the small enterprise cannot have more than 100 employees, and has to show that it has the right conditions to conduct the research and to raise funding necessary for the third phase. Four of the eight entrepreneurs engaged in high R&D-intensive activities in São Paulo State counted on subventions from this programme.

In Minas Gerais, the main programme mentioned by entrepreneurs is PRIME, followed by FAPEMIG's role in launching programmes such as PAPPE (Enterprise Research Support Programme) and AMITEC (Programme of Support to Technological Improvement and Innovation). The former is realized in partnership with FINEP and targets only small enterprises; the latter is implemented in partnership with SEBRAE and FIEMG and targets small and medium enterprises. An important condition of these programmes is that the technological innovations should have a social or commercial impact once introduced in the market. Information about which programme is used most by business start-ups is unspecified in the entrepreneurs' narratives and on the websites of business incubators and start-ups. Six of the nine start-ups developing some degree of R&D-intensive activities in the Minas Gerais State benefited from FAPEMIG's subvention to develop their products and services.

It is noteworthy that these programmes, in both states, strongly target innovative start-ups with technology-oriented projects. This shows that the formal financial environment for these start-ups is populated by governmental support institutions rather private investors, and private and public banks. The entry requirements of these make them inaccessible to

start-ups. Firm18 describes well the existence of a funding gap in the Brazilian financial market for business start-ups:

> We are here for three years, investing what we have […] to make the business viable. So we are taking up all the risk. Even FAPESP no longer bears the risk, with us. Because all the others, all the other investment lines, they take a step ahead, which is when the enterprise is already moving, already in progress. [...] So I think there is a valley there, there is a gap there, a bit complicated to… receive from the government. […] Then, you have another side, right? If I was selling snacks, then I would get it; about 20.000 reais, 30.000 reais, of investment. Isn't it true? (§ 185).

This present study observed that most low R&D-intensive start-ups counted on minimum financial incentives by SEBRAE via the business incubator. These incentives included participating in business fairs and technical visits, and regular consultations on finance and marketing. However, there is no direct financial incentive to product or process innovation. These indirect financial incentives are embedded in a network of institutions.

SEBRAE started supporting the implementation, development and strengthening of business incubators working with low R&D-intensive start-ups in 1991 and, in partnership with ANPROTEC, in 1998. The first calls for subvention supported 35 incubation projects in 15 states; in 2002 this number had risen to 234 projects in 99% of the national territory[11]. The actual amounts allocated per low R&D-intensive start-up are around 1/100 or less of the value of technological subventions to high R&D-intensive start-ups and are sporadic. Moreover, there is a big gap between the financial power of SEBRAE in the São Paulo State and in Minas Gerais. A call for proposals by SEBRAE/SP in 2010 had a budget of 20 million reais, a ceiling per proposal of one million reais, and collateral of 50% of the value of the proposal by the applicant institution. SEBRAE/MG, on the other hand, does not launch these calls and its main services are, to a certain extent, comparable to what is also found in the São Paulo State, i.e., availability of information about how to start a business, what is a business plan, other basic general information for beginners entrepreneurs, consultancies and punctual guidance. Therefore, as stated by the administrative manager of RMI, SEBRAE/SP invests a lot more in business incubators than SEBRAE/MG does. While in São Paulo resources are made available to individual start-ups through busi-

ness incubators, including low R&D-intensive start-ups, in Minas Gerais resources are targeted at clusters, such as in the footwear sector.

In relation to access to banks, middle aged and older entrepreneurs rely on their individual profiles to apply for personal loans and acquire equipment to set up the business. One of the commonly reported requirements by banks for entrepreneurs to enrol in financing programmes or to be eligible for business loans is two years of operation and a portfolio of buyers. Yet, interest rates are higher for young businesses than for bigger and established ones. Clearly, the formal financial system imposes insurmountable barriers during the most critical years of business start-up.

Exceptional cases of low R&D-intensive start-ups relied on small-scale local private investors, but these only joined the business around the second or third year of operation. Again, during the first two to three years start-ups are left with a financial support gap that is filled by the entrepreneurs' own resources, by informal loans from family and friends, or by the first sales. These dynamics of the financial institutional setting for low R&D-intensive start-ups clearly favours those who have resources of their own or in their networks to bear the fixed and development costs of a new business, at least in the first two years.

Geographical distribution of business incubators

As they host the second highest number of business incubators in the country, the States of São Paulo and Minas Gerais provided a relevant range of case studies for this thesis. Within the São Paulo State business incubators are spread across all sub-regions. In Minas Gerais, on the other hand, they are concentrated in the centre-west, centre and south of the state, with many cities having two or more business incubators while most of the state's cities have none. There are three main factors that explain this distribution of business incubators in each state: degree of R&D-intensiveness, availability of funding and other incentives, and the political will of support institutions and local governments. This section discusses the first factor.

The degree of R&D-intensity explains why technological incubators are located inside or next to universities and research centres. Start-ups linked to these incubators are often spin-offs of academic research and need partnerships with research laboratories to develop the product or

service. The incubator, then, represents a bridge between academic expertize and top technology and market opportunities for product development. In this regard, both States share the same pattern, in which the geographical distribution of technological incubators follows the regional distribution of the main universities and research centres. These are also regions in which it is easier to access knowledge-specific networks.

The geographical dispersion of business incubators in the São Paulo State, therefore, is due to traditional incubators, whose incubatees depend more on the existence of local suppliers, buyers, and institutions. Nevertheless, the current trend, according to SEBRAE (verbal information from meeting with officials at SEBRAE Nacional in 2012) is the shrinking of traditional incubators through mergers, closures, or conversion into technological incubators.

Importance of actors in the institutional setting

This sub-section highlights the role of state-level institutions for the creation and geographical dispersion of different types of business incubators. In São Paulo State, the strong presence of SEBRAE establishing partnerships with local governments is the pillar on which traditional incubators rely. Yet, for those few traditional incubators that count on the presence of a university or research centre, the establishment of partnerships with these institutions is not an easy task. Therefore, these incubators face challenges related to scarcity of skilled labour, barriers to innovation, and distance from economically dynamic centres. Broadening the scope of buyers, for example, requires extra efforts, since these are hundreds of kilometres away, there is dependence on sales representatives, and episodes of default or copying of the product by these sales representatives or outsourced suppliers are a relatively common outcome of these efforts towards growth. The advantage of these traditional incubators, nevertheless, remains in the creation of job opportunities, local level industrialization, training of entrepreneurs, and formation of a local entrepreneurial culture (Albert, Bernasconi et al. 2004).

In addition to the importance of support institutions at the federal and state levels for the establishment of business incubators, there is also the role of local governments. This political will appeared in interviews with many managers of business incubators. There are stories about business incubators that closed down for lack of local government support, and about how a lack of vision of business incubators as instru-

ments of development hindered the establishment of new incubators in remote regions. Moreover, these local governments lack the incentives of a powerful institutional web to establish such programmes with chances of success.

Another type of actor that could have a stronger presence in the institutional setting of business incubators but seem to be almost absent is industry association: FIESP in São Paulo and FIEMG in Minas Gerais. Until the end of 2007, FIESP was the managerial entity of more than 30 business incubators attending low R&D-intensive start-ups in São Paulo. However, the unexpected exit of FIESP from the web of support left a big gap. It was reported by entrepreneurs from these traditional incubators that the exit of FIESP implied losses in training opportunities, reduction and drastic changes in previously regular consultancies, stagnation of the business incubator for lack of an actor to manage the resources transferred by SEBRAE, and so on. In some cases, another business incubator took over the role of FIESP; for others, the local government did so; but others just remained deactivated.

In sum, the institutional environment of business start-ups is formed by the following key actors: funding institutions (i.e., FINEP, SEBRAE, FAPEMIG, FAPESP), local governments, managerial entities (i.e., university, local government, big business incubator), other support institutions (i.e., chamber of commerce), market actors (i.e., buyers and suppliers), the incubator as a physical installation and learning setting, and incubatees.

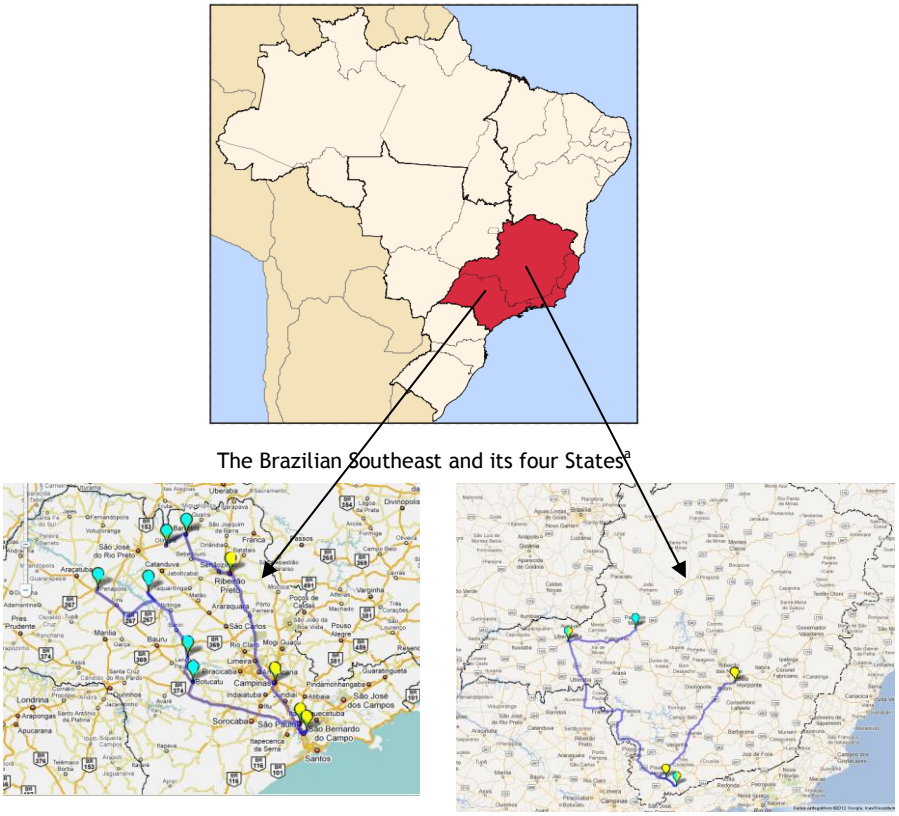
3.3 Description of the researched business incubators

Seventeen business incubators were visited; 10 in São Paulo and 7 in Minas Gerais. Interviews were conducted preferably with managers or otherwise with core support staff. Their geographical distribution is shown in Map 3.2. Yellow marks indicate technological incubators, blue marks indicate traditional incubators, and two-colour marks (only in Minas Gerais) indicate locations with both types of incubators.

Table 3.1 presents the distribution of the interviews per geographical location, type of business incubator and category of interviewee. Although the research was delimited to traditional and technological incubators, two mixed incubators were included in Minas Gerais, in order to investigate the evolution of low R&D-intensive start-ups in that State. In

one case, although the incubator manager reported that it had become technological after a revision of its strategy, it is classified as mixed here, since the start-ups interviewed are low R&D-intensive and were incubated before this change. The number of interviews was balanced per type of incubator, considering the peculiarities of each State.

Map 3.2
Geographical location of the areas investigated and geographical distribution of the business incubators



Source: [a]Wikipedia; [b]Google Maps and the author's itineraries.

Table 3.1
Distribution of the interviews

State	Type of BI	BI (n/N)	Interviews				Count
			Managers + Core staff	Incubatees	Graduates	Contrast cases	
SP (9 of 28 sub-regions)	Traditional	6/36	6	11	7	1	25
	Technological	4/20	4+1	9	4	2**	20
Total		10/86*	11	20	11	3	45
MG (3 of 12 sub-regions)	Technological	5/15	3+2	6	6	1	18
	Mixed/others	2/10	2	3	3		8
Total		7/25	7	9	9	1	26
Other interviews	RMI						1
	Local Office of SEBRAE – RP/SP						1
	Local Office of SEBRAE – SP/SP (e-mail)						1
	Local Office of SEBRAE – ATB/SP (e-mail)						1
	SEBRAE Regional – MG (e-mail)						1
Total							5
GRAND TOTAL							76

* The difference (30 business incubators) refers to types of incubators other than traditional and technological. **This total includes one interview that was indicated as match case, but that was actually a graduate from another business incubator.
Source: Fieldwork.

Table 3.1 details the demographic and economic characteristics of each municipality. In general, each city has one incubator. However in Minas Gerais there are two cities with two incubators each. In Santa Rita do Sapucaí, one incubator is part of a private institute and the other belongs to the local government. In Belo Horizonte, one is part of a foundation for information technology and the other is part of a federal university. The highlighted rows indicate technological incubators and

incubators 16 and 17 are mixed (the 17th is the one that recently changed into technological).

Table 3.2
Local context of business incubators
(BI 1-10 are in São Paulo and 11-17 are in Minas Gerais)

BI	Municipality	Population	GDP per capita	N Enterprises (% active)	Employment (% fixed)	Services (% GDP)
01	Botucatu	130348	19054	4199 (97,07)	38313 (86,72)	53,27
02	Jaborandi	6715	9446	157 (94,90)	617 (77,15)	59,42
03	Olímpia	50602	16404	1974 (97,97)	13064 (80,66)	61,75
04	Penápolis	59597	16389	2349 (97,87)	14600 (80,90)	75,14
05	Barra Bonita	36214	12018	1670 (98,56)	15182 (86,82)	70,29
06	Novo Horizonte	36271	16840	1644 (96,84)	7122 (71,67)	68,99
07	Santo André	673396	20044	23406 (96,85)	209885 (84,85)	61,41
08	Ribeirão Preto	563107	23692	30110 (97,05)	207839 (81,08)	81,55
09	Campinas	1064669	26133	44881 (96,05)	408418 (85,60)	73,44
10	São Paulo*	11037593	29394	520533 (94,90)	5241615 (86,39)	77,96
11, 13	Santa Rita do Sapucaí	36150	16508	1506 (96,75)	10860 (82,28)	52,95
12	Itajubá	90225	13377	3304 (97,22)	25840 (82,83)	57,86
14, 15	Belo Horizonte*	2452617	15835	100464 (94,54)	1412412 (89,72)	83,04
16	Patos de Minas	139841	10670	4661 (96,52)	32282 (80,74)	69,78
17	Uberlândia	634345	20520	21492 (95,88)	183888 (84,85)	71,36

*Capital cities.
Source: IBGE Cidades, 2009.

Table 3.2 shows that:

- City population sizes range from 6.715 to 11.037.593. The average population, excluding the outliers (São Paulo and Jaborandi), is 459.029.
- The average GDP per capita is 17.755 Brazilian reais (~8.293 Euros[12]); excluding outliers the average is 17.498 (~8.174 Euros).
- In all cities, more than 94% of the enterprises are active, according to IBGE-Cidades (IBGE, Directory of Research, Coordination of National Accounts,System of National Accounts 2009).
- In most cities, the rate of employment for those with a monthly income (referred to as "fixed" or "registered" jobs) is above 80%, except for Jaborandi (77,2%) and Novo Horizonte (71,7%).
- Services is the economic sector that contributes the most to the GDP in all cities, ranging from 52,95% in Santa Rita do Sapucaí to 83,04% in Belo Horizonte.

Packages of services provided

All but one business incubator provides operational and strategic services (Altenburg, Stamm 2004).[13] Operational services include office and working space for each start-up (variable in size), shared infrastructure (i.e., meeting rooms, cafeteria/kitchen, building maintenance), business facilities (i.e., secretary, security), and informational facilities (i.e., internet). Entrepreneurs pay fees below market prices, which can be take the form of a regular monthly payment and a shared variable amount to cover facility expenses. Only one business incubator does not charge, and another one has layered values according to the amount of time spent using in the business incubator facilities (from very low fees to gradually reaching market prices).

In relation to packages of strategic services, despite variations between incubators, two main categories are highlighted by the entrepreneurs: entrepreneurial formation and networking. Other types of services are financial support to participate in fairs or to access/develop technology, credibility that facilitates access to the market, conflict management and access to critical information that is too expensive or not available on the market. The distribution of these services is shown in Table 3.3.

Table 3.3
Strategic services provided by the business incubators (n=49 entrepreneurs)

Type of resource	Strategic services	Count
Conflict management	Mediation between associates in conflicting situations (i.e., joint venture breakdowns)	2
Credibility	The BI "brand" facilitates entry in the market (i.e., buyers, investors) and access to credit (bank loans)	5
Entrepreneurial formation	Regular consultancy (mostly on finances and marketing) and specific consultancies (tailor-made)	32
	Courses and trainings on specific issues (i.e., cash flow, price formation, marketing, application for governmental funds)	13
	Regular monitoring and continuous support in managerial issues (i.e., contract management, establishment of partnerships)	4
	Guidance to elaborate a business plan	3
	Redefinition of the product/service or even of the focus of the business	3
	Learning environment for networking and cooperation among incubatees	2
Financial support	Support to participate in business fairs (opportunities for sales, benchmarking, business-related networking); or to R&D (technical visits, innovation nucleus)	10
Information	Access to critical information that would be otherwise too expensive or not available on the market	2
Networking	Mediation between start-up and investors (organization of venture capital events)	5
	Mediation between start-up and regulation organs	4
	Access to buyers or mediation between start-up and buyers	4
	Mediation between start-up and university/research centre	3
	Mediation between start-ups towards business-network formation and access to business association	2
	Mediation between enterprise and government	1

Source: Fieldwork.

Items related to entrepreneurial formation, reported 57 times, include regular consultancy, and courses and trainings. Most of the incubators offer monthly assistance by finance and marketing consultants, who de-

sign tailor-made competence development programmes, in general based on a general competences programme designed by SEBRAE. Other consultancies may depend on entrepreneurs' demands (e.g., legal or design consultant) and vary substantially. Courses focus on managerial competences (i.e., break-even point, how to apply for public calls), technical knowledge (i.e., cash-flow, venture capital), entrepreneurial attitude, and how to take calculated risks (the most quoted course is EMPRETEC, by SEBRAE).

Networking services are reported 19 times, with specific items showing that business incubators mediate contacts between incubatees and several other actors, from private investors (exclusively for technological incubators), to governmental agencies, research centres, buyers and other incubatees. Although networking does not figure amongst the services provided by business incubators either in ANPROTEC's reports, incubators' websites, or even by most of the managers, this is the second most important category of strategic services provided by business incubators, from the entrepreneurs' viewpoint. As discussed in previous chapters, networking is complementary to the development of internal competences and is critical to promote access to suppliers, buyers, investors, technology, and other resources that are critical to the firm's sustainability.

Entrepreneurial formation and networking empirically strengthen the concept of business incubators as learning settings. Moreover, for those learning needs that are more often shared among entrepreneurs and recognized by incubators' managers, formal training represents a cost-saving solution to accommodate and prevent critical learning episodes. However, for daily needs, specific CLEs, and checking and balances of one's performance as entrepreneur, regular informal exchanges seem to be key.

It is noteworthy that these two processes of learning (formal and informal) interact with each other in different ways. Informal learning can happen during a formal seminar or course when entrepreneurs share their experiences (Eraut 2004). Also, informal exchanges can evolve into formal business relationships depending on the degree of complementarity between resources and the entrepreneurs' competences.

Selection criteria for new incubatees

In relation to criteria of selection, the requirements for most of the incubators are very similar. Following public calls by the incubator, entrepreneurs apply with a business plan, which is selected by a council formed by the incubator's manager and the programme partners.

It was observed that selection criteria evolve according to previous rates of success and failure, mainly in the first years of the business incubator's operation. Managers that have been in the same incubator since the beginning, report learning episodes at the level of the incubator in relation to how to select the best applications. This information, gathered from interviews with managers of individual incubators, coalesces with the overall assessment of the administrative manager of RMI about the process of incubator maturity. He states that the critical point is when the first group of start-ups graduates, two years after the call for applications. The issue of survival rates per incubator's stage of maturity appears as an important topic for future research, but it is beyond the scope of this thesis.

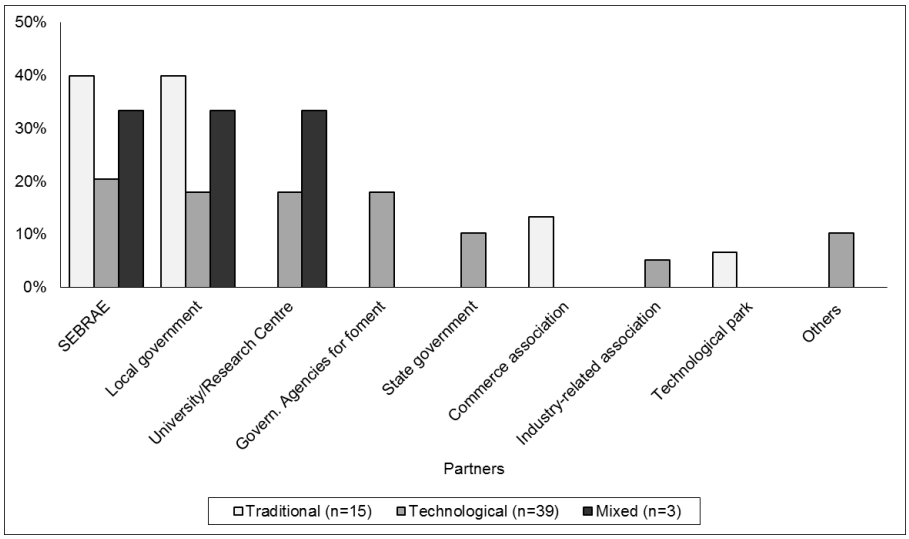
Partnerships

The establishment of partnerships to sponsor and provide services is another key factor to the survival of business incubators.

Figure 3.1 presents the participation of each partner per type of business incubator, indicating that:

- SEBRAE is a key partner, providing financial resources and indispensable experts for the majority of the businesses. It has stronger participation in traditional and mixed incubators;
- Local governments are most often responsible for providing economic resources, also considered more important to traditional and mixed incubators;
- Universities and research centres have no role in partnerships with traditional incubators but are essential for technological and mixed incubators – in the latter, for higher R&D-intensive start-ups;
- The core group of support actors for traditional incubators are SEBRAE and the local government; whereas for technological incubators the set of actors is broader and their relative importance is almost evenly spread.

Figure 3.1
Business incubators' partners per type of incubator



Source: Fieldwork. Interviews with business incubators' managers and documentary search on public relations material and websites of business incubators.

Who the managers are

To conclude the characterization of these 17 business incubators, a brief description of the profile of the managers is provided (see detailed information in Appendix 2). Managers are key actors for networking, since they are act as the hub between support institutions, service providers, government agencies, other incubators and incubatees. They play a critical role inside the business incubator, in setting up an environment of cooperation between incubatees, and being in close contact with entrepreneurs' needs to arrange services accordingly.

The educational background of these 17 managers, per type of incubator, is:

- Traditional incubators: one agronomist engineer, one business manager and one biologist.

- Technological incubators: two with higher education (the area was not defined), two engineers, one engineer specialized in strategic business management, one engineer and business manager, two business managers, one master in a non-declared area, and one lawyer specialized in the management of technological innovation.
- Four of them did not refer to their educational backgrounds and this information could not be found via other sources.
- The majority of the managers (11 out of the 17) have worked for the incubator for at least 5 years; some of them are also its founder.

The role of the incubator's manager in setting up a learning environment is so strong that in three incubators in which there was a frequent turnover in the position of manager, entrepreneurs report low or negative impacts of the incubator on the evolution of their start-ups. This is not to say that the manager is the only person responsible for the services provided by the incubator, but it seems that stability at the incubator's management level signals some degree of quality and continuity in the services provided, in the networks established with suppliers and support institutions, and a legitimacy for performing mediation roles between incubatees and other actors, such as banks, university laboratories, etc. Some evidence is provided by an entrepreneur, when she describes a negotiation event between the incubator manager and the municipality to organize an exposition that included sales:

> The knowledge he has, he is always willing to pass on. […] Whatever you need, you go to him and tell him; he gets it. He offered us, once, some rooms to have an exposition. This was also very good, because we had too much in stock. It was for… sales (Firm07, §170).

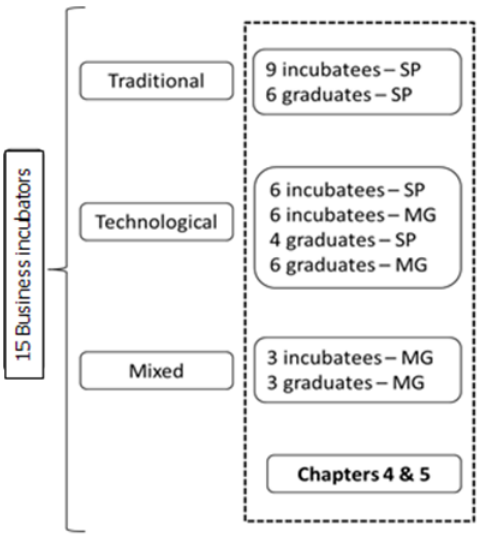
However, the role played by managers is embedded and constrained by the network of support institutions, especially the managerial institution (in this case, the university). As the quotation below shows,

> So, unfortunately, the partners do not embrace the incubator as a viable project. [In a meeting with various incubation partners in the state] there was everyone who takes decisions. And the incubator here was represented by its manager, who did not have any decision-making power in relation to the other partners (Firm38, §150).

3.4 The start-ups

This section presents the characteristics of the 43 valid cases, for the analysis in Chapters 4 and 5. Remaining cases were discarded due to poor data, i.e., in one case there were confidentiality issues which made inclusion impossible; in two cases interviews were scheduled by the incubator but it turned out that these businesses had joined the programme too recently, and there was one associated business that had already been in the market for about 15 years. In addition to this, as briefly pointed out earlier, the selection of a resource-rich region did not facilitate accessing matched-pair cases as expected. For the small number of interviews obtained, fair comparisons between incubation and non-incubation cases were not possible, so these interviews are not considered for the analysis of CLEs and pathways. Figure 3.2 characterizes the final database. Appendix 3 details some key attributes of each start-up.

Figure 3.2
Number of start-ups in the final database



The results of 43 business start-ups that were incubated or recently graduated from 15 business incubators,[14] are presented in Chapters 4 (CLEs) and 5 (pathways). This section describes the characteristics of these businesses based on a set of firm and market characteristics, in-

cluding type of economic activity, type of market, R&D-intensity, and type of business incubator.

The classification of economic activities used here follows the ISIC (International Standard Industrial Classification of All Economic Activities) Rev. 4 (United Nations 2008). The three economic activities are manufacturing (n=24), information and communication (n=11), and professional, scientific and technical activities (n=8), as shown in Table 3.4. The majority of these manufacturing enterprises are concentrated in the in São Paulo State (mainly textiles and footwear). This is to be expected due to the strong industrial tradition of the region (IBGE, Directory of Research, Coordination of Industry 2008). In Minas Gerais, there was a better balance between manufacturing (mainly products based on electric or electronic systems) and information and communication activities (websites, software development). Appendix 4 presents a list of all participants in the study with their correspondent categorizations of industrial activity and type of market.[15]

Table 3.4
Characteristics of the business start-ups (n=43)

Start-up characteristics	Values (%)
ISIC Rev. 4	
Manufacturing	55,8
Information and communication	25,6
Scientific and technical activities	18,6
SNA	
Capital goods	25,6
Consumption goods	25,6
Business services	23,3
Intermediate goods	20,9
Final consumer services	4,7
OTHERS	
Years in operation mean (SD)	3,8 (1,9)

Table 3.4 also shows the distribution of cases per type of market, based on the SNA (System of National Accounts). There is an even distribution of cases in the first four categories in the Table, except in final

consumer service, which only includes two enterprises. As expected, São Paulo has a higher number of start-ups producing intermediary and consumption goods than Minas Gerais, due to its higher industrialization level and bigger consumer market.

Start-ups were also compared in terms of R&D-intensity and type of business incubator to which they were linked. Since some start-ups have more than one product or service and they may differ in terms of R&D-intensity, the analysis considered only the core product or service; the one corresponding to the business plan upon enrolment in the programme. Results show that none of the traditional or mixed incubators host start-ups performing high R&D-intensive activities; whereas 62,5% of the technological incubators host high R&D-intensive start-ups (X^2 (1, n=43)=18,24, p<0,01). These figures are consistent with the target groups of each type of business incubator. An important remark is that some low R&D-intensive activities within technological incubators still have a heavy technological background, such as start-ups designing intranets. Yet these they are categorised as low R&D-intensive start-ups because the technology they use is well-developed and the start-up does not have to invest in R&D to create products.

Next, the relationship between R&D intensity and initial financial resources is examined. Initial financial resources refer to the number of types of financial sources, rather than the specific amounts available for investment in the business. It is considered here that, at the outset of a business, types and diversity in sources of finance are more important than amounts per se, since more sources might signal stability of inflows and, therefore, influence the evolution of pathways. Results show that 32 start-ups (74,4%, non-sig. difference between levels of R&D-intensity) counted on only one source of finance, with the entrepreneur's own resources being the most common source. This result corroborates SEBRAE's findings, in which more than 88% of start-ups relied on the entrepreneur's own resources for fixed investment and working capital (SEBRAE 2007). However, when looking more closely into types of sources, significant differences appear, with low R&D-intensive start-ups relying more on the entrepreneur's own sources, and entrepreneurs in high R&D-intensive activities relying on grants and sales of secondary products or services (X^2 (1, n=43)=25,12, p<0,01). Qualitative differences appear in the analysis of pathways (Chapter 5), since these initial sources of finance will inform different typical pathways.

Another important aspect with which to characterize these start-ups is an analysis of the richness of their initial institutional setting. Here, the institutional setting is measured by looking at the size of the network, which indicates a diversity of actors. Results show that there is no significant difference per level of R&D-intensity, since both groups have between two and four types of actors in their initial networks. In-depth analysis considering different types of actors and resources exchanged within these networks, as well as comparisons between initial and current settings are discussed in Chapters 4 and 5.

The last descriptive analysis at the level of the start-ups explores the initial market characteristics in terms of market coverage. Table 3.5 shows the size of the market of these start-ups in four levels: local, regional, national, and international, again splitting the start-ups per R&D-intensity. These categories correspond to the expected or estimated size of the market at the beginning of the business.

Table 3.5
Distribution of cases per R&D-intensity and initial size of the market (n=43)

	Size of the market			
	Local (n=10)	**Regional** (n=12)	**National** (n=18)	**International** (n=3)
Low R&D-intensity	80	100	38,9	33,3
High R&D-intensity	20	0	61,1	66,7

X^2 (3, n=43) = 14,19, p<0,01

Results indicate that the local and regional markets are predominantly marketed by low R&D-intensive start-ups; whereas the national and international markets are the aim of high R&D-intensive start-ups. These figures corroborate distinctions between traditional and technological business incubators, in relation to their main objectives and the types of businesses they target and select. Changes in the size of the market over time and for different products and services are part of the analysis of pathways in Chapter 5.

3.5 The entrepreneurs

Brazilian data show that 79% of the entrepreneurs in 2005 had pursued higher education though not all had completed it; 51% had work experience in private enterprises, 60% had some experience in their business area before starting new venture and 60% were pull-entrepreneurs (SEBRAE 2007). The same report indicates that full dedication to the business is critical to survival: once 70% of the active businesses had been run by fully dedicated entrepreneurs since the first year, compared to only 42% of the failed businesses. The most important knowledge areas pointed out by entrepreneurs in this survey were planning, enterprise organization, marketing, sales, human relations and financial analysis.

In this study, most of the entrepreneurs (84%) started a business driven by the identification of an opportunity. This high percentage of pull-entrepreneurs, much higher than national figures, illustrates their motivation to grow and, in consequence, an increased probability of searching for specialized BDSs, such as business incubators. In addition to this, the majority of cases had no entrepreneurial experience or role models before starting the business (56% of 43 entrepreneurs). For those who had role models, none of them were in the same area as the start-up. None of the 43 start-ups were family businesses either. Only 16% (seven entrepreneurs) had experienced some formal entrepreneurial education in the form of courses on entrepreneurship and/or participation in business fairs with business ideas at the college or university. This profile is distinct from the literature on entrepreneurship, in which family businesses, role models and expertise have played a major role (e.g., Praag 1999, Madsen, Neergaard et al. 2003).

Almost half of the entrepreneurs had higher education degrees and professional experience in the same field as the start-up, but these two factors do not correlate ($p>0,05$). Note that tertiary education and no professional experience are moderately correlated ($r^2=0,27$, $p<0,01$), reflecting those start-ups initiated by recently graduated engineering students. Another large group is formed by entrepreneurs with professional experience: those with some initial knowledge on production, market, etc. However, this professional experience in the same field is based on specific activities performed in previous employment. Professional experience in management appeared in only one case.

These main demographic characteristics are displayed in Table 3.6. Whenever possible, data from SEBRAE (2007) is used for comparative purposes.

Table 3.6
Characteristics of the entrepreneurs (n=43)

Entrepreneurs' characteristics	**Values (%)**
Opportunity vs. survival entrepreneurship	
Pull-entrepreneurs (driven by business opportunity)[a]	83,7
Entrepreneurial experience	
No entrepreneurial experience	83,7
Role models	
Absence of entrepreneurial role models	55,8
Entrepreneurial education	
Yes – undergraduate and/or graduate levels	16,3
Educational level	
Tertiary education[b]	46,5
Not mentioned/Secondary education	18,6
PhD degree	23,3
MA degree	11,6
Professional background	
Work experience in the same field[c]	48,8
No work experience	20,9
Work experience in a different field[d]	16,3
Academic career	14,0

SEBRAE (2007):
[a] = 60; [b] = 79 (and higher education);
[c] = 60 (knowledge of that type of business); [d] = 51 (or same field)

The high percentage (64%) of entrepreneurs with previous work experience in the same or a different field can also provide important conditions that are conducive to an entrepreneurial career (Audia, Rider 2005, 26):

- Exposure to information that may signal the existence of entrepreneurial opportunities (e.g., new technologies, unmet customer needs);

- Opportunities to perform roles useful to running entrepreneurial organizations, so that employees build confidence in their ability to set up a new organization by themselves;
- Contact with colleagues in other functional areas with whom employees might form founding teams;
- Direct access to key resource providers such as suppliers, customers, or investors who might be willing to support a new venture.

Table 3.7
Entrepreneurial characteristics and R&D-intensity of start-ups' activities (n=43)

Entrepreneurs' characteristics	R&D-intensity (%)	
	Low (n=28)	High (n=15)
Opportunity vs. survival entrepreneurship*		
Pull-entrepreneurs (driven by business opportunity)	89,3	73,3
Entrepreneurial experience*		
No entrepreneurial experience	78,6	93,3
Role models*		
Absence of entrepreneurial role models	50	66,7
Entrepreneurial education*		
Yes – undergraduate and/or graduate levels	17,9	13,3
Educational level (X^2 (4, n=43) = 14,16, p<0,01)		
Tertiary education	53,6	33,3
PhD degree	7,1	53,3
MA degree	10,7	13,3
Professional background (X^2 (3, n=43) = 13,65, p<0,01)		
Work experience in the same field	57,1	33,3
No work experience	21,4	20
Work experience in a different field	21,4	6,7
Academic career	0	40

* Values for x^2 are non-significant.

Further, it is interesting to analyse these entrepreneurial characteristics in relation to some start-up characteristics, i.e., R&D-intensity, type of

business incubator, and initial financial resources. Table 3.7 presents the cross-tabulation of entrepreneurial characteristics and R&D-intensity. Entrepreneurs in both low and high R&D-intensive start-ups have similar profiles in relation to being pulled by business opportunities, lacking entrepreneurial experience, entrepreneurial role models, and entrepreneurial education. Differences appear in terms of educational level and professional experience, with those entrepreneurs engaged in high R&D-intensive activities characteristically having PhD degrees and originating from academic careers, whilst entrepreneurs engaged in low R&D-intensive activities tend to have Bachelor degrees and work experience in the same field as the start-up (correlation coefficient between the two is non-significant).

Next, entrepreneurs' characteristics are compared per type of business incubator (Table 3.8). This analysis profiles entrepreneurs that are more typical of each incubation model and can be interpreted as a proxy for the demand that goes to each incubation model. Entrepreneurs in technological incubators tend to have less entrepreneurial experience and fewer role models; nevertheless, they can count on a more formal entrepreneurial education. Profiles differ, again, in terms of education and professional background, with traditional incubators characterized by entrepreneurs with BAs; whilst technological incubators include higher education, MA, and PhD degrees. In relation to professional background, entrepreneurs in traditional incubators tend to have work experience in either the same or different fields; whereas technological incubators generally have entrepreneurs experienced in the same field, without work experience or originating from academic careers.

The last analysis of characteristics of entrepreneurs considers the initial sources of finance. Table 3.9 shows that profiles are similar for type of entrepreneurship, lack of entrepreneurial experience, absence of role models, and educational level. Significant differences appear in relation to professional background, with those beginning with one source of finance having work experience in the same field, whilst those counting on two sources of finance typically have no work experience or originate from academic careers. These two sources of finance are commonly family and sales of secondary products or services.

Table 3.8
Entrepreneurial characteristics and type of business incubator (n=43)

Entrepreneurs' characteristics	Business incubator (%)	
	Traditional (n=19)	Technological (n=24)
Opportunity vs. survival entrepreneurship*		
Pull-entrepreneurs (driven by business opportunity)	89,5	79,2
Entrepreneurial experience (X^2 (1, n=43) = 5,85, p<0,05)		
No entrepreneurial experience	68,4	95,8
Role models (X^2 (2, n=43) = 6,07, p<0,05)		
Absence of entrepreneurial role models	42,1	66,7
Entrepreneurial education*		
Yes – undergraduate and/or graduate levels	5,3	25
Educational level (X^2 (4, n=43) = 15,80, p<0,01)		
Tertiary education	57,9	37,5
PhD degree	5,3	37,5
MA degree	0	20,8
Professional background (X^2 (3, n=43) = 13,52, p<0,01)		
Work experience in the same field	68,4	33,3
No work experience	5,3	33,3
Work experience in a different field	26,3	8,3
Academic career	0	25

* Values for x^2 are non-significant.

An interesting result in relation to education is that 37% of the entrepreneurs increased their initial educational levels following the start of their business. Most of these entrepreneurs reported that more schooling was vital to develop further competences and better run the business, thus the focus on business management courses and specializations in knowledge management. Others completed the undergraduate or graduate courses they were engaged in at the start of the business.

Table 3.9
Entrepreneurial characteristics and initial financial resources

Entrepreneurs' characteristics	**Sources of initial financial resources**	
	One (n=32)	**Two (n=11)**
Opportunity vs. survival entrepreneurship*		
Pull-entrepreneurs (driven by business opportunity)	81,2	90,9
Entrepreneurial experience*		
No entrepreneurial experience	78,1	100
Role models*		
Absence of entrepreneurial role models	50	72,7
Entrepreneurial education (X^2 (1, n=43) = 4,38, p<0,05)		
Yes – undergraduate and/or graduate levels	9,4	36,4
Educational level*		
Tertiary education	43,8	54,5
PhD degree	21,9	27,3
MA degree	9,4	18,2
Professional background (X^2 (3, n=43) = 9,44, p<0,05)		
Work experience in the same field	59,4	18,2
No work experience	12,5	45,5
Work experience in a different field	18,8	9,1
Academic career	9,4	27,3

* Values for x^2 are non-significant.

3.6 Conclusion

Business incubators mobilize, catalyse and make available resources through operational and strategic services. However, the provision of these services is constrained by the institutional environment, i.e., development policies at the national and sub-national levels. Despite the small number of participants here, they are good qualitative representatives of the general context, for instance, in relation to types of services provided by business incubators and the relative importance of partnerships with a wide range of institutions. Business incubators selected here represent the most common types found in São Paulo and Minas Gerais States.

Within this context, a new argument redefines business incubators as learning settings. A combination of formal and informal learning processes makes business incubators a distinct type of BDS since planned learning and informal exchanges are concentrated in the same space on a daily basis. It is important not to take for granted that informal learning will happen spontaneously, as a positive externality of the agglomeration of entrepreneurs. Business incubators in general and business incubator managers in particular, have an active role in creating an environment of trust and cooperation for these exchanges (e.g., Corradi 2012). In this regard, informal learning processes have become a kind of 'invisible service' as discussed in Chapter 6.

The chapter also discusses the channelling of governmental financial resources to high R&D-intensive start-ups, for product development and improvement of managerial competences. Low R&D-intensive start-ups rely mostly on their own resources and on indirect support. This scenario raises two questions. First, would the availability of credit smooth these first two years if entrepreneurs could access small loans to set up the business? Second, would the financial system be interested in creating a set of conditions to reduce risks of default by business start-ups so they could be supported during the most uncertain phase: and if so, how could incentives to entrepreneurs and to banks be balanced out?

The literature partly helps in answering the first question by showing that the development of firm capabilities can be more critical than the availability of financial resources to the growth of businesses (e.g., Hormiga, Batista-Canino et al. 2011). This does not mean that financial resources are not critical, but that there are cases in which these resources would not have prevented failure. What is missing, then, is some assessment tool or system of guarantees that could be used by the financial system to select those entrepreneurs with learning capabilities to manage resources well. In relation to the second question, the cases studied used network-based strategies to circumvent bank requirements. For instance, parents of the entrepreneurs sign as guarantors of bank loans, the parents being the ones able to fulfil the banks' requirements. Other entrepreneurs counted on the incubator manager to mediate between themselves and bank managers. The latter case uses the bank's trust in the incubator's manager as an informal guarantee of the trustworthiness of the entrepreneur. However, a complete response to these questions re-

quires empirical enquiry and pilot interventions for different profiles of entrepreneurs and start-ups.

The section about start-ups showed that the distinction between low and high R&D-intensity seems to be important to profile entrepreneurs and resources within either the traditional or the technological incubation model. High R&D-intensive start-ups start with initial networks that are more diverse than those of low R&D-intensive start-ups. Moreover, they require a broader institutional setting in which multiple actors are needed for the provision of different resources. This broadness is also reflected in the market coverage of high *versus* low R&D-intensive start-ups, with the former aiming at national and international markets and the latter at local and regional. This configuration of factors may justify the high level of governmental investment in high R&D-intensive start-ups, to ensure that their higher demands for financial and institutional resources to create technological development are attended to.

However, a significant group of start-ups is left out. Low R&D-intensive start-ups are those with higher opportunities to have an impact on local economic development, since they attend the needs of and stimulate the local market (as both suppliers and buyers) and generate income and capabilities for the local labour force. Hence, low R&D-intensive start-ups are embedded in the local and regional institutional environment. The resources they use, the outputs they produce, the networks they establish, are all rooted in local and regional institutions and markets. High R&D-intensive start-ups, in turn, are born in nationwide networks, with employees recruited nationally. The complexity of skills they require cannot be overcome by on-the-job training as is possible in low R&D-intensive start-ups.

In relation to entrepreneurial profiles, the chapter showed that entrepreneurs here have a profile similar to that described by SEBRAE (2007) in terms of educational level and professional background. As expected, there are profile differences between those engaged in low *versus* high R&D-intensive activities, those who apply for traditional or technological business incubators, and the initial sources of finance. An interesting result is that sometimes the lack of role models and entrepreneurial experience were compensated for by formal entrepreneurial training. This finding points out that, although the literature highlights the importance of role models, entrepreneurs can also be 'formed' or 'educated' to develop their creative or innovative ideas into new businesses.

Notes

[1] The last of these annual reports was published in 2006; data for 2007 was obtained during fieldwork and has not been published. No further reports are available.

[2] Recent verbal information from SEBRAE states that these numbers have changed considerably but official statistics are not yet available. Nevertheless, for the objectives of this study, the institutional environment at the time of the fieldwork is the most important in contextualizing this study.

[3] The minimum wage in 2007 was 380 reais, 1 real corresponding to 2,48 euros.

[4] A check on the invoice figures of these three firms, available online, showed that two of them invoiced 730 million reais in 2008 and the third invoiced 244,5 million reais in 2007 (in 2008 this company was sold to another enterprise). Altogether, it is possible to estimate an invoice of around 1 billion reais (approx. 308 million euros at 2009 conversion rates, when the interview was conducted). Yet, these three firms alone represent 62,5% of the estimated invoice for the group of graduate start-ups.

[5] The maturity phase is defined by Lichtenstein and Lyon (2006, 379) as the one in which the firm "has successfully achieved the advantages of size and stability, a strong market position (e.g., share of the market), a strong level of profitability, positive cash flow, and a strong management team with an effective system of controls in place."

[6] A recent effort to simplify these categories is found in the ANPROTEC/ MCT report (ANPROTEC, MCT 2012), which defines three categories: solidarity economy incubators, technology-based business incubators, and business incubators with a focus in traditional products and technologies. Nevertheless, this study kept the categorization in use at the time of the fieldwork.

[7] $N_{São\ Paulo}=86$; $N_{Minas\ Gerais}=25$.

[8] Note that in the Brazilian nomenclature, the term *microenterprise* corresponds to formal small enterprises, and the term *small enterprise* corresponds to the small to medium-sized enterprises in the international literature (e.g., Brasil 2006, Farbman, Lessik 1989).

[9] Note that participation in PRIME was not a selection criterion for interviewees for this study. However, it cannot be assured that participation in PRIME did not influence the managers of bigger incubators when they indicated possible interviewees by managers of bigger incubators. This is not the case with smaller incubators, since all start-ups that fit the selection criteria were interviewed. From the 15 interviewees developing some activity with a higher degree of R&D-intensity, 10 were contemplated by this programme.

[10] Data available at FAPESP (2012) show 963 concluded projects, 118 ongoing projects, 1719 concluded fellowships and 71 ongoing fellowships, in November 2012.

[11] Fieldwork information obtained from SEBRAE/SP (by e-mail).

[12] 2009 conversion rates.

[13] The exception is the agribusiness incubator, in which there are no resident enterprises, since this incubator attends farm-based businesses. In this case, all services are strategic.

[14] Two incubators were dropped. One is in the agribusiness sector and was discarded because of its peculiarities, i.e., incubation model (non-resident), and characteristics of the business (family business that had just recently started some manufacturing activities). The other was dropped because contact was interrupted after the manager was dismissed.

[15] When the start-up produces more than one type of good, the most important at the time of the interview was used for its categorization.

4 Critical learning episodes

When an individual faces a difficult situation and needs to make a precise choice, or elaborate a strategy, the challenge is to be able to implement a solution that will not be the fruit of past learning only. The act of inventing then rests on analogies and action combined with intuition and reason (Lazaric, 2008, 214).

This chapter is based on storylines narrated by entrepreneurs-founders of 43 business start-ups. It is organized into three studies. Study 1 is methodological and aims to explain how critical learning episodes can be identified in entrepreneurs' narratives. This study presents descriptive quantitative results for the main types of critical learning episodes and analyses them in the light of a set of explanatory variables. Study 2 provides an in-depth examination of the internal dynamics of CLEs according to the sequence of steps described in the analytical framework. These analyses show how the cycle need-acquisition-transformation of resources takes place across these critical learning episodes. Moreover, Study 2 provides an empirical check on the analytical framework, resulting in theoretical refinements. Study 3 focusses on two dimensions of these learning processes: use of resources and networking. The former is discussed theoretically and empirically; the latter provides a longitudinal take on changes in network configurations in two points in time.

The conclusion resumes the key points of the chapter in terms of the internal dynamics of CLEs. It discusses the relationships between different phases of a CLE and the intricate role of cognitive, social, and practical dimensions in the formation of organizational routines. The conclusion tackles the dynamics of declarative and procedural knowledge and how these can affect the potential for organizational change, the role of managerial competences to deal with critical events, the importance of

the creation of resources, and the process of embeddedness in business incubators' networks.

4.1 Study 1: Identification of critical learning episodes

Study 1 describes the data collection process and the procedures used to identify sub-plots in the entrepreneurs' narratives that characterize landmarks in the evolution of their business. The primary material, therefore, is the semi-structured interviews (Appendix 1), in which entrepreneurs tell the story of the business, highlighting those events that were critical because, to cope with them, entrepreneurs had to search for new knowledge and resources. This type of interview, based on critical events that are perceived to have strongly impacted on routines and practices, and that required more knowledge or skills than before, are a common research technique to investigate informal learning processes (e.g., Eraut 2004).

Most interviews were individual, except in two cases, in which two members of the team of associates were present and complemented each other's narratives. The thread at the start was "*Please, tell me the story of your business based on those episodes that marked the trajectory of the start-up; think of episodes that show critical changes in the way of doing things in the firm*". This thread was rephrased according to the flow of the initial rapport, though always referring to the two ends of a CLE: first the triggers of critical events, and at the end of the process the new routines, which referred to changes in the activities, identity, main purpose of the firm, etc. This question is purposefully leading, since the objective of the study was to fully understand these critical learning events. It was also important to make clear to the interviewees that there was no expectation of collecting only the successful part of their business stories, especially because in the last two years before this fieldwork SEBRAE and the Minas Gerais Innovation Network had produced books of success stories based on narratives of entrepreneurs (RMI, SEBRAE-MG 2007, RMI, SEBRAE-MG 2008).

Another aspect here is that these narratives are very rich in detail, since entrepreneurs contextualized every critical event, rather them narrating them as independent episodes[1]. There was a lot of information about learning from non-critical events, as well as organizational changes that took place smoothly and did not affect organizational routines.

These details were crucial to weave CLEs within the trajectory of the business. The few cases in which CLEs were described without this contextualisation had to be discarded because the data was too poor. The essential information about every CLE was: the time frame, how the episode started, who were the actors involved and what their role was, how the entrepreneurs searched for or found a solution, what the outcomes were, and how they affected the operation of the business. Most of this information was spontaneously narrated. When this was not the case, the interviewer asked for these details.

Despite the risk of memory bias caused by salience[2], the literature has pointed out that this in fact is an advantage for studies about critical episodes, since unusual events are more easily remembered (Eraut 2004). In addition, the internal coherence of the storylines was assessed following these main elements: the beginning of the idea, the first steps to set up the business, the evolution of the business based on at least two critical learning episodes, the current status of the business and perspectives for the future. The backbone of each storyline is its critical learning episodes. A trigger and the new organizational routines constitute the boundaries of a CLE. Episodes in progress, when routines are in the making, are reported accordingly in the results. Other issues, processes and contextual factors help to illustrate the relationship of the start-up with the external environment, such as sector-specific dynamics, relationships with suppliers, buyers, competitors, other incubatees. The interviews provided a lot information about not only the specific characteristics of the entrepreneurs, such as their educational and professional backgrounds, their motivation for starting the business, but also about the start-ups - such as the product, indicators of growth etc. Appendix 5 provides the final codebook from Atlas.Ti, and one diagram that exemplifies how codes developed from general to specific, in successive rounds of qualitative analysis.

Triggers and new routines were used as the initial markers of a CLE. Narratives of potential episodes often began with expressions that signalled the importance of an event. For instance, "***What indeed pushed us ahead*** *was, in the next year, when we went to a [business] fair*", or "*But as things evolved, in eight months' time,* ***there was a disagreement between me and my associate***", and "***Our critique was accepting that*** *in a given time we would have to accept the entry of an investor*".

Following these expressions, entrepreneurs addressed the triggers to the episodes. For instance, "*We had* ***follow-up of the people who provide consultancy****, who started passing information on*", or "*Then you enter a market, a huge market.* ***It's a shock.*** *It's quite a shock*", or "***Until the end of 2006 we earned nothing.*** *We were working 12 hours a day and earning nothing*", and "*To be honest, when I started,* ***I didn't even know that commercial area, financial area existed***". Then, the identification of the end of an episode could have two possible sets of expressions: those indicating new routines and those indicating work in progress.

Completed episodes were signalled by the description of new routines, such as "*Where did we aggregate more? I think it was in the* ***entrepreneurial culture***", "***Now we create our own documents****, our own registers* [referring to quality procedures]", "***First we established the [business] model, then the strategies to fulfil that model.*** *In fact it was a gradual thing*", "***We already have a whole system of project management.*** *We have focused on development. We have partnerships with many universities*".

Episodes in which routines were in the making were indicated by expressions such as "***It's the very beginning*** *and all, we're in the first steps in this part*", "***Currently the biggest barrier*** *is the associate having to work at something else to be able to survive. [With subvention] you don't need to be weaving several other things at the same time*", "***We have a problem here… of demand management.*** *We haven't been able to attend to the demand*". It is noteworthy that some of these expressions, when out of context, could also signal a trigger, but all the ones here appeared in the entrepreneurs' narratives as consequences of an episode.

Categorization of critical learning episodes

Once all CLEs were identified, the next step was clustering them in comprehensive categories. This was a challenging task given the many elements involved in each CLE, i.e., types of triggers, types of actors, types of resources, etc. The element that worked best in highlighting the key challenges activating a search process was the triggers, despite the fact that they often did not reflect the main content of the episode nor had a direct relationship with the resulting routines. Preliminary categorizations, based on the empirical properties of these episodes, were revised and adjusted according to the current literature (e.g., Stretton 1999). This first categorisation was double-blind checked by two experts from the

International Institute of Social Studies. Each of them received an evaluation sheet with the definitions of each category and a short description of a sample of 56 episodes. The assessments of these evaluators were compared and mismatches guided further reviews and the refinement of specific categories. The final 10 categories of CLEs are defined as follows:

- **Access to and relationship with suppliers:** refers to finding a workable combination of quality and price from suppliers and buying from them; it includes establishing trust-based relationships that facilitate negotiation and trading.
- **Access to technology:** refers to producing new technology by deploying endogenous resources (i.e., the entrepreneur's expertise) or by establishing partnerships (i.e., with universities or other enterprises). It includes low and high R&D-intensive products and services, and the development of prototypes.
- **Access to investment capital:** refers to needing to cover high costs of product development. It encompasses two main sources of investments: public subsidy for R&D and venture or angel capital. Each source of investment capital has its own requirements and poses different demands upon entrepreneurs.
- **Entrepreneur-specific triggers:** refers to decisions by entrepreneurs that trigger critical learning episodes. They relate, for instance, to needing to develop managerial skills, decisions to expand the business, participation in university entrepreneurial programmes, etc. This category relates to the literature on learner-induced learning, which claims the agency of the learner to trigger a critical learning event (e.g., Moraes, Borges-Andrade 2010). It also relates to the innovation literature that claims the proactive role of agency to change one's own knowledge and to change the firm (Xu 2011).
- **Entry and survival in the market:** this category has three dimensions: entering a well-established market, entering or creating a new market niche and surviving threats. Established markets rely on working institutions and supply and demand structures; but they also call on the competitive differential of new entrants to attract buyers. New markets lack market structures from both supply and demand sides, and institutions, if existent, are incipient. In this case, accessing potential buyers, who have never heard of that innovative product or ser-

vice is the critical event. Once in the market, businesses are subject to other critical episodes triggered by threats to survival such as the case of episodes related to price wars and unfair competition.

- **Joint venture breakdowns:** refers to the dissolution of the association between founders, triggering a reorganization of the business and the distribution of its assets. It changes the managerial routines at various levels, since the start-up has to cope with financial and expertise losses.
- **Labour force issues:** refers to a lack of skilled or specialized workers, high turnover rates (i.e., attractive positions in big companies) and poor human resources management.
- **Lack of working capital:** working capital is the difference between current assets and current liabilities. For nascent enterprises, it is common that there are no current assets other than the entrepreneur's savings, triggering critical episodes to raise the needed financial resources.
- **Regulation issues:** refers to dealing with compliance costs, registration costs and managing the length of regulatory procedures that impact on the sovereignty of the business. Regulatory agents may be governmental or sector-specific institutions such as ANVISA and industry or professional associations that set up standards, rules and sanctions on economic activities.
- **Other triggers:** this category clusters a few other triggers not covered by the above categories. Examples are one case of gender prejudice, and one case of a senior executive dismissed from a multinational.

The distribution of these CLEs is presented in Table 4.1. A total of 207 critical learning episodes were identified, with an average of 3,3 different types of CLEs per start-up. The frequencies are ordered by descendent values of the first two columns. The most common episode, reported by 82% of the start-ups, is entry and survival in the market, appearing at least once in 25% of the CLEs. When multiple occurrences are counted, in the last two columns of Table 4.1, this category accounts for 36% of all CLEs. Given their prevalence, episodes triggered by needing to enter and survive in the market are further analyzed in Study 3.

Table 4.1
Distribution of CLEs in 10 categories of triggers

Types of triggers	Cases		Occurrences	
	N	%	N	%
Entry and survival in the market	35	24,65	73	35,27
Entrepreneurial specific triggers	29	20,42	43	20,77
Other triggers	15	10,56	18	8,70
Labour force issues	13	9,15	17	8,21
Lack of working capital	10	7,04	10	4,83
Access to and relationship with suppliers	9	6,34	10	4,83
Access to investment capital	10	7,04	14	6,76
Joint venture breakdowns	8	5,63	8	3,86
Regulation issues	8	5,63	9	4,35
Access to technology	5	3,52	5	2,42
Total	**142**	**100,00**	**207**	**100,00**

Note: The first two columns of values consider one occurrence of each episode per start-up. The other two count multiple occurrences

These categories were further clustered into five broader categories based on the key functions of a business: market relations, production, management and entrepreneur-specific issues. These categories are similar to those recognized in SEBRAE (2007) as being the most important for the survival of business start-ups[3]. These five categories are:

- Entry and survival in the market: defined as above.
- Production-related issues: sum of access and relationship with suppliers, access to technology, access to investment capital, labour force issues, and regulation issues.
- Entrepreneur-specific issues: defined as above.
- Managerial issues: sum of joint venture breakdowns, lack of working capital and some episodes from the category 'others' that reflected management-related triggers.
- Others: the rest of the episodes in 'others'.

This more parsimonious clustering facilitated comparative analysis between CLEs within the analytical framework (Study 2) and the investiga-

tion of pathways (Chapter 5). The updated distribution is presented in Table 4.2.

Table 4.2
Distribution of CLEs in five categories of triggers

Types	n	%
Entry and survival in the market	73	35,27
Production issues	55	26,57
Entrepreneur-specific issues	43	20,77
Managerial issues	26	12, 56
Others	10	4,83
TOTAL	**207**	**100,00**

Values in Table 4.2 include re-occurrences of the same type of CLE within a case. Entry and survival in the market continues to be the most frequent trigger, followed by production-related issues, entrepreneur-specific issues and managerial issues. The percentage of other triggers is marginal. One example of each type of CLE is presented next in Boxes 4.1 to 4.4, following the pathway of Firm30, a start-up in the information and communication sector.

Each box contains the theoretical elements of a critical learning episode in the first column and the empirical content in the correspondent second column. They are ordered according to the sequence in which these CLEs occurred:

- Box 4.1: entrepreneur-specific CLE;
- Box 4.2: entry and survival in the market;
- Box 4.3: production-related CLE;
- Box 4.4: a CLE triggered by managerial issues.

These examples show how information about each step of a critical learning episode was organized and provide an idea about the richness of the content that is aggregated in the analyses that follow.

Box 4.1
Critical learning episode: entrepreneur-specific issues

Seq01	Duration: 2006-2008, *focus on the core product*
Topic of the episode	Development of managerial competences
Trigger and initial actor(s)	All associates in the area of IT; need of managerial competences. Actors: associates, start-up.
Resource use	Access to managerial knowledge
Learning strategies	Taking courses and seminars for the development of managerial competences (human resources management, costs, finance, marketing, etc.); consultancies (marketing and finance); and trimestral monitoring (business incubator indicators). E.g.: elaboration and implementation of marketing plan and sales strategies. Master degrees to cover the weakest areas. Interpersonal/Inter-organizational help seeking + Practical application + Intrinsic reflection + Extrinsic reflection.
Learning contents	Development of meaning and method.
Learning outcomes	*Interpretation:* One associate did a master programme in the production and management of projects, and the other in knowledge management. *Network:* Introductions to potential buyers by the business incubator; exchanges with other incubatees, informally and for sales, and partnerships in projects. *Practices:* Application of techniques of knowledge management to cope with the loss of knowledge by high turnover of employees and interns.
Routine	Technological strategies to make tacit knowledge explicit (CRN, Twik, database of errors etc.)
Source of resources	Business incubator, courses, seminars, incubator consultants, university master courses, other incubatees
Notes	The business incubation was “almost an MBA for free” (§076).

Box 4.2
Critical learning episode: entry and survival in the market

Seq02	2006, *focus on the core product*
Topic of the episode	First sales
Link in the sequence	CLE complementary to Seq01, since it coincides with the development of managerial competences.
Trigger and initial actor(s)	Two very big sales right from the start. Actors: buyers, start-up.
Resource use	Creation of production conditions to cope with big sales
Learning strategies	Hiring workers, all associates dedicated to programming to develop the software and cope with delays; (later) half of the associates dedicated to revising the business model. Interpersonal/Inter-organizational help seeking + Practical application + Extrinsic reflection.
Learning contents	Development of meaning and method.
Learning outcomes	*Interpretation*: "[W]e saw that the project was much bigger than we had foreseen. We had taken much too big a step and the value was too low for the size of it." (§029). They saw on time that the strategy had to be reviewed – this is when half of them stopped programming to develop an alternative strategy. *Network:* Loss of one buyer; trust-based relationship with the other. *Practices:* Income enough to cover expenses; modules delivered every 6 months; creation of a web portal, in which the buyer can manage the content.
Routine	(end of 2006) Modularization of the system; easier sales and less work-load with the web portal; partnerships for product development
Source of resources	Buyers, associates
Notes	Since the second sale closely followed the first one, the entrepreneurs did not have time to realize the scope of the project before selling it to the second buyer. The project that they had planned for three months in 2006 was still in progress in 2009, with the development of one module per semester. One buyer recommends the start-up to other buyers, working as a kind of "partner" (§033). About the web portal, "this is the one that provided us turnover here; it is what gave us some breath" (§033). The same routine was applied, with few adaptations, to the retailers' market in 2007 and was successful. No CLEs related to entering this new market are reported. The fabric of software was resumed in 2009, attending to the demands of buyers for customized software. One of the working routines is regular payments per hour of labour. "He [the buyer] has a number of hours per month; he sends the demand and we make it [the software, the module etc.] for him." (§043).

Box 4.3
Critical learning episode: production-related issues

Seq03	Since 2006, *focus on the core product*
Topic of the episode	Workers' training and turnover
Link in the sequence	CLE complementary to Seq01 and Seq02 for the establishment of the first managerial routines and for the need of skilled labour that is highly valued in the market.
Trigger and initial actor(s)	Scarce skilled labour and high turnover of trained workers. Actors: workers, big companies. CLE initially classified as Labour issues.
Resource use	Loss of resources due to losing trained workers to big companies
Learning strategies	Training of undergraduate students to become skilled programmers. Interpersonal/Inter-organizational help seeking + Extrinsic reflection.
Learning contents	Development of method.
Learning outcomes	*Interpretation:* Time-consuming training of workers was providing skilled labour to big companies that offered more attractive jobs; creating a career plan to retain the best workers. *Practices:* Development of their own "corporate university" with web courses in modules that include training, testing, scoring and gradual advance in competence level.
Routine	Reduced work on training through the web training system (3 months) followed by on the job training and effective work in gradual degrees of difficulty; high number of interns to cope with further turnover.
Source of resources	Workers, big companies, the training system developed by them, entrepreneurs
Notes	One example of labour dynamics is an enterprise from Belo Horizonte that carried away three of this start-up's best workers who had not even concluded a bachelor degree. "The guy [from the big enterprise] said like this 'No, you finish your courses in Belo Horizonte and I'll pay five times more than you earn here.' […] These guys are very valued. So we have big difficulties in paying. These days we already pay a lot more than before." (§062). Figures show that half of the trainees remain in the firm, the other half realize that they do not like the job. Of the half that remains, some of them will be grabbed by big companies before they finish their bachelor degrees. Thus, turnover of employees is incorporated into the routine.

Box 4.4
Critical learning episode: managerial issues

Seq04	2006, *focus on the core product*
Topic of the episode	Joint venture maintenance.
Link in the sequence	CLE caused by Seq02, the consumption of the entrepreneurs' time in developing the first product.
Trigger and initial actor(s)	No income for the entrepreneurs until the end of 2006 and difficulties in keeping the joint venture going. Actors: associates. CLE initially classified as Lack of working capital
Resource use	Creation of internal organization to generate income
Learning strategies	Management of each situation to maintain the team of associates; i.e., replacing an associate who left the joint venture by a high potential employee; financial inputs by one associate who left the start-up for a while for a good job at Motorola. Interpersonal/Inter-organizational help-seeking + Practical application + Extrinsic reflection.
Learning contents	Development of commitment and method.
Learning outcomes	*Interpretation:* Revision of sale goals to increase the entrepreneurs' income and keep them exclusively dedicated to the start-up. *Practices:* Maintenance of the structure of five associates.
Routine	Clear administrative structure focused on results to generate income; (in 2008) stable income for all associates.
Source of resources	Associates, high potential employee in the marketing area
Notes	The strategy to increase the associates' income was generating more revenues in the start-up. "Until the end of 2006 we were getting nothing [income]. We'd be working twelve hours a day without income." (§058). One of the associates "couldn't handle it" (§058) and left the joint venture to study diplomacy and have a stable life.

Descriptive quantitative results

This section starts with the temporal distribution of CLEs, sequenced according to the time when each CLE started. Figure 4.1 shows that episodes triggered by entrepreneur-specific issues predominate in the first two sequences (Seq01 and Seq02 in the Figure), after which their frequency drops considerably. Then, after sequence 2, market relations and production issues gain importance, until sequence 6 (Seq06 in the Figure). Episodes triggered by the need to enter into and survive in the market become the most frequent from sequence 3 and are quite steady

across all sequences. Most of the episodes occur between sequences 1 and 5, representing 85% of all CLEs.

Analysis of the distribution of critical learning episodes also considered firm, institutional, social and individual characteristics. Figure 4.2 illustrates a pattern for five variables: R&D-intensity, region, initial financial resources, type of entrepreneur, and type of business incubator. The upper part of Figure 4.2, with its higher percentage of critical learning episodes, has a high concentration of pull entrepreneurs, those who started with one source of finance (in 70% of the cases corresponding to their own resources), and those start-ups developing low R&D-intensive products. A mirrored result, referring to the lower percentages of CLEs, is observed at the lower end of the figure. In the middle of Figure 4.2, with narrower discrepancies between distributions (between 40% and 60%), are the regions of São Paulo and Minas Gerais and the two types of business incubators, traditional and technological. Statistical tests showed differences in the number of CLEs only by type of entrepreneur[4], with pull entrepreneurs experiencing significantly more critical learning episodes than push entrepreneurs ($t(4, n=207)=2{,}17$, $p<0{,}05$). No significant differences were found in relation to the other pairs of variables.

Figure 4.1
Distribution of CLEs per type and sequence of occurrence

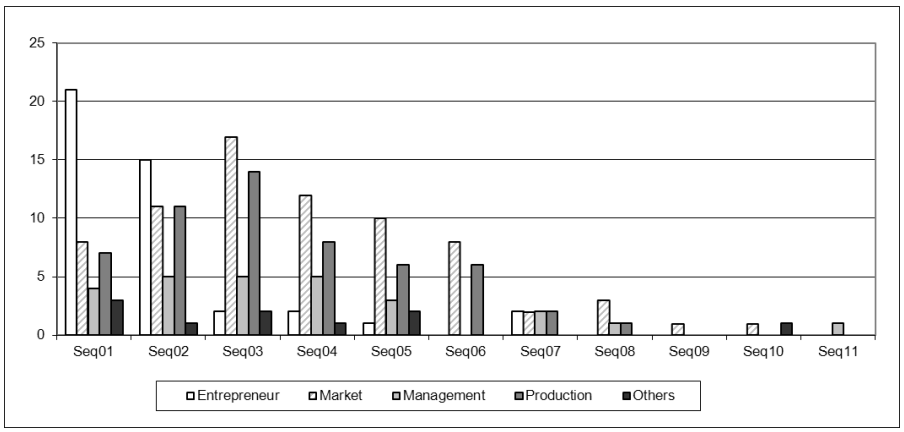
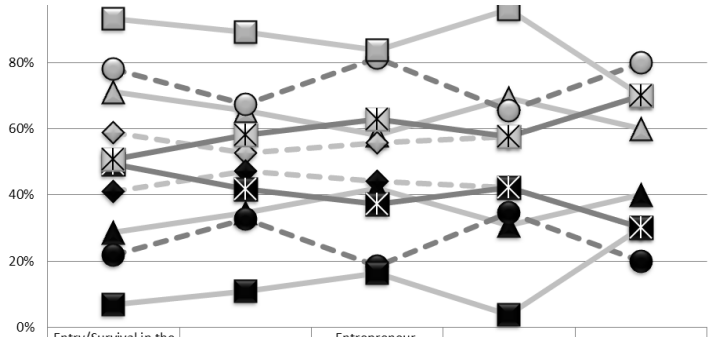


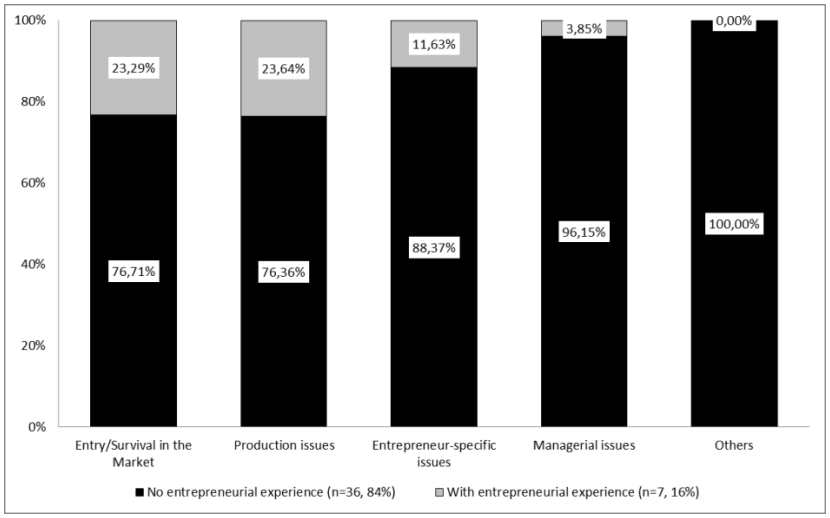
Figure 4.2
Distribution of CLEs per R&D-intensity, region, initial sources of finance, type of entrepreneur and types of business incubator



	Entry/Survival in the Market	Production issues	Entrepreneur-specific issues	Managerial issues	Others
High R&D (1st prod)	28.77%	34.55%	41.86%	30.77%	40.00%
Low R&D (1st prod)	71.23%	65.45%	58.14%	69.23%	60.00%
SP	58.90%	52.73%	55.81%	57.69%	70.00%
MG	41.10%	47.27%	44.19%	42.31%	30.00%
One initial source of finance	78.08%	67.27%	81.40%	65.38%	80.00%
Two initial sources of finance	21.92%	32.73%	18.60%	34.62%	20.00%
Push entrepreneur	6.85%	10.91%	16.28%	3.85%	30.00%
Pull entrepreneur	93.15%	89.09%	83.72%	96.15%	70.00%
Traditional incubator	49.32%	41.82%	37.21%	42.31%	30.00%
Technological incubator	50.68%	58.18%	62.79%	57.69%	70.00%

Another interesting result shows that entrepreneurs with entrepreneurial experience report rare CLEs triggered by managerial issues, and very few triggered by entrepreneur-specific issues ($t(4, n=207)=9{,}70$, $p<0{,}05$). For CLEs related to market entry and survival and production, however, even experienced entrepreneurs report critical events. This result suggests that managerial and general entrepreneurial knowledge from previous experiences are an asset when starting a new business. This previous knowledge brings in resources that are useful when dealing with episodes that would otherwise be perceived as critical. Moreover, none of the previous experiences were in the same type of business, which may explain the percentage of CLEs triggered by production and market issues.

Figure 4.3
Distribution of CLEs per entrepreneurial experience

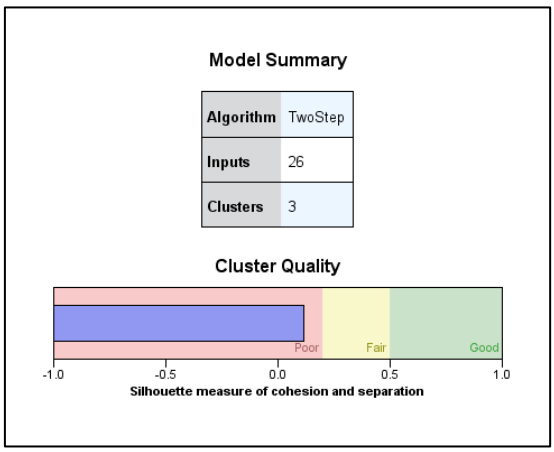


The analyses described so far were based on the five categories of CLEs that resulted from the entrepreneurs' narratives. The cluster analysis that follows provides a statistical test of this aggregation of CLEs and explanatory variables. These variables are: type of industrial activity, type of market (SNA), professional background, educational level, type of entrepreneur, entrepreneurial experience, learning strategies (separately: intrinsic reflection, extrinsic reflection, help seeking in written material, interpersonal/inter-organizational help seeking, and practical application), new vs. established market vs. survival in the market, type of resource use, R&D-intensity of the first product, focus of the CLE, market coverage (from local to international), entrepreneurial role, entrepreneurial education, time in operation, year of operation in which the CLE started, duration of the CLE, diversity of initial financial resources and initial networks, sum of learning strategies. This analysis provides two key parameters: the number of clusters and the relative importance of explanatory variables to the clustering.

Results show that three clusters with a poor model fit (Figure 4.4). The five main variables for the overall clustering are: professional background, educational level, type of industrial activity (ISIC), R&D-intensity, and type of market (SNA). The relative weight of each predic-

tor varies per cluster, although educational and professional background remain amongst the top three predictors. A table with the details per cluster is found in Appendix 6. The cross-tabulation between these three clusters and the five categories of critical learning episodes showed no significant chi-square values, with CLEs from one cluster distributed between the categories of the other. Given the poor fit of this clustering and the low discrimination between the two sets of categories, Studies 2 and 3 will follow the five categories identified in the qualitative analysis.

Figure 4.4
Model fit of two-cluster analysis for critical learning episodes



4.2 Study 2: Critical learning episodes and the analytical framework

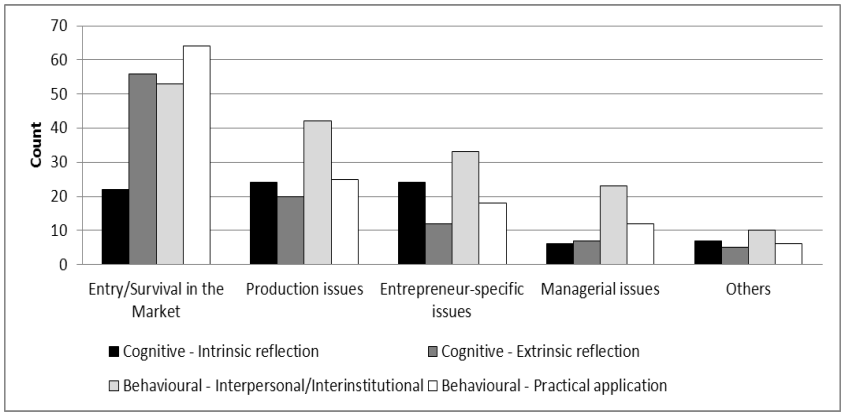
This study describes the dynamics of CLEs in line with the conceptual relationships defined in Chapter 2. Each sub-section is organized per pair of concepts.

Triggers and learning strategies

The analysis of learning strategies in relation to triggers asks: Are there patterns in the use of learning strategies according to types of critical learning episodes? This analysis takes into account the most often applied sub-categories of learning strategies: intrinsic reflection, extrinsic

reflection, interpersonal/inter-organizational help seeking, and practical application (Figure 4.5). Statistical tests showed significant differences in relation to intrinsic reflection (X^2 (4, n=207) = 14,58, p< 0,01), extrinsic reflection (X^2 (4, n=207) = 38,67, p<0,01), and practical application (X^2 (4, n=207) = 36,22, p<0,01). However, instead of interpreting these results per strategy across types of CLEs, this section focusses on patterns of combinations of strategies.

Figure 4.5
Distribution of the most common learning strategies per type of CLE



A common pattern is shared between episodes triggered by production-related issues, entrepreneur-specific issues and others, in which the most common strategy is networking with resourceful actors. These are followed by cognitive strategies of intrinsic reflection and behavioural strategies of practical application. Since entrepreneurs combine different strategies in the majority of the episodes, this result suggests that information is gathered from other actors and processed by the entrepreneur both cognitively and in practical activities to achieve a solution to the triggers.

A different pattern is observed for episodes of entering and surviving in the market. Here, the practical application of new knowledge to the current routines is the most common strategy, followed by the cognitive strategy of extrinsic reflection and interpersonal or inter-organizational help-seeking. Therefore, this type of CLE seems to be resolved through learning by doing. This type of learning includes the deployment of in-

ternal resources, the use of which is combined with reflections on the interaction between these internal activities and information from the outer environment; hence, the interpersonal and inter-organizational exchanges (i.e., with competitors). This is an expected result, since the entrepreneur has little control over how the market will respond to his or her market actions.

A third pattern appears in management-related triggers, which are sorted out mainly through interpersonal and inter-organizational exchanges, mostly with incubators' consultants and other incubatees. This result provides a dynamic social and episode-driven perspective to the acquisition of managerial competences in business start-ups. It is noteworthy that most of these triggers relate to joint venture breakdowns and lack of working capital. Needing to develop managerial competences as part of a trigger is categorized under entrepreneur-specific issues, since these episodes start with the entrepreneurs' perception of their own managerial gaps.

This section corroborates the contingent character of learning strategies (Riding, Rayner 1998), and their combined use to create variation in the range of possible solutions to the trigger. Further steps in the learning episode have to be described in order to address the efficacy of these variations. Two propositions are drawn from these results:

Proposition 1a. Learning strategies are combined to generate variation of resources to cope with all types of CLEs.

Proposition 1b. These combinations vary per type of CLE.

Learning strategies and learning contents

This section addresses the question: Are there specific patterns associated with learning strategies and learning contents, so that to learn content A, a combination of strategies X and Y is preferred over other combinations? Learning contents can refer to the development of new meanings, new commitments, and new methods. Respectively, they refer to, for instance, creating the firm identity, building market networks, and establishing operational routines.

In terms of individual strategies, the preferred ones are the same across CLEs: intrinsic reflection, extrinsic reflection, interpersonal/inter-organizational help seeking, and practical application. Combined per-

centages showed a preference for the use of one cognitive and two behavioural learning strategies across all three types of learning contents.

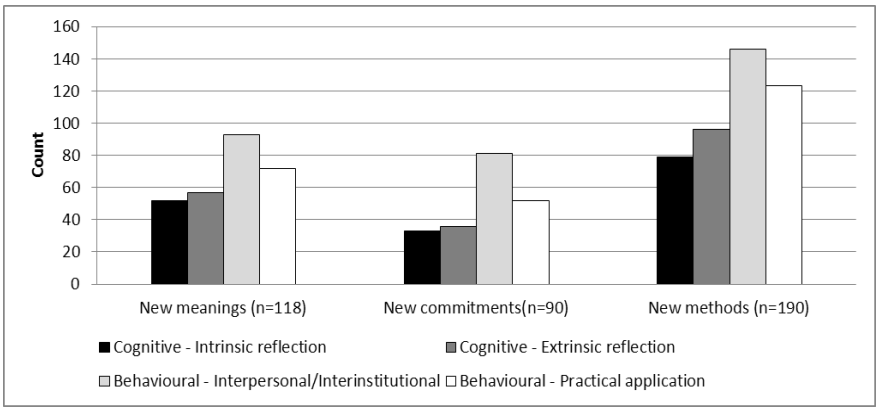
Figure 4.6 shows that the overall pattern across learning contents is the same, with percentages between 36 and 50 in the use of cognitive strategies, and percentages between 58 and 90 in the use of behavioural strategies. Statistical tests showed significant differences between extrinsic reflection and development of new commitments (X^2 (1, n=207) = 4,40, p<0,05), extrinsic reflection and development of new methods (X^2 (1, n=207) = 4,55, p<0,05), interpersonal/inter-organizational help seeking and development of new commitments (X^2 (1, n=207) = 13,76, p<0,01), and practical application and development of new methods (X^2 (1, n=207) = 18,30, p<0,01)[5].

There is neither significant chi-square nor correlation coefficients in relation the development of new meanings and any specific learning strategy. This result, in addition to percentage values showing that 60% (n=70 CLEs) of the development of new meanings was based on combinations of two or three learning strategies, suggests that this learning content might be more demanding than the others in terms of combinations of learning strategies.

Positive significant correlation between the development of new commitments and the use interpersonal/inter-organizational help seeking (r=0,25, p<0,01) was observed. This result is expected, as the development of new commitments refers to changes in the configurations of entrepreneurs' networks. The prominent role of networking to develop new commitments is corroborated by the low combination with other strategies, since 57% (n=51 CLEs) of these episodes used only one or two learning strategies.

For the development of new methods, there were positive correlations with using a combination of learning strategies (r=0,25, p<0,01), mainly practical application (r=0,30, p<0,01) followed by extrinsic reflection (r=0,15, p<0,05). This result indicates, as expected, that developing new methods requires the application of new information to working routines, or to trial-and-error procedures to develop new working methods adapted to the start-up's needs. However, this is only efficacious if there is an understanding of the connections between different parts of the work. Note that 63% (n=119) of the development of new methods was based on combinations of two or three learning strategies.

Figure 4.6
Distribution of learning contents per preferred learning strategies



From these results, the following propositions are drawn:

Proposition 2a. Combinations of cognitive and behavioural learning strategies are important to achieve all kinds of learning contents.

Proposition 2b. The development of new meanings requires even combinations of the cognitive, social and practical dimensions of learning.

Proposition 2c. A network-based strategy such as interpersonal/inter-organizational help seeking is the most coherent to achieve learning contents for building or expanding networks.

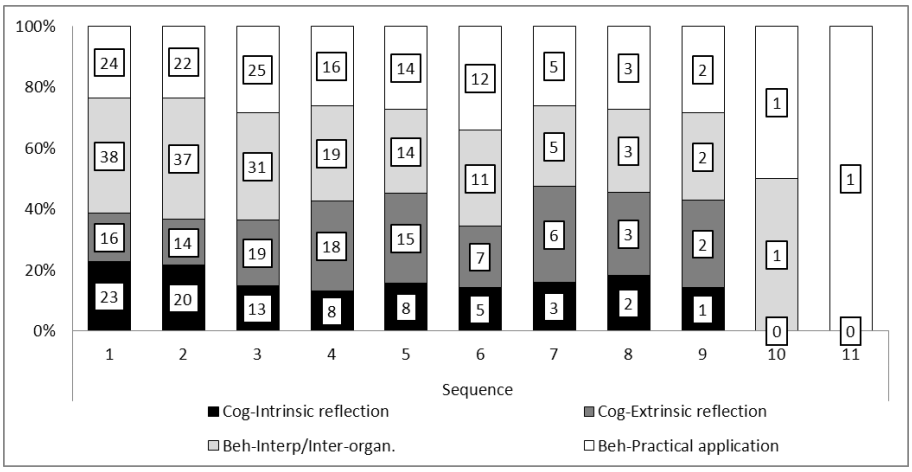
Proposition 2d. The development of new methods requires a combination of practical application of new knowledge and extrinsic reflection to combine this new practice with working routines.

Learning strategies across time

This section examines patterns in the use of learning strategies in the sequence of CLEs. This longitudinal analysis answers the question: Do patterns in the use of learning strategies change through time? The hypothesis is that, since the use of learning strategies is contingent to the context, a firm with more resources available and more routines to rely on will influence types of learning strategies used to cope with new CLEs. This analysis considered only the most frequent learning strategies: intrinsic reflection, extrinsic reflection, interpersonal/inter-organizational help seeking and practical application. Figure 4.7 shows

the distribution of these learning strategies per sequence. Statistical tests showed that only the use of extrinsic reflection changed significantly over time (X^2 (10, n=207) = 19,33, p<0,05), with observed values below the expected values in the first two sequences, changing to values above the expected values in sequences 4 until 9 (this learning strategy is not found in Sequences 10 and 11).

Figure 4.7
Distribution of learning strategies across time



These results are interpreted based on the contingent character of learning strategies. Thus, they suggest that contingencies to learning are similar during the start-up period, with great importance of behavioural learning strategies, especially networking, to acquire and create resources. At the cognitive level, however, as the sequence of CLEs increases, relating pieces of information from internal and external sources, at different levels, becomes more important. This means that start-ups start to count on established routines, which efficacy is cognitively evaluated when entrepreneurs face a new CLE. This assessment corresponds to the replacement of the deliberative/analytic mode of cognition, typical of initial critical events, for the rapid or intuitive mode of cognition (Eraut 2004). The intuitive mode of cognition requires

> familiarity with most or all aspects of the situation, but cannot be described as procedural knowledge if it does not lead to rapid decisions. This could be either because no sensible options readily come to mind or because the level of risk suggests that the original understanding should be checked before taking any further action (Eraut 2004, 253).

Proposition 3a. As internal routines are established, the intuitive cognitive processing of information, through extrinsic reflection, becomes increasingly important.

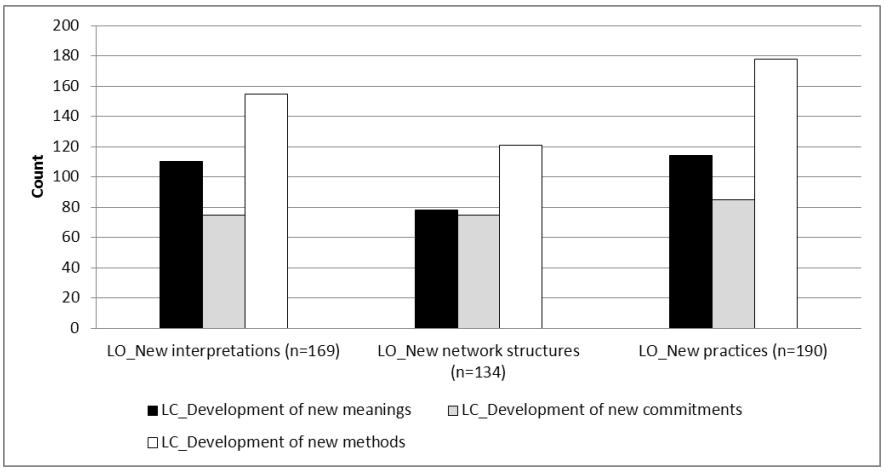
Learning contents and outcomes

The analysis of learning contents per learning outcomes investigates the question: Do specific learning contents lead to specific types of learning outcomes? The cross-tabulation between the two indicates that the answer is negative. As shown in Figure 4.8, the pattern in the distribution of learning contents is the same across all types of learning outcomes. The development of new methods is the most frequent content across all outcomes, indicating that even when entrepreneurs are only searching for new working methods they might develop new interpretations and new networks as well. Similarly, searching for the development of new meanings is likely to also result in new networks and new practices; and searching for new networks might also lead to new interpretations and new practices. This cross-effect between learning contents and learning outcomes was examined statistically.

Results showed positive significant correlations between the development of new meanings and outcomes of new interpretations ($r=0,35$, $p<0,01$) and new practices ($r=0,17$, $p<0,05$), between the development of commitments and outcomes of new network configurations ($r=0,35$, $p<0,01$), and between the development of new methods and outcomes of new practices ($r=0,26$, $p<0,01$). Moreover, chi-square tests showed significant results for the same pairs of variables.[6]

These results show that, although some pairs of associations suggest a stronger connection within dimensions (i.e., development of new methods and outcomes in the form of new practices), the complexity of CLEs involves more than one learning content and more than one learning outcome. These findings confirm the literature on critical learning episodes in relation to the non-linearity between these dimensions (Knight, Pye 2007).

Figure 4.8
Distribution of learning outcomes per learning content



Additional propositions drawn from these results are:

Proposition 4a. Cognitive and procedural knowledge are interdependent. This proposition indicates the need for theoretical refinements in the literature that splits these two dimensions of knowledge (e.g., Feldman, Pentland 2003), in order to better specify where this distinction takes place. Findings here suggest that this distinction may relate to the type of knowledge that is identifiable in the observation of organizational routines. However, during a learning process, these dimensions are necessarily intertwined.

Proposition 4b. Cognitive processing of information is as important as the practical application of new knowledge. This proposition opposes two branches of the literature. One that claims the superiority of the cognitive dimension (e.g., Cope 2003) and the other that claims the complementarity between different dimensions (e.g., Eraut 2004).

Proposition 4c. Learning processes create multiple variations that cross the cognitive, social, and practical dimensions of learning outcomes.

Proposition 4d. The deliberate agency of the entrepreneur, represented by learning contents, can only partially foresee the variations resulting from a CLE. This proposition concurs with the literature that claims a role for the unpredictability of learning outcomes in creating resources for the firm (e.g., Eisenhardt, Martin 2000).

Learning outcomes and routines

Learning outcomes and organizational routines differ in their ontology (episode-specific versus firm level) and relative stability over time. Nevertheless, the analytical framework states that they can be similar at the very beginning of the start-up, when the first routines are simple and loosely interrelated. This is the question investigated in this section, by examining variations in learning outcomes and organizational routines for CLEs triggered by needing to enter and survive in the market. This type of CLE is the richest in examples of these dynamics for its prevalence across the sequence of CLEs.

This analysis considers the three dimensions of critical learning episodes of entry into and survival in the market: entering a well-established market, needing to create a new market niche for an innovative product, and needing to outlive threats to survival. The analysis presented in Tables 4.3 and 4.4 (note that tables show a sample of the totality of episodes analysed in the text) compares the three categories of learning outcomes with the resulting routines across two years. The episode trigger is also presented to show how each CLE started. The specific content of learning outcomes is detailed in the text.

In general, this analysis shows high dynamism of networks in the first two years. Even when entrepreneurs did not aim to change the configuration of their networks, in 35% (Year 1) and 36% (Year 2) of these episodes there were outcomes of maintenance, expansion or strengthening of networks, including during crises. This pattern is not observed in further years.

Moving to the analysis per year, Table 4.3 shows that needing to enter an established market generates learning outcomes that show the development of new interpretations about how to work, changes in the identity of the firm and the aggregation of different actors into the network. Some start-ups report drastic changes, with new routines expressing their adaptability to market niche demands through refocusing the business, reconfiguring strategic networks and balancing product development and market opportunities.

Table 4.3
Critical learning episodes started in the first year of the business start-up (n=11 out of 17)

	Trigger	Actors	Learning outcomes	Routines
Established market (n=8)	Refusal of clients to accept receipts (to reduce tax expenses)	Buyers	I, P	A combination of formality and informality in the business transactions
	Need to cope with high barriers to entry in the surgical instruments' market	Big companies	I, N, P	Development of a new production line, with a new business-network. Continuous search for easier markets in which they can apply their productive capacity
	Refocusing of the start-up to the wholesales' market	Start-up	I, N, P	Close negotiation with buyers for alternative products to keep prices down and quality high
	Development of a software that was not marketable	Start-up	I, N, P	Prize "Best enterprise of 2008"; "The entrepreneur has to know his market"; Shared focus: development and market
New market (n=6)	Need of water-soluble packages for ethanol fermentation	Buyers	N, P	Service provision in packaging chemical products according to tailor-made formulas
	Increasing demand for the products	Buyers	I, P	Formalization of the business; structuration of formal labour
	3rd place in an entrepreneurial contest in the university (incubation + money)	University	I, P	Orientation towards after-marketing (regular motorcycles); temporary end of the fellowships for interns
	Market research showed a period of 2-3 years to generate income	NPT (Nucleus for technological research, BI)	I, N, P	Creation of an educational department, apart from the core business. Business is a long-term investment
Survival in the market (n=3)	Too many sales for the production capacity (4000-8000 pairs)	Start-up	I, N, P	Better balance between sales and production capacity
	Loss by the failure of the second product to enter the market	Buyers	I, N, P	Reduction of use of financial favours by friends, bank loans cause more costs; focus on services for the food sector
	Clients in default	Buyers	I, N, P	Bank system to invoice clients, instead of bank transfers to their personal accounts.

I=new interpretation; N=new network configuration; P=new practice.

Table 4.4

Critical learning episodes started in the second year of the business start-up (n=12 out of 22)

	Trigger	Actors	Learning outcomes	Routines
Established market (n=4)	Need of new buyers	Start-up	N	Broader portfolio of clients
	Need to participate in fairs to enter the market	Incubator consultants	N	Business-related partnerships to share costs related to entering the market.
	Negative advertisement and unfair competition by his former employer	Big companies	I, P	Production of regular and special pieces, with high quality and good price to be able to compete
	Two too big sales right from the start	Buyers; start-up	I, N, P	Modularization of systems, creation of a web application (easier sales, less workload). Partnerships to develop new products
New market (n=9)	First contacts with potential buyers (researchers)	Entrepreneurs; buyers	I, N, P	Spin-off of the first start-up for the agriculture sector; balance between market needs and technology developed
	Resistance of laboratories to outsource R&D	Buyers	I, N, P	Creation of conditions to develop higher scale innovations in advance of the market demands; possibility to profit from royalties
	Demand for services from enterprises in similar areas than the target sector	Buyers; Ministry of Agriculture	I, N, P	Expansion of the scope of the business to other sectors in food production
	Research with high economic potential, but no expertise in industrialization	Start-up	I, P	Change of equipment (research vs. production); research vs. firm timeframes
Survival in the market (n=9)	International financial crisis reaches the industries (buyers) - no new contracts	Buyers	N	Maintenance contracts are an alternative to market crisis.
	Market demand for monthly new creations	Buyers	I, N, P	Division of tasks between associates: sister does exclusively modelling; monthly creations
	Important client in default	Buyers	I, N, P	End of the working capital problems, given the bank facilities to the business (from year 2 on)
	Rapid acceptance of the 1st product + demand for a mix of products	Buyers	P	Fast development of new technologies and derived products; focus on "development for technological innovation"

I=new interpretation; N=new network configuration; P=new practice.

In cases of needing to create or enter a new market, learning outcomes included the development of new meanings, commonly the formation of a business' identity linked to the development of alternative products and services. New routines also reflect profound changes, i.e., refocusing the business towards a more easily-entered market. There are also new routines driven by growth, such as expanding the portfolio of products or services and creating spin-offs.

Episodes related to survival in the market are, already in the first year, typical of entrepreneurs who had some expertise and networks in the sector, and of low R&D-intensive start-ups. Learning outcomes indicate unlearning previous behaviours and replacing these with new routines, i.e., incorporation of expert advice and use of business services for financial management.

In the second year (Table 4.4), new routines reflect less profound changes than those occurring in the first year. Instead of redesigning the whole business, there seems to be a stronger effort in developing variations in the existing mix of products or services and in developing technological innovations based on the products or services that are already being traded. It is in the second year that high R&D-intensive start-ups report the first episodes of entry into and survival in the market, representing the majority amongst those creating or entering a new market.

Episodes of entering an established market starting in the second year show learning outcomes of an expansion in networks and the development of new interpretations of how to become competitive and about the scope of the product in terms of demands for R&D. New practices relate to an improved organization of production. These outcomes are well-reflected in new routines of reaching out into the market, improving the production process, and establishing partnerships to reduce market entry costs and diversify the mix of products. Episodes of entering or creating a new market show learning outcomes of expansion of networks within the same or related markets. These aim at dealing with new opportunities, expanding services and productive capacity related to these new opportunities, as well as developing technology. In terms of new interpretations, the second year is marked by understanding the dynamics between market and technology in order to combine demands from both sides with the entrepreneur's competences. There are routines of participation in business fairs with the support of the business incubator, and growth up to semi-industrial production levels. Other episodes relat-

ed to expansion and growth show routines of investment in sectors similar to the target market, and the creation of spin-offs.

In the set of episodes of needing to survive in the market, buyers are the key actors, predominantly posing barriers. Episodes triggered by the international financial crisis, for instance, affected the networks' configurations and resulted in routines of maintenance of clients and contingency of expenses. In three other cases the outcomes were redesigning production practices to cope with market demands and competition, resulting in new routines of expanding innovation processes through a shortened product creation cycle and an increased variety of products.

An overall list of routines, considering all CLEs, is presented in Appendix 8.

These results show a dynamic scenario that includes the internal organization of the business and its relationships with other actors. At the same time that procedural knowledge is developed, there is a lot of information flowing and triggering changes in the search for new solutions. Nevertheless, in a two-year timespan, signs of the process of attachment to and accumulation of procedural knowledge are already identifiable and may affect creativity in innovation (Lazaric 2008). This happens when attention is channelled to procedures and the current system of working routines stimulates reduced flexibility.

These signs indicate increased cognitive automatism and reduced attention to many details, so that the entrepreneurs can focus on different/new firm demands. As detailed by Lazaric (2008), there will be two types of information processing; both important for adaptation to the environment: controlled and automatic processes.

The key to automatic processes is the repetition of successful routines. Each time a routine is applied, it evokes automatic and deliberate dimensions of these routines, so that they can be both stable and evolve. It is through this process of repetition and gradual adaptation of successful routines that individual learning outcomes have affect at the organizational level. The performance of routines, therefore, carries the potential for creating "new strategies, face uncertainty and project into the future" (Lazaric 2008, 215). It is through these processes that the same resources are used for different services and that certain resources and the services rendered by them become obsolete and replaced by new ones.

The main propositions resulting from this analysis are:

Proposition 5a. Network dynamics mark the formation of organizational routines in the first two years of business start-ups.

Proposition 5b. The first year of a business start-up is the most instable and dynamic, due to the flexibility of entrepreneurs to apply the available resources to a wide range of uses.

Organizational routines and triggers

The feedback arrow in the analytical framework showed that routines can trigger change. However, this process cannot be taken for granted. Routines are very difficult to change, not only because this would imply a negative evaluation of one's previous practice but also because such change involves a period of disorientation while old routines are gradually unlearned and new routines gradually developed (Eraut 2004). This section examines the triggering of new CLEs by operating routines through qualitative longitudinal analysis. Results show that organizational routines become triggers under two main conditions: a) when the working routine becomes obsolete and no longer provides the services the start-up needs; and b) when the reproduction of a working routine generates new needs that imply critical changes in the system of routines.

Box 4.5 illustrates the first condition by describing a context in which a routine is formed and later replaced by another one. This condition implies a particular sequencing of events that does not entail relations between CLEs. The details of the case show that the first routine was formed when the start-up relied on three associates who could share responsibilities and engage in different activities. As labour available decreased, managerial competences were acquired, and an alternative product was developed, thus the initial service-provision routine became ineffective. The case shows that the whole mix of resources and potential services matters for both the end of a working routine and the adoption of a new one. The case is a start-up originally formed in the medical engineering sector.

The second condition in which routines trigger CLEs is aligned with theorizations by Feldman (Feldman 2000, Feldman, Pentland 2003) on changes in routines that stem from iterations in their performances. The difference here is the focus on changes or the creation of different routines rather than changes to the same routine. An illustrative example is shown in Box 4.6. This is the case of a small manufacturer of guitar ped-

als, who developed the product from scratch and needed to keep manual production techniques to guarantee the firm's identity. With rapid growth, the entrepreneur developed an on-the-job training routine and started lobbying the local government to bring some technical training courses to the city for the benefit of other businesses and local labour.

Box 4.5
Routines as triggers: Firm27

In the first CLE, a routine for service-provision was developed in order to generate working capital for the start-up and income for the entrepreneurs. This routine was meant to be a temporary solution while the core product, R&D-intensive equipment, was developed. For a period of one year, this temporary arrangement became the identity of the firm, consuming all its resources, mainly the entrepreneurs' capabilities and time. This hindered the development of the core product at the origin of the business. At this stage, the team of associates was dissolved (CLE nr. 3), applications for R&D grants were demanding the firm's resources in the form of bureaucratic procedures (since CLE nr. 1), the core product was far from being developed, and the manufacture of an alternative, lower R&D-intensive gadget, had recently started (CLE nr. 4), thus imposing barriers to reaching out to buyers (CLE nr. 5). In the sixth CLE, the entrepreneur realizes that the service-provision routine is no longer functional and (re)defines the focus of the business towards the manufacture sector.

Box 4.6
Routines as triggers: Firm06

Since the formation of the business, the entrepreneur aimed at creating alternative products to the digital sound techniques available on the market. With the slogan 'Vintage in the can', he developed guitar pedals that do not distort original guitar sounds. The development of the product is characterized by learning by doing and trial-and-error strategies (CLE nr. 2 and 3) and is followed by an unexpected successful entry into the market (CLE nr.4). In order to cope with sales demands, this entrepreneur had to hire employees, which led to another CLE: the city does not have skilled labour in electronics, or courses which potential employees could follow. In the fifth CLE, then, this start-up develops a routine of 'constant on-the-job training' of employees, with the best performers being quickly hired in full-time positions.

These cases show not only that change can be endogenous, but that endogenous events or processes can cause discontinuity in the current ways of doing things. As stated by Lazaric (2008), with the evolution of

organizational memory, part of the existing knowledge is activated, but only part of it is repeated in a seemingly automatic way.

Proposition 6a. The evolution of organizational routines relies on endogenous processes that can be continuous or discontinuous.

Illustrative cases

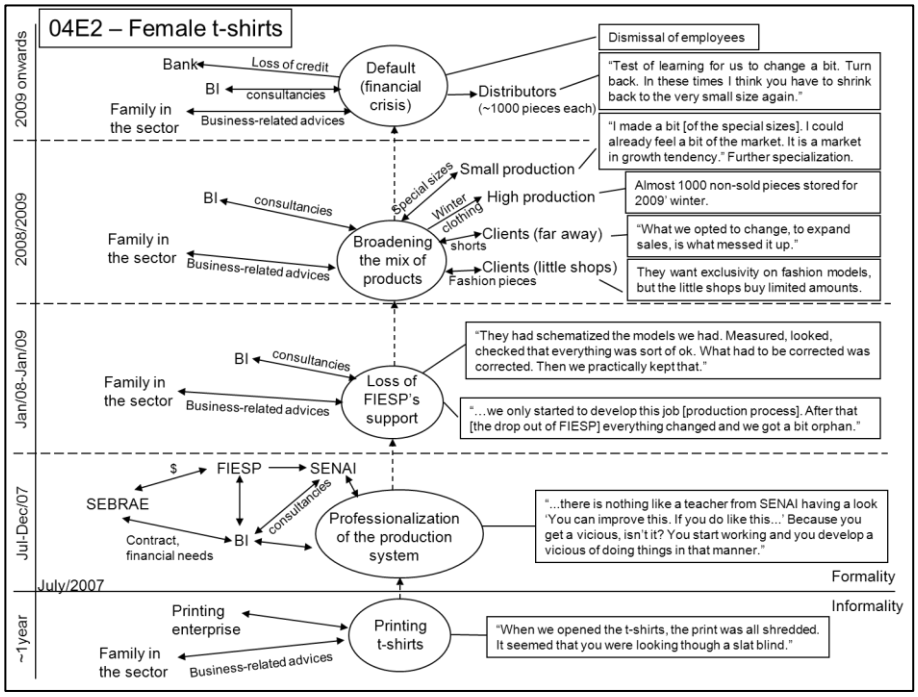
This section reframes the story of the two business start-ups described at the beginning of Chapter 1 in the light of the analytical framework and the empirical dynamics of CLEs investigated in Study 2. These cases are represented in flowcharts, organized as follows:

- Y axis: timeline;
- Circles: the content of the main episodes;
- Left hand side of each circle: the supporting network and the resource exchanged or acquired;
- Rectangles on the right hand side: the main outcomes of each episode, including quotations.

The first case shows the evolution of one low R&D-intensive business start-ups in the clothing sector. Starting at the bottom, Figure 4.9 shows that before joining the business incubator, the business was operating informally at home, with a **routine** of receiving advice from family experts and buying from low quality suppliers. As the business became too big for the household, the owners **searched** for larger facilities in the business incubator (**trigger**). The first six months of incubation enlarged the support network by introducing important regional and local actors, which provided consultations (**strategy**) to professionalize the production system (learning **content** of developing new meanings, commitment and methods). Innovative production techniques started to be implemented (learning **outcome**), until FIESP, the main partner of traditional incubators, withdrew. This led to the collapse of this support network (**trigger**), resulting in the start-up bouncing back to the family experts and to the consultations that were still available in the incubator (limited to finance and marketing) (learning **strategy**, learning **outcome**). In order to survive and grow (**trigger**), the entrepreneur tried to expand her network of buyers and distributors, selling big quantities also outside the state (**strategy**). She also diversified the mix of products at various times (**trigger**), trying to work in different sub-sectors (i.e., winter cardigans, shorts, uniforms, fashion models) (learning **strategy**). Most of her exper-

iments went wrong (learning **outcome**), so she decided to keep the two successful products: basic tank tops and special sizes (extra-large and above), though the latter was still at an initial stage at the time of the interview (new **routine**). Despite these sales efforts, with the international financial crisis (**trigger**), she faced several problems with distributors defaulting, which led to the loss of bank credit. The coping strategies included dismissal of employees and reduction in the size of the start-up. At the time of the interview, the entrepreneur had decided to only sell to reliable buyers, within the state, in order to "put the house back in order" (learning **outcome**).

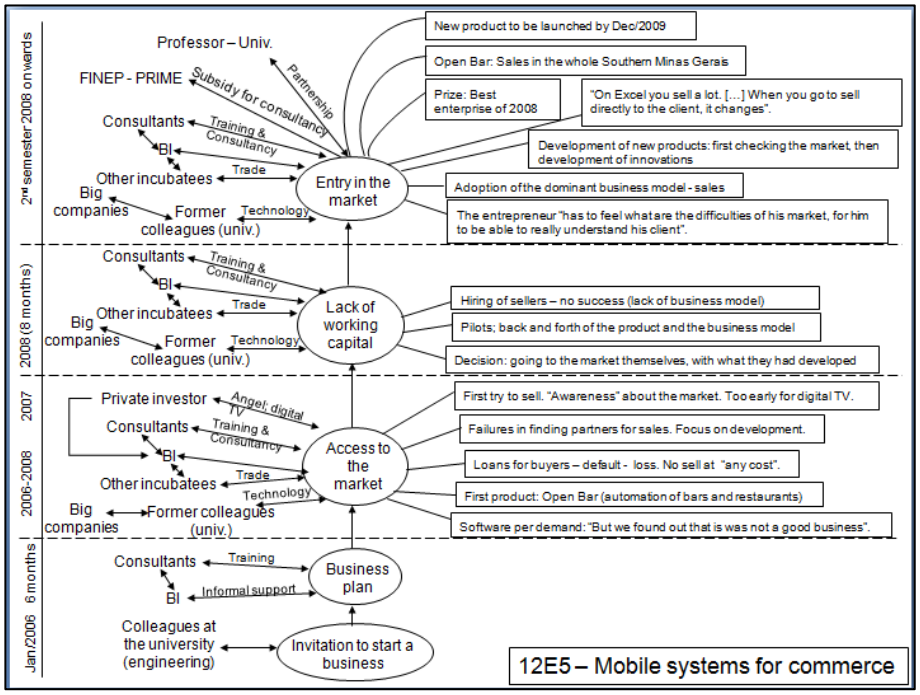
Figure 4.9
Evolution of Firm07 – Female t-shirts



The second case is a start-up in the information technology sector that has two main products: a built-in system for bars and restaurants and a cost control system for SMEs. Figure 4.10 shows that the entrepreneurs founded the start-up at the invitation of a colleague from the

university (**trigger**). They sought the support of the business incubator from the very beginning, because none of the associates had an entrepreneurial background (**strategy**). The incubator provided guidance and access to courses during the six months of the elaboration of the business plan (**strategy,** learning **content**). The start-up enrolled in the incubation programme in mid-2006 and soon realised that the initial idea of producing software on demand would not work (learning **outcome**). Therefore, the owners decided to create their first product (learning **outcome**). At this point, their network had expanded towards other incubatees and former colleagues who were employed in big companies and from whom they gained access to innovations, trends, and technology (**strategy, learning outcome**).

Figure 4.10
Evolution of Firm32 - Mobile systems for commerce



Despite this relatively wide network, they faced several difficulties in accessing the market (**trigger**). "Selling at any cost" led to financial loss-

es and poor knowledge of the market led to unsuccessful sales partnerships (learning **outcomes**). Meanwhile, an angel investor was interested in their technology and capacities and they started to develop a new project together, with an opposite approach to their previous one: selling before developing (**strategy**). The project did not work out, but they became "aware" of the market (learning **outcome**) and learned to start with the market, before spending time in product development (new **routine**). The time spent on developing the first product (almost two years) used up their working capital (**trigger**). They decided to learn how to sell, and tried several business models for a period of eight months (learning **strategies, content**). Finally, they adopted the most commonly adopted business model and sales rocketed. In the space of one year they developed new products, took over the regional market previously dominated by bigger enterprises from another region (learning **outcomes**), got a prize for "Best Enterprise of 2008" (learning **outcome**), and had a project approved with a PRIME/ FINEP grant (**strategy; outcome**). They also joined forces with a university professor to develop another product (**routine** for product development).

In contrast to the first example, this start-up increased its support network, created technological innovation in a field dominated by big companies, established long-term partnerships with other incubatees, joined forces with a university professor for product development, and constantly took advice from the incubator's consultants. The new routines show the firm's maturity in exploring the market and balancing the investment of resources between market demands and opportunities, and technology development.

4.3 Study 3: Use of resources and networking

Study 3 carries out an in-depth analysis of two aspects of Study 2 that are essential to understanding the evolution of business start-ups: the dynamics of resources that trigger CLEs and the dynamics of networking that affect the configuration of business start-ups networks and, therefore, the resources that are transacted in these networks. This study has two objectives: a) to expand the concept of resource use to include creation and loss of resources as triggers to critical learning episodes; and b) to explore longitudinal changes in entrepreneurs' networks taking into account the changes in the diversity of actors as a proxy for diversity of resources.

Access and creation of resources

Penrose (1980 [1959]) defined two categories of resource use: access and under-utilization. This section introduces the concept of resource creation, which emerged from the entrepreneurs' narratives as a third category of resource dynamic that is critical in business start-ups. The main distinction between access and creation of resources is based on availability.

Start-ups can acquire available resources either by purchasing them or by joining a programme or a professional network that allows access to them. In the former, hiring specific consultancy services for product development is a way of acquiring resources that are very knowledge-specific. In the latter, a business partnership for sales can open access to business fairs, introducing the start-up's product onto the market. However, the business start-ups in this study rarely purchased critical resources as the high costs of specialized inputs were often unattainable. For example, imported machinery and specialized guidance for internal structuring of specific routines are very expensive. A strategy to reduce the costs of accessing specialized consultancy and infrastructure is enrolling in a business incubation programme. In addition, the image and credibility of business incubators are a critical resource (e.g., Albert, Bernasconi et al. 2004) that increases opportunities to access public and private investment capital, and to reach out to buyers.

In a similar way, participating in professional networks such as business associations, virtual networks of university graduates, and general virtual networks are sources of knowledge, skilled labour, suppliers and buyers. These networks, for their specific characteristics, are sources of specific resources, reducing the costs of searching in the market with limited knowledge of where and what to search for (e.g., Shane 2003). They work as shortcuts for accessing resources and also as sources of new ideas and partnerships to create alternative or non-existing resources, as discussed next. When networks perform these functions, they become a source of social capital (e.g., Xu 2011).

In the case of resources that may not exist, such as a specific machine, or a certain technology, processes of creation can take two forms. In many start-ups resources are created internally, through trial-and-error learning to develop parts of the product or of the production process. As narrated by Firm06, which produces electronic guitar pedals,

> to develop a product like ours, it was a bit more complex [in comparison to the clothing sector], because we did not know; no one showed us how to do it and we had to learn. Right? How to work with the tools… And then the development of… internal technology. How to operate certain… software, up to the elaboration of the circuits. To make the printed circuit board that is part of… it's electronic, right? Then, how to develop the board. In the beginning, the board was made here. We passed through learning processes such as the use of photo sensitive material, then we moved to the silkscreen, also no one knew how to do it. We had to learn how to do the silkscreen, to make the letters. The painting was… we were learning and developing with what we had here, in the enterprise (§050).

A second way of creating as yet inexistent resources is to form partnerships with other start-ups in order to combine complementary expertise for the development of a product, technology or process. In contrast to acquisition, this includes the internal development of resources based on exchanges with the external social environment through networking. An example is the partnership between two start-ups to develop a machine for chemical processes on small scale. Similar equipment exists in the market, but is designed for big factories. The development of this equipment for small scale production is a resource that was *created*. It is common that business incubators deliberately bridge these partnerships by connecting entrepreneurs, or, by offering a cooperative environment via courses and general guidance. Other partnerships for innovation originate from previous personal networks with other businesses, not necessarily linked to a business incubator. This second form of resource creation is more collective than the internal trial-and-error form and highlights the higher added value of complementary competences, in comparison to purchasing power. Firm29 provides a clear example of the distinction between acquisition and creation.

> During the counseling process, the venture capital consultant said 'this product… All your products have potential, but this one here has potential, it could even become a new business.' Then we separated this product from the rest of the business and started studying it and we got very scared at the size of the market that the product would link to. […] As it would involve a part of technology that we didn't master, which is the internet part […]. We made a partnership with the people from Firm32 to make this other enterprise. And then, what could we give them? I said 'Look, we have a monstrous business at hand. I set up

> the business and have been financing it since the beginning, 51% is mine and you enter with 49%. So I give you 49% of the enterprise and, in exchange, you develop the web, internet system, and enter into the management of the business.' They agreed. We moved on and the business took off. Now we have signed the first contract for the product. (§033-035).

Firm29 could not simply acquire the necessary knowledge, because the software had to be developed together with the new product. This resource was not available and, moreover, was critical for the continued existence of this new spin-off. It is noteworthy that the distinction between acquisition and creation of resources is more obvious the more the resource is tangible, i.e., creation of tailor-made software, development of machinery, etc. However, in the case of intangible resources such as those of managerial nature, this distinction may, to a certain extent, become blurred. Nevertheless, the distinction between the two is made clearer if learning processes and asset specificity are taken into consideration. A managerial resource that is acquired (financial control sheet) does not require a complex combination of learning strategies and is found in all businesses. Conversely, the development of internal knowledge of management systems is a type of managerial resource that is much more specific and requires more learning efforts to be developed; the investment in learning is higher.

Dynamics of resources in critical learning episodes

This section is based on the following fundamental assumptions:

- The dynamics of resources are based on access, under-utilization (Penrose 1980 [1959]), creation, and loss of resources;
- Resource dynamics are at the core of CLEs. Therefore, this analysis does not take into account resources at the level of learning outcomes or routines.

This second assumption may raise questions such as 'What about the dynamics of resources during or after a CLE?' However, this question does not need to be considered because, by definition, at the end of every CLE something is learnt; this would highlight resource acquisition or creation in comparison to under-utilization and loss of resources. Another reason is consistent with Penrose (1980 [1959]), in which resource use is a trigger for growth and expansion of firms:

> Unused productive services are, for the enterprising firm, at the same time a challenge to innovate, an incentive to expand, and a source of competitive advantage. They facilitate the introduction of new combinations of resources – innovation – within the firm" (p.85).

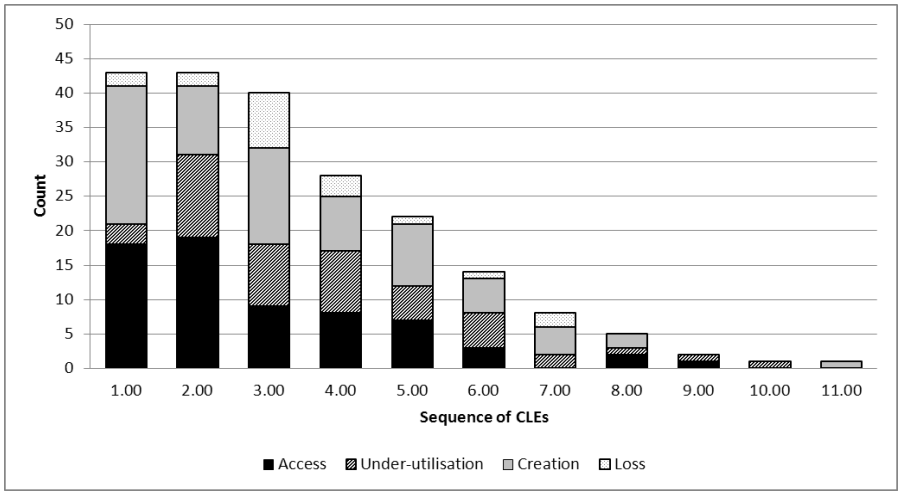
In addition to this, there are methodological difficulties to distinguishing each resource in the intra-CLE dynamics and between CLEs, since the same resources are used in different services appearing in more than one CLE. The four dynamics of resources in relation to triggers are:

- **Access to resources**: following Penrose (1980 [1959]), this category refers to any existing resource the start-up acquires in order to establish its routines and survive. One example is the acquisition of managerial competences through courses and consultancies;
- **Under-utilization of resources**: following Penrose (1980 [1959]), this refers to the availability of resources inside the start-up, but which are not fully deployed. For instance, the start-up creates all conditions for production but the process is delayed by months waiting for governmental licenses;
- **Creation of resources**: this category refers to the impossibility of accessing resources because they do not exist, or because they are not attainable by the entrepreneur, or because the entrepreneur decides to develop them internally. This is the case of start-ups developing new technology, and also smaller scale innovations that support the core product; i.e., the development of machinery for the production process;
- **Loss of resources**: losing resources can also trigger CLEs. It is common, for instance, that joint ventures are dissolved in the first years and the remaining entrepreneurs have to cope with the loss of expertise and/or financial resources. In some cases, this helped growth, as it ended disagreements between associates. Another type of loss, in some cases, is leaving the business incubator facilities.

These types of resource use were analysed in relation to the temporal (sequence of episodes), individual (learning strategies), firm (CLEs), and structural aspects of the evolution of these start-ups (within pathways, discussed in Chapter 5). The analysis of these four dynamics of resources across the sequence of critical learning episodes shows non-significant differences in chi-square tests. Nevertheless, Figure 4.11 suggests some patterns. In general, access and creation of resources are the two most

prominent categories of resource use found in the first sequence. This reflects the need to establish the first organizational routines, such as acquiring initial managerial competences and developing the product. In sequence 3, triggers that demand the creation of resources and loss of resources become more frequent. These are caused mostly by the insertion of these start-ups into the market, when they create their market strategies and start being noticed by competitors. Two main types of losses were reported in this third sequence of CLEs: unfair competition via product copying or price war, and the attraction of trained employees by big companies.

Figure 4.11
Use of resources across sequences of CLEs



These dynamics of resources are now examined in relation to types of CLEs (Table 4.5). The general pattern shows that, apart from loss of resources, all categories of resource dynamics are found in all types of CLEs. Statistical tests examined differences in this distribution. Results showed that access, under-utilization and loss of resources had distributions significantly different from the expected values. There are more occurrences of access to resources (X^2 (4, n=207) = 15,09, p< 0,01) than expected in CLEs triggered by production issues and entrepreneur-specific issues. The main resource accessed is managerial knowledge. It is utilized for specific issues, such as financial management, human re-

sources management, technical issues about the type of business, etc. Other resources that commonly demand access efforts are investment capital and knowledge about production (i.e., production organization, production techniques), followed by knowledge about the market, technological expertise and facilities for product development. It is noteworthy, and probably typical of business start-ups, that most of these resources are knowledge-based. This has impacts on the need for networks, since this knowledge is predominantly acquired from other people.

Table 4.5
Use of resources per type of CLE (n=207 CLEs)

Use of resources	Market	Production	Entrepre-neur	Manage-ment	Others
Access	14	19	21	7	6
Under-utilization	20	17	4	7	0
Creation	28	16	18	7	4
Loss	11	3	0	5	0

Cells in grey indicate observed values significantly above the expected values.

In relation to under-utilization, there are more occurrences than expected in CLEs triggered by needing to enter and survive in the market and by production issues (X^2 (4, n=207) = 10,44, p< 0,05). For market issues, the most commonly under-utilized resource is the development of products for which there is no market or for which entry barriers hinder the start-ups. Other under-utilized resources relate to investing production and management efforts in one single buyer. If this buyer cancels the contract, the start-up goes through a large internal reorganization. For production-related triggers, two main resources are found to be under-utilized. The first is labour, since conflicts within the group of employees and between employees and entrepreneurs hinders production and the sustainability of the firm. The second is production inputs, which cannot be used before registrations, patents, and licenses are obtained. Delays in formalizing the firm's activities may take from months to years, depending on the type of activity.

Loss of resources, (X^2 (4, n=207) = 12,46, p< 0,05), in turn, is significantly frequent in CLEs triggered by the need to enter into and survive in the market and by managerial issues. This is reflected in financial loss as a result of attempts to enter into the market; for example selling more than the firm can produce, using business models that do not work, and realising that the expected target market is not interested in the product. In relation to management, these losses refer to joint venture breakdowns and the consequent loss of expertise and investment capital, and to lack of working capital.

The dynamics of resources, learning strategies and services by the start-up

This section investigates the question: Are there patterns in the use of learning strategies in relation to the dynamics of resources? The distribution of learning strategies per type of resource use is shown in Table 4.6. In general, the preferred learning strategies across all dynamics of resources are behavioural, especially interpersonal/ inter-organizational help-seeking and practical application. Nuances in these distributions are statistically identified.

Chi-square tests showed only two significant differences. One of them is the high use of intrinsic reflection to cope with CLEs that demand access to resources (X^2 (3, n=207) = 18,38, p< 0,01). This is indicates that only acquiring information from others (as indicated by the high frequency of interpersonal/inter-organizational help-seeking) is not enough to solve a CLE. There is also an urgent need to understand this new information before it can be applied. Note that the use of intrinsic reflection in slightly more frequent than the use of practical application in relation to access to resources.

The other significant difference is in the distribution of self-regulatory learning strategies in CLEs triggered by under-utilization of resources (X^2 (4, n=207) = 24,00, p< 0,01). Despite the relatively small frequency, CLEs triggered by under-utilization of resources concentrate all occurrences of emotion control. This is a clear indicator of the distress involved in these episodes. Some of the learning contents are matching productive capacity and sales when unexpected and discontinuous sales peaks demand an unsustainable increase of production inputs. Other contents refer to defaults by important buyers or the cancelation of contracts by the single buyer.

Table 4.6
Types of resource use and learning strategies (n=207 CLEs)

Type of learning strategy	Access	Under-utilization	Creation	Loss
Cognitive				
- Intrinsic reflection	39	12	29	3
- Extrinsic reflection	25	22	43	10
- Reproduction	3	1	2	0
Behavioural				
- Written material	10	5	10	0
- Interpersonal/ Inter-organizational	57	35	55	14
- Practical application	35	27	51	12
Self-regulatory				
- Emotion control	0	7	0	0
- Motivation control	0	3	2	0
- Comprehension monitoring	4	2	4	0

Cells in grey indicate observed values significantly above the expected values.

The last analysis of resource and their dynamics refers to the multiple services provided to business start-ups. Boxes 4.7 to 4.10 cluster all these resources per category of resource dynamic. Rows are sequenced in descending order of frequency. Box 4.7 shows that managerial knowledge is the most important among the acquired resources. Entrepreneurs need access to this knowledge, especially to set up the new business.

Box 4.8 shows that the most under-utilized resource is productive capacity. This table details the point above about the impact of long waits for regulatory procedures, licenses, and R&D grants.

Box 4.9 lists the resources that are created and the corresponding services. The procedures to start a new business and managerial competences are the two most important resources here. The former refers to pooling resources within the firm-organization; the latter refers to the first developments of routines for internal organization and to interaction with market actors.

Box 4.7
Resources that are acquired and corresponding services

Type of resource	Services to the start-up
Managerial knowledge	Establishing the first managerial routines of the start-up Redesigning the routines of an acquired bankrupt business Overcoming flaws from failed entrepreneurial attempts Dealing with unexpected growth Negotiation competences
Investment capital	Development of the start-ups' projects
Information about the market	Shaping of the initial idea Understanding market dynamics
Expertise in elaborating grant proposals for public and private investors	Accessing investment capital to develop the core product
Knowledge of how to use technology to develop a product	Defining the market niche Transforming technology into product
Specific expertise	Replacing knowledge lost by the breakdown of the initial joint venture
Finance and network	Establishing business partnership
Infrastructure and other facilities	Replacing the facilities so far provided by the business incubator

Box 4.8
Resources that are under-utilized and related services

Type of resource	Services to the start-up
Productive capacity	Competences focused on only one buyer vs. diversifying buyers Associates fully dedicated to the start-up but sales did not happen as expected Focus on only one big client Focus on services to survive when the core business is industry Efforts diverted to solve problems caused by inefficient accounting Awaiting the implementation of R&D grants Unhealthy sales; too broad market niche
Sales efforts	Barriers imposed by big players in the market Focus on a market that is not the most interested in the start-up's services Lack of awareness of the length of the sales cycle
Scarce financial resources	Expensive suppliers (linked to lack of knowledge on calculating costs)
Expertise	Focus on only one sector due to lack of knowledge about similar sectors Disagreements between associates about the division of functions to deal with growth
Relationships with employees	Conflicts with employees who want to participate in managerial issues
Technological potential	Lack of awareness of the potential of the technology they created
Human capital	Entrepreneur did not have development possibilities in his job and decided to start a new business

Box 4.9
Resources that are created and corresponding services

Type of resource	Services to the start-up
New business	Redesign of a production line of a bankrupt start-up Setting up the business Setting up minimum conditions to form the business
Managerial competences	Dealing with wholesales instead of retailers Dealing with growth Quality procedures based on ISO requirements Human resources management to cope with growth Decision-making process to deal with offers from big companies (risky partnerships) Combination of consultancy and academic knowledge to deal with business constraints Development of outsource services to broaden the mix of services and lower fixed costs
Market relations	Expansion in the mix of services Development of trust-based relationships with buyers Networks with suppliers for reduced costs Development of strategies to cope with unfair competition Business partnership for the first interactions with the market
Productive capacity	Workers learning manufacturing skills Shortening of the production cycle Achieving the break-even point with limited skilled labour Establishment of an internal expert team
Technology	Development of the product Methodology for software testing Equipment in medical engineering Conditions to develop the prototype into product
Second product or service	Attending an opportunity in a similar field New products out of the same technology Survival of the business while the core product is developed
Financial resources	Setting up the production structure Improving the production cycle to increase working capital Overcoming barriers to access R&D grants
Infrastructure	Replacement of the business incubator facilities
Conditions to cope with regulations	Complying with regulation requirements for production and commercialization
Entrepreneurial interests	Setting up a business instead of being an employee
Development partnership	Combination of research and market competences

Box 4.10 concludes this analysis showing that human capital is the resource that is at most risk in business start-ups, mainly the expertise and financial capital that is lost when there is a joint venture breakdown.

Box 4.10
Resources that are lost and remaining services

Type of resource	Services to the start-up
Human capital	Exit of associates
BI facilities	Setting up conditions to function outside the incubator
Buyer	Price war competition

Networking dynamics

This section examines changes in the network configurations of business start-ups, comparing the beginning of the business (initial network) and the time of the interview (current network). It applies techniques of social network analysis (e.g., Scott 2005) to describe who the resourceful actors were at those two points in time. The basis of the analysis is CLEs of entry into and survival in the market because they are the most frequent and typically involve interactions between the firm and the external environment. Moreover, since CLEs are not independent of each other – except for in few cases – it is probable that these results can be generalized to other CLEs.

Results show three types of actors: family members or friends providing financial support or expertise, acquaintances from previous jobs, and support institutions. For the initial network, in-degree centrality measures[7], identified the following actors, from the most to the least central: other incubatees, university, buyers, business incubation consultants, and university professors. Central actors are those that provide information and support; they hold a position of power in the network because they possess critical resources. Hence, it is expected to find university and buyers here. However, an unexpected result is the high centrality of other incubatees, with whom the entrepreneurs have friendship and kinship ties.

In the current network, new actors were included whilst others excluded, showing the increased embeddedness of these start-ups in mar-

ket setting. These changes indicate a more rigorous selection of suppliers, buyers and reconfigurations in the team of associates. These actors are, from the most to the least central, buyers, business incubation consultants, university, other incubatees, suppliers, support institutions (State level SEBRAEs), university professors, family experts, and two business incubators. There is also a qualitative change in the resources exchanged. For instance, the university, initially, was a source of business ideas and part of the informal networks. Later, the university becomes a source of partnerships for product development and technological upgrade. These relationships tend to be more formalized and in some cases there are contracts regulating intellectual property rights.

These two networks are compared in terms of density, geodesic distance, components and relationships of core-periphery (Table 4.7). Indicators point out a denser current network, with shorter paths to reach other actors (geodesic distance) and more actors grouped together in closer ties (principal component). The current network is less fragmented than the initial network and might allow a more intense flow of resources between actors.

Table 4.7
Structural measures comparing network configurations at two points in time

Measure	Initial network	Current network
Density (proportion of effective ties)	0,236	0,263
Geodesic distance (average number of intermediaries between two actors)	3,54	2,89
Components	18 (137 nodes in component 1)	9 (147 nodes in component 1)
Core-periphery	Core actors: Incubator01, Incubator04, Incubator10, Incubatees, SEBRAE/SP, SEBRAE/MG, FIESP, Incubators' consultants	Core actors: Incubator01, Incubator04, Incubator05, Incubator10, Incubator12, Incubator14, Incubatees, SEBRAE/SP, SEBRAE/MG, Incubators' consultants, University, University professors, ParqTec, ParqTec consultants

The analysis of the core-periphery indicates that the core actors in the initial network are: three business incubators, incubatees, support institu-

tions (SEBRAE, FIESP) and incubators' consultants. The current network presents more core actors and stronger relationships. These include more business incubators, support institutions, incubators' consultants, university, and university professors. It is through them that more resources are exchanged and from whom peripheral actors search for resources. The process of embeddedness into the institutional setting of business incubators is noteworthy, with 43% of the business incubators positioned at the core of the current network.

Inside the business incubator, incubatees play an important role, either introducing their acquaintances to business development services, or providing informal exchanges of information about funding, managerial practices, and social support. Later, some of these informal relationships become formal partnerships for product development and/or service provision. Results of this nature corroborate the literature about the effects of power over knowledge resources to the centrality of powerful actors in social networks (e.g., Nienhüser 2008). Since these networks are based on the narratives of entrepreneurs, the observed changes in the centrality of some actors reflect changes in the perceived need for the resources these actors provide.

In innovation studies, this relates to social capital dynamics in the feedback loop between innovation outputs and network configurations (e.g., Xu 2011). Other predictors of change in the configuration of start-ups' networks are market dynamics (i.e., competition), entrepreneurial decisions (i.e., investing in a new market niche), and networking activities (i.e., access to investors).

4.4 Conclusion

This chapter showed, in three studies, the methodology to identify and categorize critical learning episodes, how they provide empirical substance to the analytical framework, and the key dynamics of resources and networking of CLEs. Study 1 described how critical learning episodes were identified and categorized based on trigger events. It demonstrates the application of grounded theory principles to entrepreneurs' narratives, using the analytical framework to provide hints on where to start and what relations to observe in the first place. Furthermore, this inductive approach contributed to a categorization that includes the role of agency (entrepreneur-specific triggers), firm conditions (i.e., working

capital), social factors (i.e., labour issues), market dynamics (i.e., entering a new market), and institutional factors (i.e., regulation issues). It showed that 'Entry and survival in the market' is the most prominent of all categories. In addition, this type of CLE shows different patterns in various analyses; i.e., steady presence across time, and its own configuration of learning strategies, when compared to other types of CLEs.

Two entrepreneurial characteristics are highlighted in the distribution of CLEs: opportunity-driven entrepreneurs experience more CLEs; whilst entrepreneurial experience is associated to a smaller number of CLEs. This profile seems to combine proactivity and risk-taking, with entrepreneurship-specific human capital. The former are two classical individual characteristics in the literature of entrepreneurship (e.g., Gelderen, Thurik et al. 2006, Casson, Yeung et al. 2006). The latter partially corroborates SEBRAE's (2007) and Nichter's (2005) findings on the role of experience in the success and growth of SMEs. However, these studies have explored work experience as a proxy to knowing the market and as an indicator of better preparation to start a business. Work experience, here, seemed to reduce the impact of production-related triggers, but it does not reduce the criticality of other types of triggers. Entrepreneurial experience, therefore, seems to be a more specific measure of individual capabilities to deal with the demands of the first years of a business start-up and should be considered in entrepreneurship studies.

Study 2 empirically explored the relationships between concepts within a CLE, following the sequence in the analytical framework and refining the theory; i.e., the identification of creation and loss of resources as part of the resource dynamics triggering CLEs. This sub-study showed that, rather than indicating a linear relationship between the cognitive, social and practical (or procedural, as termed by Lazaric and others) dimensions of learning, these work jointly. These combinations of dimensions, or cross-dimension effects, appear between learning strategies and learning contents in the generation of all kinds of outcomes, expected or not. This implies that the selection of variation involves mental models and trials to assess effects of alternative actions (Eraut 2004), including learning from unsuccessful outcomes (Eisenhardt, Martin 2000). This inductive process of selection (Bataglia, Meirelles 2009) is implemented through learning. An explanation of the mechanisms through which it occurs is found in Lazaric (2008).

This author discusses the impacts of organizational memory and cognitive automatisms on procedural and declarative knowledge. Declarative knowledge, through interpretation and selection, is converted into procedural knowledge. The conversion occurs via a compilation mechanism of interpretations that are kept and repeated in the memory of the individuals. Successful repetition of these rules of action increases efficiency in performance, speed of reaction, and the probability that they will be selected again in the future. Each time a routine is performed, it evokes the declarative and procedural dimensions of that knowledge and this brings in potential for change. Hence, discontinuity may stem from (apparently) continuous and (temporarily) stable processes. Routines, for that matter, have functions beyond guaranteeing the regular functioning of the business. As reliance on them increases, routines become a source of solutions for new triggers as one of the endogenous resources; or they become triggers themselves.

Study 2 showed that changes in routines are more dynamic in the first year, when resources are being experimented and are not yet compromised in well-established systems of routines. Therefore, learning outcomes have a higher impact on organizational routines during the first year. Outcomes depend on a combination of factors, including interactions between different CLEs and between the start-up and the external environment to promote change at the organizational level. Organizational change becomes more costly to the extent that processes of internal complexity and interdependence between routines take shape, with increased reliance on their effectiveness, and embeddedness in market and institutional networks. Thus, the working system of routines will tend to prevail over the outcomes of individual CLEs.

Breaking this path-dependence requires, to a great extent, the entrepreneurial agency to read the trigger well and decide which resources to use and how to make use of them (Eraut 2004, Xu 2011). In a proactive manner, agency is crucial in combining the three dimensions of learning to change the resource-base of the firm, for innovation, competitiveness and sustainability. Study 3 contributes to understanding these resource dynamics. It shows that networking is essential to cope with all kinds of CLEs, to establish business-related networks and to become embedded in market relationships. The longitudinal effects of networking, within business incubation programmes, for network configurations and embeddedness, are demonstrated in Study 3.

Embeddedness is essential for access and exchange of information (e.g., Granovetter 1985), but it may be a barrier to the sustainability of the business when, at the end of the business incubation programme, the firm is very dependent on its incubation network. Results show that, in general, market actors gradually become more central as the business approaches the end of the incubation programme. However, a few start-ups reported CLEs related to leaving the business incubator. In addition to changes in who the actors are, there are also changes in their roles, with the formation of multiplex networks (e.g., Wasserman, Faust 2006) that tend to be stronger and longer lasting. For instance, when the university also becomes a buyer, in addition to providing technological information.

These three sub-studies demonstrate what authors like Feldman and Pentland (2003), Lazaric (2008) and Dopfer (2004) have claimed about the micro-foundations of routines and economic dynamics in general. Specifically, this thesis contributes to filling the research gap in the evolutionary economics literature by offering an explanation of the selection process of variations developed by firms (Bataglia, Meirelles 2009). Here, learning processes generate variation in and uses of resources to solve critical learning episodes. Successful outcomes are selected, retained and disseminated inside the firm as components of the system of working routines (e.g., Zollo, Winter 2002). These new routines support the sustainability of the business in the face of environmental and endogenous demands (e.g., Eraut 2004), and also contribute to further changes. Propositions in Study 2 highlight the main theoretical contributions of this thesis to the literature on routines, search and learning in organizations. These and other aspects are further discussed in Chapter 6.

Notes

[1] The duration of each interview was between 1h and 1h50min.

[2] Salience: "the property of a stimulus that makes it stand out relative to other stimuli in a particular context" (Hogg, Vaughan 2010). It can influence which episodes are remembered first and affect the judgement of entrepreneurs about how critical they were.

[3] As shown in Chapter 3, SEBRAE's (2007) categories are planning, enterprise organization, marketing, sales, human relations and financial analysis.

[4] The average number of critical learning episodes (Mean=4,80) was the cut point to split the group, since the mean corresponded to the third quartile of the distribution.

[5] In the significant differences, only extrinsic reflection and development of new commitments showed an observed value below the expected value in the chi-square test. For all others, the observed value was above.

6 Significant chi-square results: New meanings & New interpretations: X^2 (1, n=207) = 24,55, p< 0,01; New meanings & New practices: X^2 (1, n=207) = 8,47, p< 0,01; New commitments & New network structures: X^2 (1, n=207) = 24,13, p< 0,01; New methods & New practices: X^2 (1, n=207) = 11,04, p< 0,01. In all cases, the observed value was above the expected value. Comparisons between all other pairs of variables resulted non-significant p-values.

[7] Centrality is a whole network measure that considers all indications of relationships between all actors. However, here, relationships between other actors were narrated by the entrepreneurs, implying in probable under-representation of these other relationships. In-degree centrality is a measure of how much these actors are indicated by the entrepreneurs.

5 Pathways

> *[...] but economic analysis is not equipped to analyze these non-economic determinants of entrepreneurial ideas and behaviour. Consequently, we make the simple assumption that firms are in search of profits. This assumption has always created difficulty for many, partly because in an uncertain world there is no single objectively identifiable road to the greatest profit and different entrepreneurs with different temperaments choose different roads, and partly because money profits do not encompass the whole of entrepreneurial ambition. These two difficulties reinforce each other"* (Penrose, 1980 [1959], 184-185).

Chapter 2 defined pathways as arrangements of critical learning episodes in the storyline of a business start-up, which emerged from the analysis of the dynamics of resources within and between CLEs. Therefore, a pathway has two elements: CLEs and the relationships between them. These relationships are characterized by multiple factors, the most important being the entrepreneurial decisions in relation to possible uses of resources to deal with a new trigger. Evolutionary paths, therefore, are shaped by what and how resources are used in each episode.

This complexity inherent to pathways makes each start-up trajectory unique; hence this chapter describes the analytical steps used to disclose patterns between individual pathways that could aggregate the 43 individual stories. This chapter shows how, through the investigation of configurations of resources across CLEs, five typical pathways were found. These could, then, be aggregated into two main categories of pathways, clustering those firms exclusively dedicated to the core product or service *versus* those combining core and secondary products and services. Properties of these pathways are also explored and discussed in terms of individual, firm, social, and institutional factors.

5.1 Constructing a definition of pathways

Following the analytical framework set out in Chapter 2, critical learning episodes are seen as the building blocks of pathways. Although Chapter 4 described several dynamics within CLEs, it did not address how these blocks interconnect or what drivers explain different arrangements of CLEs. Can individual businesses' trajectories be grouped? The first attempt to analyse this was by examining sequences of CLEs in each firm's pathway. Results showed that entrepreneur-specific issues are the most common trigger initiating individual firms' pathways, which were followed by CLEs of production or market. This sequence generated a first clustering of cases, named Pathway A, Pathway B, Pathway C and Pathway D. This clustering was analysed in light of factors associated to firm performance and change (e.g., Michor, Harms et al. 2010).

These factors are divided in characteristics of the start-up and characteristics of the entrepreneur. Characteristics of the start-up are industrial activities (United Nations 2008):

- manufacturing (n=24), information and communication (n=11), and professional, scientific and technical activities (n=8);
- type of market (EC, IMF, OECD, UN, World Bank Dec. 2009): capital goods (n=11), intermediate goods (n=9), consumption goods (n=11), business services (n=10), and final consumer services (n=2);
- status of the start-up: incubated (n=18), graduated (n=25);
- region: São Paulo (n=25), or Minas Gerais (n=18);
- time in operation: up to 2 years (n=3), 2.1-3 years (n=10), 3.1-4 years (n=10), 4.1-5 years (n=9), 5.1-6 years (n=5), or over 6 years (n=6).

Characteristics of the entrepreneur are:

- professional background: no work experience (n=9), experience in the same field as the business (n=21), experience in a different field (n=7), or academic career (n=6);
- educational background: secondary education (n=1), tertiary education (n=20), master degree (n=5), PhD degree (n=10), or not mentioned (n=7);
- entrepreneurial experience: none (n=36), or some previous entrepreneurial experience (n=7).

Pathway A was simplified as a sequence of

ENTREPRENEUR–PRODUCTION–MARKET

and was typical of business start-ups in the manufacturing sector, of entrepreneurs with higher education and located in both federative units, amongst other features.

Pathway B was characterized by

MARKET–PRODUCTION–ENTREPRENEUR

chains of critical learning episodes and was typical of the information and communication sector, reported more often by older enterprises (operating from between 5-6 years) and by those with entrepreneurial experience.

Pathway C,

ENTREPRENEUR–MARKET–PRODUCTION–MARKET,

was typical of PhD entrepreneurs with an academic career.

Pathway D, simplified as

ENTREPRENEUR–MARKET–ENTREPRENEUR,

was typical of start-ups in the business service sector, operating for less than two years and run by entrepreneurs with experience in the same field of activity.

It was intriguing that CLEs triggered by managerial issues were not included in this first categorisation of pathways. This is because management-related episodes do not follow a pattern within sequences of CLEs. They may figure before or after any of the other three types of CLEs. One possible explanation is that the low frequency of this type of CLE does not allow for the identification of patterns. Another is that managerial competences are more important as resources used or created to deal with CLEs than as triggers to them.

Despite some interesting insights, only few actual cases fitted into the statistical distribution of attributes of Pathways A-D. Therefore, this was a weak strategy to identify representative patterns. It also indicated that typical pathways were not sector-specific or driven by only one main variable. Consequently, a search for combinations of variables across time started. This strategy embedded the concept of pathways in temporal dynamics instead of testing the weight of variables that are *a priory* static. The strategy to search for typical pathways switched to a correlational approach, which investigated variables that could be related to specific

types of CLEs, their duration and diversity. These variables were, in addition to those mentioned above, learning strategies, initial networks, structural and temporal factors, etc. This linear approach to pathways was not successful in identifying patterns and explaining processes, possibly because it was based only on triggers and sequences of triggers, which often do not reflect the content or the outcomes of a critical learning episode. Although these results did not answer the question about aggregation of business start-ups' pathways in groups, they provided interesting findings in relation to associations between variables of the learning process and these factors.

5.2 Descriptive correlational results

This section presents some key results from preliminary analysis of individual firm's pathways following the linear relationships between the variables above. (Appendix 7 provides the codebook and the correlation and covariance matrices). An important methodological note is that these relationships fulfil descriptive purposes, since advanced statistical tests are compromised by the size of the sample[1]. Therefore, these results focussed on three key aspects: type of CLE, length of the sequence of CLEs, and diversity of CLEs. Type of CLE refers to the five categories described in Chapter 4; length of the sequence of CLEs refers to the number of episodes reported by the entrepreneur (range=2-11 CLEs); and diversity of CLEs refers to the combinations of different categories of CLEs in the pathway of each start-up (range=1-5 types).

Correlational results for type of critical learning episode

Correlations centred on types of critical learning episodes showed that entry and survival in the market is associated with a higher complexity of factors in comparison to the other types of CLEs. An excerpt from the correlation matrix is presented in Table 5.1.

Entry and survival in the market correlates positively with learning strategies in general, and specifically with cognitive (particularly extrinsic reflection) and behavioural strategies (particularly practical application). This result corroborates the need for combinations of internal and external resources in this type of CLE. In relation to market characteristics, entry and survival in the market correlates positively with start-ups facing triggers to survive in the market. It also correlates with the year of the

start-up's operation in which those CLEs started, confirming the pervasiveness of this type of CLE through time. Furthermore the correlation between entering and surviving in the market with loss of resources indicates the exit of critical resources, such as human and investment capital.

Table 5.1
Significant positive correlations between types of CLEs and process and firm variables

	Entry and survival in the market	**Production issues**	**Entre-preneur-specific issues**	**Manage-ment issues**
Learning strategies – Intrinsic reflection			0,16	
Learning strategies – Extrinsic reflection	0,42			
Sum of cognitive learning strategies	0,20			
Learning strategies – Practical application	0,41			
Sum of behavioural learning strategies	0,23			
Sum of all learning strategies	0,28			
Learning content – Development of new meanings			0,20	
Learning content – Development of new methods			0,15	
Learning outcomes - Development of new interpretations				0,14
Year of start of CLEs	0,25			
Entering a new market			0,15	
Surviving in the market	0,24			
Dynamic of resources – Access			0,18	
Dynamic of resources – Loss	0,15			
Other initial sources of finance		0,16		

In relation to the other types of CLEs, production-related issues correlate positively only with start-ups that could count on initial sources of resources, such as business plan contests, and other punctual sources of finance. Entrepreneur-specific issues correlate with the learning strategy of intrinsic reflection, access to resources, development of new meanings and methods, and with entering a new market. This combination of correlations confirms the description of this type of CLE as acquisition of knowledge about specific parts and routines that are linked to innovative products, to which there is little benchmarking possible. And finally, CLEs triggered by managerial issues correlate positively with learning outcomes for the development of new interpretations. This result indicates that this type of CLE tends to result in new resources at the cognitive level, possibly in relation to understanding how a firm works.

Correlational results for the length of sequences of critical learning episodes

Results for the length of Sequences of CLEs (at the centre of the mind-map in Figure 5.1 below) showed direct and indirect significant positive correlations between a combination of entrepreneurial characteristics, learning strategies, firm characteristics, and initial networks. From the centre, factors directly correlated with longer sequences of CLEs include being in the survival phase (r=0,45), lack of previous work experience (r=0,21), CLEs of entry and permanence in the market (r=0,23), diversity of types of CLEs (r=0,39), use of the cognitive strategy of extrinsic reflection (r=0,22), and the self-regulatory strategy of emotion control (r=0,14).

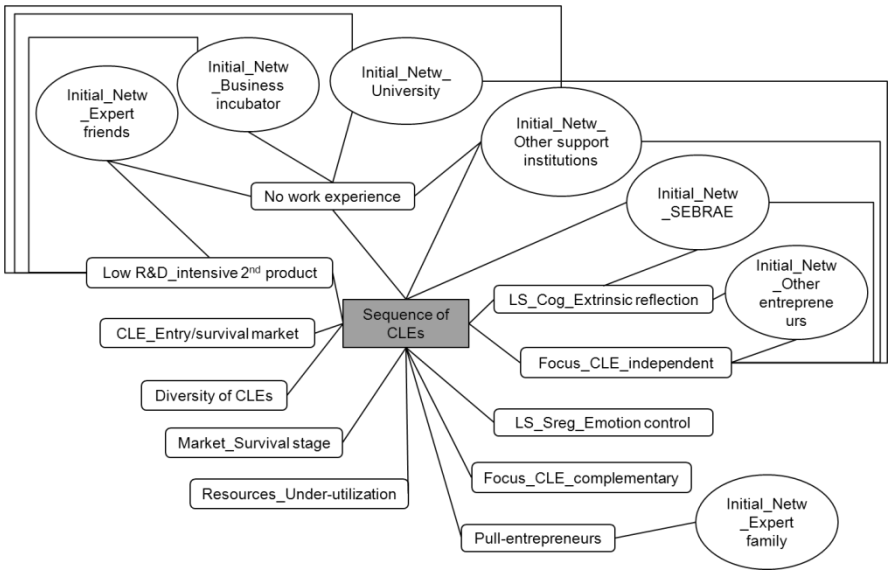
Start-ups with longer sequences of CLEs tend to experience CLEs of under-utilization of resources (r=0,16), focus on complementary (r=0,30) or independent products or services (r=0,21). They tend to be run by pull-entrepreneurs (r=0,20), develop secondary products or services that are low R&D-intensive (r=0,20), and benefit from initial networks with support institutions, such as SEBRAE (r=0,15), and others (r=0,20). An ample setting of actors from the initial networks of the entrepreneurs presented positive correlations with the first layer of factors, such as business incubator, other entrepreneurs, university, expert friends and family, and other support institutions.

Some of these correlations were expected. For instance, entrepreneurs without working experience are expected to report a higher number of

CLEs, based on evidence about the role of work experience in the same field in ameliorating perceptions of criticality for events commonly perceived as critical by newcomers (e.g., Kelley, Bosma et al. 2010, Nichter, Goldmark 2005). Start-ups in the survival stage are expected to have a higher number of CLEs due to the greater length of time of being exposed to the market, and a higher number of CLEs triggered by needing to enter or survive in the market.

However, the positive correlation between number of CLEs and initial networks with support institutions was unexpected. A possible explanation is that these institutions assume leading roles in pushing entrepreneurs into actions that are critical to changing the business, such as engaging in business-oriented networks, or providing training that speeds the pace of growth.

Figure 5.1
Mind-map of positive correlations around the length of sequences of CLEs

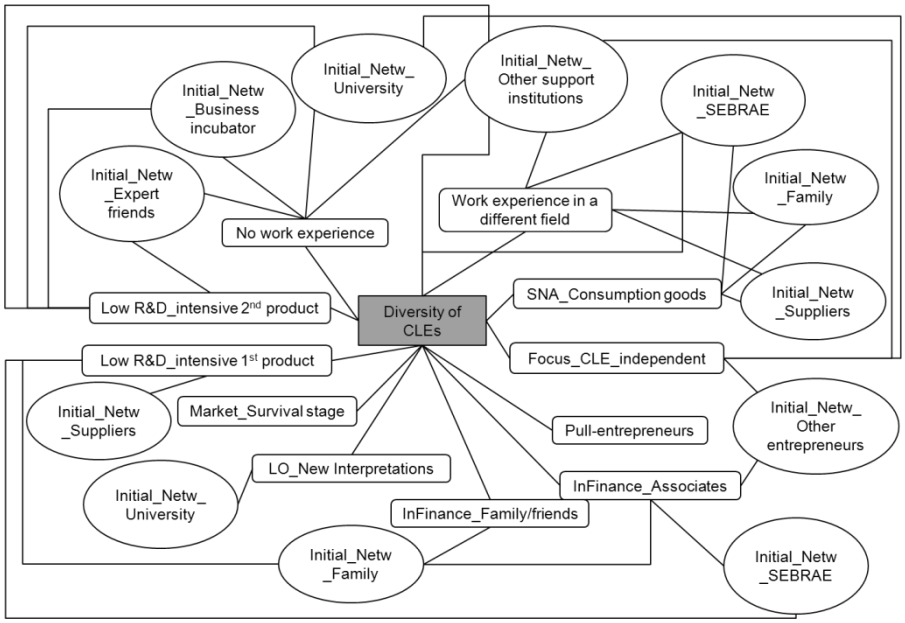


Correlational results for the diversity of critical learning episodes

Positive correlations between the diversity of CLEs and individual, firm, institutional, and process variables are illustrated in Figure 5.2. Diversity

of CLEs correlates with having no work experience (r=0,27) and having experience in a different field (r=0,31), indicating that these entrepreneurs have more diverse learning demands through the evolution of their business start-ups. A complementary association appears between diversity of CLEs and learning outcomes that result in new interpretations (r=0,16). Other positive correlations were found between diversity of CLEs and start-ups producing consumption goods (r=0,32), run by pull-entrepreneurs (r=0,31), and with initial finances from family or friends (r=0,14) or from the team of associates (r=0,15).

Figure 5.2
Mind-map of positive correlations around the diversity of CLEs



Diversity of CLEs correlated positively with business start-ups already in the survival stage (r=0,15), experiencing CLEs with focus on independent products or services (r=0,37), and developing low R&D-intensive activities for both core (r=0,17) and secondary (r=0,26) products and services. This set of correlations suggests the effect of time (when the survival stage is seen as a proxy for time in operation), and of

the development of secondary products or services, especially in the low end of R&D-intensity.

Analysis considering initial networks showed that diversity of CLEs correlates positively with SEBRAE (r=0,41) and other support institutions (r=0,47), corroborating the proactive role of these institutions in fostering diverse learning in business start-ups. Around these, a wide range of initial networks indirectly relates to the diversity of CLEs, such as experts from the family's and friends' networks, support institutions and market actors. SEBRAE's role is highlighted here for the several positive correlations with type of entrepreneur, professional background, type of market, source of finance, R&D-intensity of the first product or service, and diversity of CLEs.

5.3 The five typical pathways

Since the attempts described above, based on *a priori* categories that are commonplace in the literature to explain industrial development and the growth of firms, could not provide a substantive argument for the evolution of business start-ups, a deeply qualitative and inductive strategy was adopted to reanalyse all interviews. Hence, grounded theory principles provided the methodological solution to investigate these evolutionary processes. This section describes how grounded theory principles led to the identification of patterns between individual firms' pathways. It explains how five typical pathways emerged from this analysis and characterizes them in-depth.

Grounded theory principles

Strauss and Corbin (1998) claim that grounded theory is a strategy to identify, inductively, building blocks of theory. They present a series of techniques to identify categories and their general properties and dimensions. Properties differentiate between classes of events and disclose variations within a range, allowing differentiation within classes. A precursor analysis to theorizing is defining concepts in terms of their specific properties and dimensions. These authors call this phase 'conceptual ordering' and, from its three possible types, this study applied the ordering of data in steps, guided by the sequence of the narratives and with the analytical framework in the background. Although this section describes properties and dimensions of pathways that characterize the evolution of

business start-ups, it is out of the scope of this study to construct a theory that explains the evolutionary processes of these businesses beyond CLEs.

Since the research was not designed to be exclusively empirically-driven, analyses of the interviews, in this phase, were anchored in codes for critical learning episodes, networking dynamics, etc. (Appendix 5). These were delimited by their chronological position in relation to other CLEs and their duration (when the episode started and when it ended). Hence, stories of the relationships between these CLEs took a central position in this round of analysis. Therefore, grounded theory principles were applied to investigate relationships between CLEs instead of intra-CLE dynamics.

A new set of tentative aggregating variables was investigated in each interview:

- Relationships between CLEs – instead of sequence
- Drivers or guiding principles of the business start-up
- Entrepreneurial formation and attitude
- Entrepreneurial experience and experience in the field
- Scope of the target market
- Value chain insertion
- Use of resources
- Sources of resources in the firm pathway
- Initial and 'current' networks
- Sector specific issues
- Growth perspective
- Degree of innovation

None of these variables seemed to differentiate groups of start-ups, but, from this systematic investigation, another factor that could possibly disclose pathways emerged: the raison d'être of the business. By 'raison d'être' one can understand the core purpose of the entrepreneur when he or she decided to start a new business; i.e., to develop machines, to provide services to sector A, etc. It was observed that the use of resources was, at times, directed to the needs of this core product or service, pointing out that the initial idea continued to be at the centre of the business. However, at times, the use of resources was directed to secondary activi-

ties, which were developed to secure the survival of the business, but which affected the development of the core product or service in different ways. This raised the following question: Would these configurations of resources shape pathways according to the focus on core *versus* secondary products or services?

To answer this question, each CLE was codified as a core or secondary product or service, based on the target for which resources in that episode were being acquired, created and transformed. As the analysis progressed, differences between these secondary products or services were observed. These differences were based on the extent in which the resource-base[2] of these secondary products or services overlapped with the resource-base of the core. This differentiation resulted in a subcategorization of secondary products or services, as follows:

- **Complementary**: the resource-base of the secondary product or service complementary to the core one. Hence, the secondary product paves the way for the core product enter the market. As defined by Wernerfelt (1984, 175), complementary resources are those that "combine effectively with those you already have". An example is Firm 31. Its core product is entertainment games aimed at the international market. The development of these games requires at least a team of experts in management, programming, artwork, and content-(specific to each game). Access to the market is through sales representatives, who link small-scale developers to multinationals in the game industry. Since this market demands high standards, the team of entrepreneurs needed R&D grants to hire the expertise needed to form a team. The complementary product is an educational game for language teaching, aimed at the local market. The same expertise in management, programming, artwork, and content is required. However, market relations take place at the local level and games are much more customized in comparison to the scenario for the core product;
- **Independent**: while the core product or service is being developed, secondary products or services are in place in the form of spin-offs. For this group, the resource-base of the secondary product or service is independent from the resource-base of the core. An example is Firm36. Its core product is equipment for the early diagnosis of deafness, which requires R&D for the development of the prototype, then investment capital to develop the product, test it, certify it, and finally to start producing it. The resource-base requires up-to-date

knowledge in medical engineering, licenses and certifications, (future) partnerships for a shop floor, and networks in the audiometric equipment industry. The secondary product, created to generate income, is the provision of a technology course (micro-controlled systems), which material is available for online purchase. The main partners are the university, for use of the auditorium, and the business incubator, for mediating this partnership. This secondary product is a spin-off that runs independently from the core business and counts on a rudimentary board of directors to coordinate the management of the two start-ups;

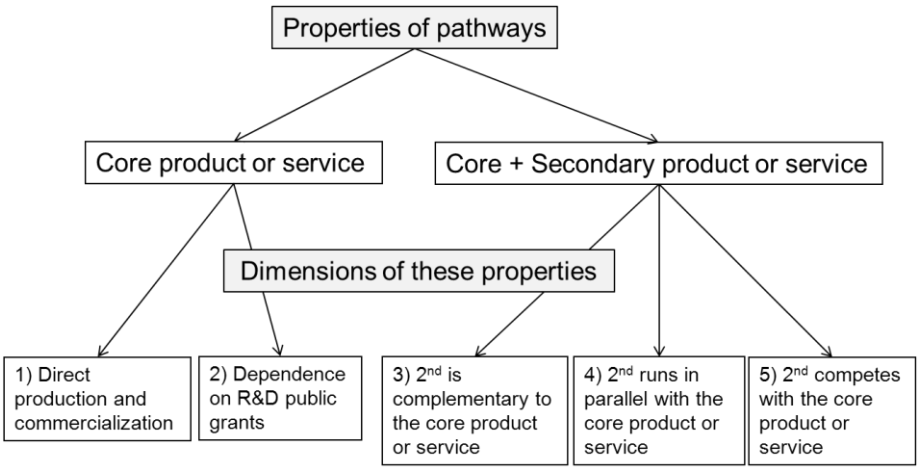
- **Competing**: the secondary product or service competes for the resource-base of the core. The former uses up these resources and hinders, or completely takes over, the possibility to develop the core product or service. An example is Firm37. Its core was the production of open source software, for which expertise and time for development are the most important pre-conditions. However, several difficulties to generate working capital led the start-up to becoming a temporary service provider in short-term projects. One of these projects, mediated by the business incubator, combined open source with software testing. This was the entry point for a business opportunity with a big buyer in the software testing market. The demand increased so rapidly that the workload of most employees and interns became dedicated to this one client. Once in this market, the team of associates started to broaden the resource-base in software testing; they identified other opportunities, built specific networks, and started specializing in a sub-niche through vertical integration and an R&D project to develop the start-up's own methodology of software testing. Clearly, the resource-bases of core and secondary products and services became incompatible, and the latter took over the position of the former.

CLEs whose resources were targeted to secondary products or services were re-categorized following this typology. As a result, business start-ups could be aggregated in five pathways that reflect these sets of resources and uses made by entrepreneurs. The final step was identifying the emergent properties of these five dimensions. This resulted in two main properties of these pathways: full dedication of the resource-base to the core product or service (65% of the cases), and shared dedication of the resource-base to a combination of core and secondary products or

services (35% of the cases). It is noteworthy that these properties were not obvious at the beginning, especially because the same property of exclusive dedication to the core product or service would aggregate both traditional and technological businesses. The resulting structure of pathways is shown in Figure 5.3 (this figure is unfolded in Appendix 11, showing which cases belong to each category).

The next step was to characterize each typical pathway based on a set of features related to the CLEs, the start-ups and their value chains, the entrepreneurs, and the configurations of resources.

Figure 5.3
Structure of pathways



Initial and current conditions

Initial conditions refer to initial resources, available to the entrepreneur when the business was set up (Box 5.1). Current conditions refer to the status of these and other resources by the time of the interview (Box 5.2). These conditions are a set of more or less stable variables that supported the interpretation of the typical pathways. Some of them were compared over time, as indicated in Box 5.2.

Box 5.1
Initial conditions

Entrepreneurial formation: previous education- this was reported as influential when making the decision to start a business instead of becoming an employee.
Entrepreneurial experience and **experience in the field**: these are indicators of previous knowledge on how to start a business (even if in a different field) and of experience in the field of the start-up, not necessarily as entrepreneur. This information provides hints about a baseline of competences.
Guiding principles, or **drivers:** five categories were found: entrepreneurial opportunity (identification of a business opportunity), technological development (transforming top level technology into marketable products), investment for life (retirement, personal dream), market trends (market forces towards entrepreneurship), and return to society investments (public universities and research centres). These guiding principles are not assumed to be exclusive or fixed[3].
Entrepreneurial attitude: how entrepreneurs perceive risks and difficulties, market dynamics, and their capacities to cope with challenges, such as CLEs. It also considered whether the entrepreneurs started the business on their own initiative (pull-entrepreneur) or as a result of other actors (push-entrepreneur).
Value chain insertion: this is a proxy for the position of start-ups as price-takers or price-makers and for the extent to which the start-up has the power to articulate with other actors, *versus* being in the hands of chain leaders. It does not entail any value chain analysis, but benefits from that perspective to understand relationships between the focal start-ups and market actors linked to its activities. This is a useful tool to understand, for instance, barriers to entry imposed by strong competition, the power of bigger players in establishing regulatory frameworks, and the establishment of partnerships to overcome limitations of size and scope.
Size of the market: refers to the expected or estimated size of the market at the beginning of the business. It is divided into four levels: local, regional, national, and international. When the start-up acts in different markets, information about each product or service is provided.
Initial financial resources: refers to any initial sources of finance, rather than to amounts available for investment in the business. Different types of financial resources include loans from friends, R&D grants, economic support to start the business (e.g.: donation or lending of equipment).
Initial network: measured by the number of actors (size) and the richness of resources transacted (diversity of actors is expected to impact on the diversity of resources).

Box 5.2
Current conditions

Guiding principles: have the initial guiding principle(s) changed since the beginning? Results showed that these drivers are rather stable and tend to remain the same in the first years for most of the start-ups studied.
Entrepreneurial attitude: has it changed since the beginning? Results showed some refinement of entrepreneurial attitudes for most of the cases, with more references to market dynamics in how they position themselves and the business.
Size of the market: may have changed after the start-up entered the market, because of changes in products or services, creation of new products and services aimed at different target markets, and as an result of exogenous factors on the size of the start-up's market. Moreover, the initial perceived size of the market was based more on the entrepreneurs' expectations whereas in current conditions, the size of the market refers to actual exchanges with buyers.
Value chain insertion: value chain insertion may change with the evolution of the start-up's products or services. In addition to that, insertion in a value chain may result in changes in the start-up's networks, by bringing in intermediaries or by creating shortcuts to reach consumers. Also here, there are differences between what entrepreneurs expected at the beginning and the actual insertion in the value chain after a couple of years.
Current network configuration: qualitative comparisons between the initial and the current networks. Results show expansion toward market actors, indicating an expansion of the available and potential sources of resources. These comparisons also disclose networks' dynamics of embeddedness in the market.
Sector-specific issues: general information about the start-up's sector of activity and its impacts on the evolution of the start-up, reported by the entrepreneurs. Sector dynamics provide insights into competition and potential for cooperation to business start-ups.
Growth perspective: growth indicators narrated by the entrepreneur and expectations for future growth. Data varies from growth estimations to actual growth rates. It also includes qualitative indicators of growth processes, such as negotiations for partnerships with bigger enterprises, offers for merging etc.
Degree of innovation: following the OECD (2005) definition of less vs. high R&D-intensive activities and industries.

Pathway 1: Direct product of the core product or service

In this pathway, entrepreneurs could directly manufacture the core product or provide the service, without needing to develop secondary ones. This is a linear model of start-up development and aggregates at 53,5% of the cases. These start-ups report on average up to three CLEs in the first three years (s.d=1,53). Only two start-ups in this group, both

in the clothing sector, reported more than five CLEs in the first three years (Firm07 and Firm15).

The most frequent types of episodes here are related to entering or surviving in the market (36,1%). Eleven cases (47,8%) did not report any critical learning episodes related to production, of which eight already had professional experience in the same type of activity. This result indicates that the entrepreneur's expertise provided the firm with internal capacity to deal with production issues, and this affected the perception of criticality about events of this type. Nevertheless, experienced entrepreneurs also report CLEs triggered by production issues. These episodes were about, for instance, the high turnover of employees, regulation issues, and access to technology, indicating that professional experience alone is not enough to dilute the criticality of external factors stemming from competitors, regulatory frameworks, and technological limitations.

Most of the business start-ups included here develop low R&D-intensive products or services (n=20), the markets for which have established institutions. In general, low R&D-intensive start-ups can begin directly producing and commercializing their core outputs more easily than high R&D-intensive start-ups if one considers that the technology for production is accessible, suppliers and buyers are in the market, and marketing strategies are well-known. In consequence, the entrepreneurs' main challenges are raising investment capital, finding suppliers, developing managerial competences and reaching out to buyers. At the start-up's level, the main tasks can be summarized as establishing the production unit, producing and selling. This apparently simple linearity, however, should not obfuscate the difficulties faced by these businesses, as demonstrated by the critical learning episodes in this pathway.

For his commonly assumed path, an unexpected result is the presence of three high R&D-intensive start-ups, all developing biotechnology-based products or services. This is explained by the characteristics of these cases. Two of them (Firm24 and Firm25) are service providers to big companies in similar markets as the start-ups' (biotechnological tests for medicines and cosmetics, and technology for pharmaceutical companies, respectively) and one (Firm35) is a small scale manufacturer of inputs for academic research. The founders of all three start-ups had suppliers and buyers in their initial networks. These networks facilitated the acquisition of inputs from suppliers and the realisation of the first sales

to enter the market. All of them are researchers in their business area and continue relying on their university-based networks to access innovation and to establish partnerships for R&D. These cases strengthen the argument that, for both low and high R&D-intensive start-ups, access to an established institutional arrangement is a facilitating scenario for nascent businesses to enter the market directly with their core product.

A complete figure of the evolution of business start-ups in Pathway 1 combines entrepreneurial competences (for instance, in production processes), with an institutional setting where market actors are already operating, and where the entrepreneurs have been connected to these actors since the beginning. In sum, the two key variables to facilitate this evolutionary path is the possession of technology for production and the embeddedness in specific market and institutional networks. The specificity of these networks is inherent to the resource-base required by the core product or service.

In relation to initial and current conditions, a great majority of these start-ups are driven by entrepreneurial opportunity (n=13) or because entrepreneurship is seen as a life-long investment (n=8). In general, the interviewees had no entrepreneurial experience (n=18). The other five cases are distributed as follows: one interviewee had previous, failed entrepreneurial endeavours (Firm06), two had started businesses in the same field of the start-up but with different products (Firm38 and Firm40), and two had entrepreneurial experience in a different field (Firm01 and Firm04). The market size varied from local, to regional, and national, reaching the international market, indicating that the scope of the market might not influence this pathway. In relation to strategies to reach out to buyers, 12 enterprises did direct sales, six combined direct and indirect sales through sales representatives (Firm35, Firm04, Firm13, Firm06, Firm09, Firm26) or through business partnerships (Firm01), three, who currently only sell through sales representatives, started by direct sales when the scope of the business was smaller (Firm33, Firm07, Firm15), and one depended on wholesalers (Firm11) who kept close control on the quality and price of the product.

The evolution of the networks from the beginning of the business up till the time of the interview showed an expansion towards business-driven ties. All of the businesses reported business actors in their networks by the time of the interview. Fifteen entrepreneurs (65,2%) reported business actors in their initial networks with varying strengths of

ties (Firm03, Firm28, Firm24, Firm12, Firm11, Firm25, Firm04, Firm05, Firm41, Firm13, Firm06, Firm38, Firm07, Firm15, and Firm01). For some, these were kinship relations within the field of the start-up; for others, they were friends who owned small enterprises in different fields; and for others these actors were part of their professional networks in previous jobs. These latter actors included initial networks of suppliers or buyers. One interesting result is the presence of the local government in the current network of three business start-ups (Firm03, Firm35, and Firm12). For the first one, the government occupies the position of buyer in the network; for the other two, the local government plays the role of support institution, by providing resources (i.e., terrain, building) for the installation of the production plant after the business incubation programme. Cases in this pathway are illustrated in Appendix 9.

The results in this section lead to the following proposition:

Proposition 7a. The linear evolution of business start-ups is rooted in the possession of product technology and embeddedness in resource-specific networks.

Proposition 7b. Experience in the field, access to technology, and a favourable institutional environment are the greatest facilitators of the linear evolution of business start-ups (Pathway 1). This proposition is partly supported by the literature on innovation and social capital, which claims that relational embeddedness is linked to access to institutions that facilitate the establishment of the business and its insertion in the market (Xu 2011).

Pathway 2: Dependence on investment capital to develop the core product, without secondary products

The second pathway, the specific cases of which are illustrated in Appendix 9, is characterized by high R&D-intensive start-ups – two in the biotechnology sector, two in information and communication, and one in manufacturing of chemical products – which fully depend on investment capital, mainly public R&D grants, to develop the core business. Other products or services, when eventually developed, are not marketed, since the whole resource-base is directed at R&D. In fact, after four or more years of investments, these start-ups had not entered the market at all, which is a key feature of this pathway. Only Firm17 briefly mentioned a possibility of entering the market with by-products generated from the technological platform they produced. However, this start-up

had been active for five years and this first insertion in the market still appears as a vague possibility.

Critical learning episodes typically take place in the first two years of the start-up, when applications to governmental R&D grants are elaborated and the internal structure of the firm is built. Production-related triggers, mainly access to investment capital, are the most resource-demanding, representing 42,1% of all CLEs in this typical pathway. As expected, CLEs of entering or surviving in the market are rare (only one occurrence, corresponding to 5,3%). The average number of CLEs in the first three years is three (s.d. = 1,02), similar to Pathway 1.

Start-ups in this pathway are driven mostly by technological development, which may later change to entrepreneurial opportunity after years of struggles to establish the initial business idea. This long period before the main motivation for the business changes is explained, in this typical pathway, by the attachment to the core product, which prevents the expansion of the resource-base towards alternative entrepreneurial opportunities. These interviewees had no entrepreneurial experience but had years of working experience in the field of the start-up, as employees or researchers. All of them aimed at the national market and two (Firm20 and Firm17) saw potential for internationalization. Their possible insertion in a value chain was not clear, since none had entered the market by the time of the interview and had no clear ideas about how to do it.

In terms of their networks, they started well connected to academic actors, such as the university, and two were also connected to business incubation actors. Their networks expanded, but to a lesser extent than in other pathways, towards market actors. Their current networks are still very much embedded in the university circle, including entrepreneurs who graduated from the same university. Firm17 is exceptional in its connections with a nationwide network of resourceful actors in the biotechnological sector; and Firm21 is exceptional for having all technological expertise in-house. The latter does not depend on the university for technology, since the entrepreneur has the technological expertise, more than 20 years of professional experience in that type of product, and the market networks from his previous jobs. Nevertheless, the development of the innovative product, totally funded with governmental R&D grants and without the commercialization of by-products, characterizes this start-up in Pathway 2.

Results for this pathway challenge the literature on embeddedness and innovation, which claims that embeddedness in homogeneous networks relates to imitation, and embeddedness in heterogeneous networks relates to less standardized routines and higher levels of innovation. As discussed here, Pathway 2 combines the characteristics of being the only one formed exclusively by high technology-driven start-ups and, at the same time, as having the most homogeneous and less changing networks, formed mainly by universities and research institutes. These networks show higher density, trust, coordination and task specialization, resulting in a higher intensity of technological information sharing (Granovetter 1985, Xu 2011).

Proposition 8a. Dynamics of networks in Pathway 2 favour embeddedness and homogeneity with technology centres for technological development.

Proposition 8b. Exclusive dependence on R&D grants affects the pace of product development negatively due to the long time spent on procedures and the consequent delayed contact with the market.

Pathway 3: Secondary product as means to enter the market while the core one is developed

The third pathway is composed of business start-ups that entered the market with a secondary product or service while the core product was being developed (illustrative diagrams in Appendix 9). The resource-base of the secondary product or service is similar to the core one (i.e., type of technology, inputs for production etc.), so that entering the market with this secondary product corresponds with establishing business networks with those who will be the suppliers, buyers, or other actors for the core product too. Cases here demonstrate that this is an interesting strategy for quicker income generation and network building that paves the way to the core product. The average number of CLEs in the first three years is 5 (s.d.=2,56).

Overall, the most frequent types of episodes are related to production (34,4%), and entering and surviving in the market (34,4%). Dynamics in this pathway comparing core and secondary product or service show that while for some of the cases episodes are scattered over years (Firm43 and Firm10), for others there is an avalanche of simultaneous episodes starting in the first two years (Firm31 and Firm34). The latter corroborates the literature about the fragility of business start-ups in the first two

years (e.g., Cressy 2008 [2006]). In addition to this, these episodes focus on core and secondary products or services, predominantly in relation to production issues. This result indicates that the resource-base for both core and secondary products is developed simultaneously.

Entrepreneurs report that the move towards a secondary product is driven by three key factors: the need to use up working and investment capitals (Firm32 and Firm43), business opportunity (Firm32, Firm31 and Firm23), and guidance by business incubator consultants about alternative strategies (Firm10). An exception is Firm34, which adopts a strong managerial perspective on the structuration of the start-up, in consonance with the business management background of this entrepreneur.

One important result of this pathway is that the secondary product is not necessarily successful. For instance, Firm32 was approached by a venture capitalist with whom the entrepreneurs spent months working on business plans, market research and prototyping for a secondary product. When they realised that there would not be a market for that innovation, the partnership was dissolved and the entrepreneur resumed the development of the core product. Nevertheless, the resource-base had been broadened by knowledge about alternative strategies of product development and marketing.

Three of these six start-ups develop core products or services that are high R&D-intensive; whereas four develop secondary products or services that are high R&D-intensive. The main factor influencing the level of R&D is the drive leading to this secondary product. The four high R&D-intensive cases are those in which the secondary product resulted from a business opportunity, sometimes combined with access to investment capital.

The characteristics of the initial and current contexts showed that three start-ups were driven by investment for life (Firm23, Firm31 and Firm34), two by entrepreneurial opportunity (Firm32 and Firm10), and one was driven by technological development (Firm43). None of the cases had had entrepreneurial experiences, although three of them counted on role models from within the family (Firm10 and Firm31) or from other entrepreneurs (Firm34). In relation to market coverage, each case described different insertions in their value chains, depending on the type of product. Four of them tackled the regional and national markets. Firm43 was the only one with potential for internationalization of

the core product, but provided services at the regional level while this core product was being developed.

The initial networks of three cases are characterized by academic actors, such as universities, former university colleagues, researchers, and so forth (Firm43, Firm32, and Firm31). Three already counted on some support institutions in their initial networks (Firm32, Firm31, and Firm34), or with some degree of business expertise from family members (Firm10 and Firm31).

Few market actors, such as other incubatees, were indicated in the initial networks of three cases (Firm32, Firm10, and Firm34). The current networks, however, indicate an increased presence of support institutions and business-related actors, especially other incubatees. Relationships with other incubatees are very diverse. For three cases (Firm43, Firm31, Firm34), they are a source of information about markets, management, and solutions to common problems in the business. Two cases (Firm32 and Firm10) reported incubatees or graduated start-ups as business partners in the development of combined products and the creation of spin-off projects. One case (Firm32) had other incubatees as buyers. Another crucial actor in the current networks of two cases (Firm31 and Firm34) is private investors. In one case the access to investors was liaised by the business incubator, whilst in the other investors were attracted by the product, when it was launched in the market. Public investors, such as governmental agencies for scientific and technological research, are also present for the development of high R&D-intensive products. It is noteworthy that both private and public investments focus on the core product.

Based on these results, the following proposition is drawn:

Proposition 9a. Similarity between the resource-bases of core and secondary products and services favours the concomitant development of multiple products, and the generation of working capital, investment capital, business networks and internal expertise within a specific technological platform.

Proposition 9b. Secondary products or services will be more value adding if created out of a business opportunity.

Pathway 4: Independent or complementary products or services that become spin-offs with parallel administrative structures

The fourth pathway is characterized by the development of independent or complementary products or services that become spin-offs of the core business with their own administrative structure. These parallel structures create a situation of relatively independent businesses, almost as if there were two core products or services. Nevertheless, there is always one product or service that is regarded by the entrepreneur as the core. The surge of these spin-offs relates to the identification of a business opportunity beyond the scope of the first business (Firm30, Firm29, Firm19, and Firm22), or to the need to generate working capital while the core product is being developed (Firm36 and Firm02). Similar to the results of Pathway 3, three of the spin-offs driven by business opportunities are high R&D-intensive (Firm30, Firm29 and Firm19), whereas the others, together with those driven by needing to generate working capital, are low R&D-intensive. In terms of numbers, the average number of CLEs in the first three years is 5 (s.d.=1,21).

Many features differentiate Pathway 4 from the other pathways related to developing secondary products or services. The first and most important is that both core and spin-off businesses in Pathway 4 have distinct resource-bases, so they run in parallel. This implies independent needs, which are dealt with through relatively independent business structures. These parallel administrative structures are based on partnerships with other enterprises (Firm29, Firm02, Firm19, and Firm22) or on the internal reorganization of tasks within the team of associates (Firm30 and Firm36). Both strategies distribute the internal managerial resources in a way that allows focussing on the core business and on smaller efforts to run the spin-off. The second distinctive feature is that the spin-off product does not take as many resources as the core one, in contrast to that observed in Pathway 3.

The third distinctive feature is that, in Pathway 4, the secondary product is not meant to be discontinued once the core one is introduced on the market. Since the resource-base of core and secondary products or services is so different, the growth perspective for many of the entrepreneurs in this group depends completely detaching one business from the other (Firm30, Firm29, Firm36, and Firm02), with independent legal identities, market niches, institutional settings, and so on. This is already the case for half of them (Firm30, Firm19, and Firm22). For Firm19, the

first business became an R&D enterprise that supplies the spin-off, dedicated to bridging basic research to market products. There is no pattern in the distribution of CLEs, but it is clear that the core product takes most of the start-ups' efforts. In general, episodes triggered by needing to enter or survive in the market are the most common (55,6%), followed by episodes of production (19,4%).

In relation to contextual factors, guiding principles differ amongst the entrepreneurs, from entrepreneurial opportunity, to investment for life, technological development, and returning to society its investment in research. It is noteworthy that after the success of the first business, the guiding principle for the development of by-products or for the creation of the spin-off changes to entrepreneurial opportunity. These entrepreneurs seem to have learned during the first years that their initial drivers can only be achieved if there is a market opportunity for their business ideas. Therefore, they start combining their interests with the identification of these opportunities. The entrepreneurs share the characteristic that none had entrepreneurial experience, but had expertise in the field either as customers, employees, or researchers (except in Firm22). This previous contact and knowledge about the field was crucial in determining the type of business for underlying the entrepreneurs' interests. The initial finances for most cases originated from sales of the start-up's products or services. Most cases (Firm29, Firm36, Firm19, and Firm22) aim at the national markets, but have potential or are already starting some international activities. Apart from Firm22, these are all high R&D-intensive start-ups.

A comparison between the initial and current networks shows expansion towards market actors for all of start-ups. Entrepreneurs working on high R&D-intensive activities had initial networks with universities and research centres, while the others had initial networks with family or friends, other entrepreneurs and support institutions such as business incubators or SEBRAE. The current networks systematically show the presence of business partners, support institutions or knowledgeable persons for advice, and of investors, enabling start-ups to develop high R&D-intensive core products and a spin-off. Incubated and graduated start-ups again figure in the current networks, as buyers (Firm30), business partners (Firm29), or informal advisers (Firm36). Details of these cases are found in Appendix 9.

This pathway corroborates the literature that illustrates the important role of inter-firm cooperation for the reduction of transaction costs and the expansion of a firm's boundaries through reduced knowledge transmission costs (e.g., Pfeffer, Salancik 1978, Foss 1999). Moreover, formal interdependence between firms reduces uncertainty about resource acquisition, production practices, and marketing of outputs (e.g., Casciaro, Piskorski 2005). In this pathway, partnerships are key to capitalizing on a partner's resources in order to expand the resource-base of each start-up. This makes possible the development of products and services that one start-up alone cannot manage. Despite increased interdependence in relation to the spin-off, this arrangement allows the concomitant development of the core product or service, which tends to be more firm-specific and tacit, impacting on the competitive advantage of firms (e.g., Eisenhardt, Martin 2000). Thus, Pathway 4 leads to the following proposition:

Proposition 10a. The concomitant development of core and secondary products and services with different resource-bases is possible through business partnerships to create spin-offs.

Proposition 10b. Whereas inter-firm spin-offs increase interdependence between firms, these spin-offs allow each start-up to develop its core product or service independently.

Proposition 10c. Inter-firm spin-offs tend to develop high R&D-intensive products and services if the creation of the spin-off is driven by a business opportunity.

Pathway 5: Secondary product becomes the core business or competes with its development

This last category of pathway is characterized by the development of a secondary product or service, the resource-base of which is so different to the core that it becomes the core product or service, or competes with its development. This pathway differs from the others by the higher average number of CLEs in the first three years (mean=6; s.d.=0,47), and for the parallel efforts to develop two incompatible resource-bases. CLEs are not concentrated in one year, but they are spread over the first three to five years (see Appendix 9 for illustrations).

The most frequent types of CLEs are production issues (34,8%) and entering and surviving in the market (26,1%), always for the secondary product. Despite these similarities, the three cases in this category are

very different from each other in their individual pathways. Firm27 and Firm 42 developed secondary services to generate working capital; necessary once the entrepreneurs became aware of the costs and time required to develop the core product. Thus developing a resource-base for the secondary product or service diverted focus, time and effort from the resource-base of the core product. This, in consequence, had an impact on the identity of these firms. Firm37, on the other hand, was under pressure from the incubator to define its focus and swiftly changed to a new market niche, following a business opportunity liaised by the incubator. This start-up started specializing in this niche, reshaping the identity of the firm. This new resource-base allowed the start-up to overcome its internal financial crisis, although it became dependent on one big buyer. Two cases in this pathway develop less R&D-intensive services and one, Firm27, developed a core project which was high-R&D-intensive.

The initial and current conditions of these cases show that all three were pull-entrepreneurs, driven by principles of entrepreneurial opportunity (Firm27 and Firm 42) or by a mix of drivers (Firm37). None of them had entrepreneurial experience, since they started their businesses just after concluding their undergraduate or graduate studies. However, one case (Firm37) saw in his parents entrepreneurial role models. Each start-up had different market coverage, from local to regional and international levels. In terms of value chain positioning, two were outsourcers and one was a supplier to big companies. This subordinate position in the chain is illustrated by Firm27, whose product disappeared in favour of the partner's brand, who does the commercialization of the product. The initial networks of all three firms included academic actors, the business incubator, and other local SMEs in the sector. They expanded towards business actors, other SMEs, business partners, buyers, suppliers, and investors (Firm42).

The dynamics of this pathway, as shown in the literature, provide a counter-example of the net balance between selection and adding things up as discussed by Bataglia and Meirelles (2009). According to these authors, this balance reduces learning costs for firms, since adaptation is considered a smoother process when compared to the selection of organizational routines. This argument provides a possible explanation for the nearly impossible task of resuming the development of the core business, if this turns out to be more value-adding. Routines to pursue

the secondary product require a resource-base that is so discrepant to the one required by the core product that human, financial, managerial, infrastructural and other costs to resume the development of the core product become unbearable. The following proposition derives from Pathway 5:

Proposition 11a. Incompatible resource-bases between core and secondary products or services will result in the replacement of the core for the secondary, which tends to be less R&D-intensive – even when the core was already a low R&D-intensive product.

Proposition 11b. The costs of learning routines of incompatible resource-bases cannot be borne by business start-ups.

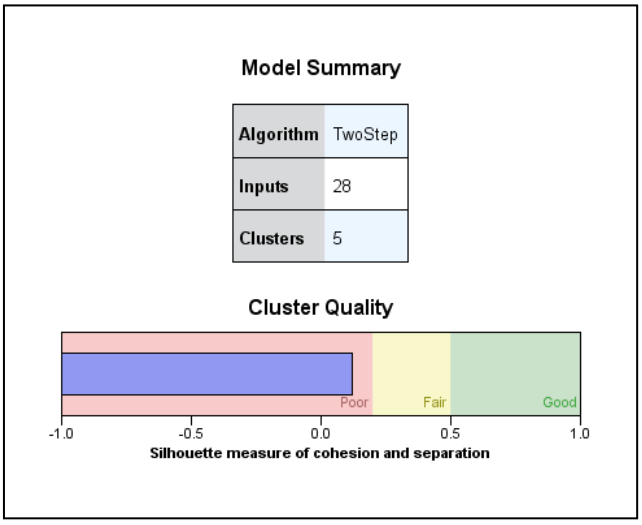
Statistical clustering

A two-step cluster analysis was conducted in SPSS (IBM Corp. Released 2011) to cross-validate the qualitative aggregation of cases in typical pathways. Results show five clusters, the first one with 30% of the cases, the second with 22,2%, the third with 17,4%, the fourth with 16,4%, and the fifth with 14% of the cases. The measure for cluster quality indicates a poor model fit (Figure 5.4), possibly explained by the high number of inputs (n=28 variables), the small number of cases (n=207 CLEs), and the low variance of some inputs and dummy variables. These variables are: type of industrial activity, type of market (SNA), professional background, educational level, type of entrepreneur, entrepreneurial experience, type of CLE (five categories), learning strategies (separately: intrinsic reflection, extrinsic reflection, help-seeking in written material, interpersonal/inter-organizational help-seeking, and practical application), new *vs.* established market *vs.* survival in the market, type of resource use, R&D-intensity of the first product, focus of the CLE, market coverage (from local to international), entrepreneurial role model, entrepreneurial education, time in operation, diversity of CLEs, year of operation in which the CLE started, duration of the CLE, diversity of initial financial resources, sum of learning strategies, and initial networks.

The five main variables for the overall clustering are: professional background, educational level, previous entrepreneurial experience, entrepreneurial role models, and R&D-intensity. The relative weight of each predictor varies per cluster, although professional background remains amongst the top three predictors. A table with the details per cluster is found in Appendix 10. The cross-tabulation between these five

clusters and the five typical pathways shows significant chi-square values (X^2 (168, n=207) = 821,02, p< 0,01) and a clear distinction between high and low R&D-intensive activities in Clusters 1 and 3, respectively. Appendix 10 presents the table of predictors per cluster. Given the poor fit of this clustering and the low discrimination between sets of categories, the comparisons that follow consider the result of the grounded theory clustering.

Figure 5.4
Model fit of two-cluster analysis for pathways



Comparative analysis between pathways

This section examines differences and commonalities between the five pathways. It starts by comparing the focus of resource configurations and production (Table 5.2). One important aspect is that most of these businesses produce families of products, that is, they diversify products within the same technological platform (i.e., different types and shapes of scissors for different surgical uses), but this diversification does not represent completely new innovations or new production lines based on a different resource-base. Therefore, the two distinctive categories of core and secondary products are kept, with 'secondary' representing new sets of production outputs that require another resource-base.

Table 5.2
Typical pathways per focus of the resource-base and production

		Main resource-base	
		Core	*Secondary*
Focus of production	*Core*	Pathway 1	
	Secondary	Pathway 3	Pathway 5
	Both	Pathway 4	
	No production	Pathway 2	

Next, Table 5.3 summarizes information about number of start-ups, and the characteristics of CLEs and R&D-intensity for core and secondary product or service per pathway. Results show that, even considering the first five years, most CLEs start between the first and the third years, with average durations ranging from one to two years. This corresponds to the 'valley of death' in the first two years of business start-ups (e.g., Cressy 2008 [2006]), during which these firms are more unstable. This 'valley of death' seems to be larger in Pathway 5 due to the considerable number of CLEs starting in the third year, the higher range of CLEs, and the higher average number of CLEs. Note that, across pathways, management-related triggers do not figure in the most common types of critical learning episodes. This result corroborates the role of the acquisition of managerial competences as strategy to cope with triggers to CLEs described in Chapter 4, rather than as triggers per se.

The description of these differences between pathways raises the question of how they develop, or rather, what are the factors driving a start-up to one or another pathway. For Pathways 1 and 2, the answer is more obvious and guided by the institutional settings in which these businesses are embedded. As discussed in Pathway 1, access to market actors brought together start-ups producing low and high R&D-intensive businesses for the direct production and commercialization of the core product or service. In Pathway 2, the close connections with academic actors kept these entrepreneurs dependent on public R&D grants for the development of their R&D-intensive activities while entering the market remained a secondary aim of the business.

Table 5.3
Summary of key characteristics

	Pathways				
	1	***2***	***3***	***4***	***5***
Number of start-ups	23	5	6	6	3
Range of CLEs	2-8	3-5	3-9	5-8	6-11
Number of CLEs (5y/total)	83/97	18/19	29/32	29/36	21/23
Average (s.d.) number of CLEs (X^2 (32, n=207) = 281,51, p< 0,01)					
	4,98 (1,96)	4,05 (1,03)	6,13 (2,12)	6,22 (1,22)	8,39 (2,55)
Critical year* (X^2 (28, n=207) = 59,28, p< 0,01)					
	2nd	2nd	2nd	1st	3rd
Mean (s.d.) duration of CLEs (in years)** (X^2 (20, n=122) = 32,28, p< 0,05)					
	1,31 (1,40)	1,56 (1,01)	1,84 (1,21)	1,67 (1,50)	1,07 (0,88)
Common type of CLE***	Entry/ Survival in the market	Prod.; Entre-preneur	Prod.; Entry/ Survival in the market	Entry/ Survival in the market	Produc-tion
R&D-intensity (core product) (X^2 (4, n=43) = 15,37, p< 0,01)					
	3 High 20 Low	5 High	3 High 3 Low	3 High 3 Low	1 High 2 Low
R&D-intensity (secondary product) (X^2 (8, n=43) = 41,70, p< 0,01)					
	-	-	4 High 2 Low	3 High 3 Low	3 Low

*Year in which the highest number of CLEs started. **It excludes CLEs in progress (N=67); X^2 calculated only for the first 5 years. *** Larger than 30% of the CLEs in the first 5 years.

For the other pathways, results showed the multiple influences of combinations of needing working and investment capital with business opportunities to drive the development of secondary products and services. In addition to this, the choice for a specific type of product or service is explained by entrepreneurial capabilities, intra-firm resources, and the possibility of cooperation with other firms. Business opportunities are crucial to stimulate the development of high R&D-intensive products and services. The level of alertness to these opportunities can be in-

creased by business incubators' consultants, venture capitalists, buyers, and competitors. Moreover, entrepreneurs envisage business opportunities through technological innovation, during the development of the core product or service, and through the identification of market niches and contact with market actors. Implications of these findings are discussed in Chapter 6.

5.4 Pathways and individual factors

This section compares pathways on the basis of two individual factors: entrepreneurial characteristics and learning strategies.

Pathways and entrepreneurial characteristics

Three entrepreneurial characteristics are discussed here: work experience, entrepreneurial experience, and the motivation to start the business. Work experience seems to be associated to a lower frequency of production-related triggers in CLEs and pathways, given the predominance of experienced entrepreneurs in Pathway 1. This is explained by the role of this human capital factor on equipping entrepreneurs with knowledge about the industry, production methods and processes, and with business and expertise networks (e.g., Nichter, Goldmark 2005, Gelderen, Thurik et al. 2006). Nevertheless, work experience does not prevent the criticality imposed by exogenous factors, which are beyond the control of the entrepreneur, such as high turnover of employees for better offers in the market, regulation requirements, and factors dependent on strategic networking, such as access to technology. Conversely, lack of work experience was positively correlated to longer sequences and higher diversity of types of critical learning episodes. Firm37, the one with the longest sequence of CLEs, reports that

> Now I believe that the entrepreneur that will be more successful is the one that works in the market for a while, for he can understand what he is working on, he sees an opportunity in what he is already working on, then leaves to start his own business. Why? First, he will already have a network of contacts formed. Second, he will already master the business. And third, he already understands. Depending [on the case] he will already leave with a big client, the enterprise in which he was working. I think this scenario is like this; for us it was not. We had a lot of difficulties because we did not follow this line (§057).

Entrepreneurial experience is another factor that brings outcomes of previous learning to the new business (Gelderen, Thurik et al. 2006). All pathways but Pathway 5 included entrepreneurs with and without entrepreneurial experience. This previous expertise can be potentially exploited in the new start-up, ensuring entrepreneurs are aware of threats inherent to the start-up period, and alerting them to business opportunities in their own or other sectors. However, previous entrepreneurial experience was reported only by seven entrepreneurs (16%). A proxy for entrepreneurial experience is the presence of role models from family businesses or acquaintances, but these were also infrequent in the cases studied (n=11 start-ups). In fact, none of the cases were family business.

The third entrepreneurial characteristic is the guiding principle of the business, which some authors have called motivation to start (e.g., Gelderen, Thurik et al. 2006, Kelley, Bosma et al. 2010) or opportunity *versus* necessity – as synonym of pull- *versus* push-entrepreneurship (e.g., Delmar, Davidsson 2000, Gelderen, Thurik et al. 2006). Here, the term guiding principle refers to more than the individual motivation; it reflects the perception of the entrepreneur on why he or she became engaged and continues to be engaged with the start-up's activities. Guiding principles are the underlying motivation for the existence of the business, which influences the entrepreneur's decision-making processes in the long run. The literature has associated this guiding principle to profit and fast growth, in opposition to survivalist entrepreneurs and entrepreneurs that do not count on business networks for accessing resources and support (Nichter, Goldmark 2005).

In addition to entrepreneurial opportunity, this chapter shows that there are other guiding principles related to pro-growth efforts in business start-ups. These principles are mainly technological development and investment for life, the latter being similar to the argument of preference for self-employment presented by Delmar and Davidsson (2000). Although the number of cases does not allow further elaboration on the specific role of these guiding principles in each pathway, there is some evidence that the focus on technological development of start-ups in Pathway 2, for instance, influences decisions of focusing on the core business, leading to the consequent dependence on R&D grants, even when the start-up has developed marketable by-products.

Pathways and learning strategies

Another individual factor in which pathways differ is the use of learning strategies. Again, assuming that learning strategies are contingent to the context, it seems that some pathways function as different contexts that call for distinct combinations of learning strategies. Figure 5.5 shows the proportion of each strategy in the total number strategies used within each pathway.

This figure shows an overall consistent pattern across pathways, with around 48-57% of strategies being behavioural, and between 37-45% of them being cognitive, and corroborating what was found in Chapter 4 at the level of CLEs. Self-regulatory strategies are marginal in most pathways and non-reported in Pathway 2. Discrepancies between cognitive and behavioural strategies were bigger than 10 pp. in Pathways 1 (direct production of the core product or service), 2 (dependence on investment capital to develop the core product without insertion in the market) and 5 (secondary product that becomes the core business). For Pathways 3 (secondary product or service complementary to the core) and 4 (secondary product or service as spin-off) this difference was 4 pp. This result indicates that developing secondary products with a resource-base which is either complementary to the core or developed independently, demands a more evenly matched combination of cognitive and behavioural learning strategies, since the latter works on two parallel lines of products or services. An analysis of the most frequent sub-categories of learning strategies showed significantly higher use of extrinsic reflection in Pathways 3 and 4 ($X^2(4, 207)=19{,}69$, $p<0{,}01$). This suggests that entrepreneurs more often combine extrinsic reflection with interpersonal/inter-organizational help-seeking (Figure 5.6). These strategies help entrepreneurs to acquire information from resourceful actors, which are adapted internally for both core and secondary products or services. This new information is incorporated into or reshapes the current routines, influencing the evolutionary path.

Figure 5.5
Proportion of main learning strategies per pathway

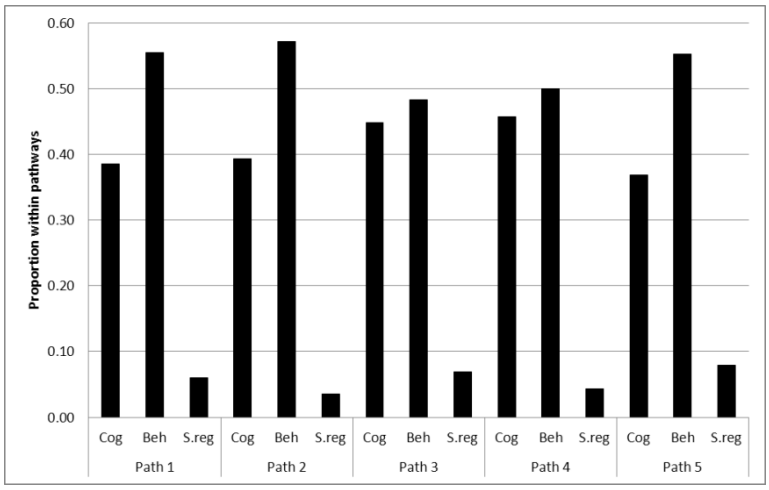
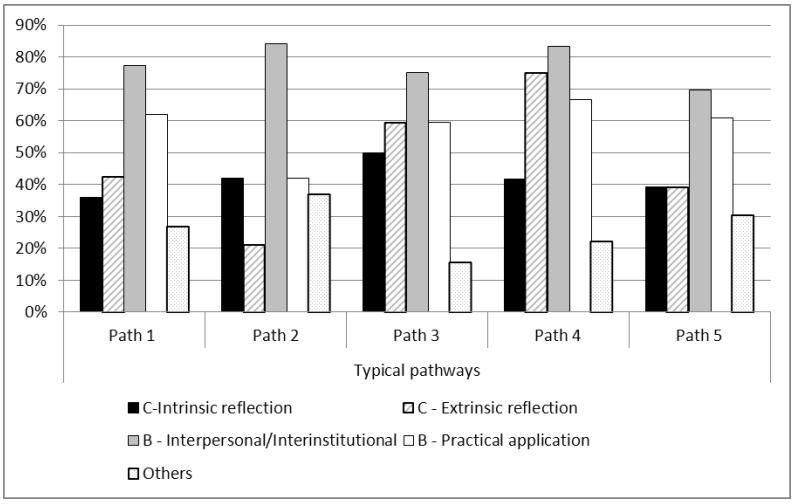


Figure 5.6
The most common sub-categories of learning strategies per pathway (n=43 start-ups)



In relation to the other pathways, although no other significant differences were found, the preference for interpersonal/inter-organizational help-seeking amongst the behavioural strategies, often in combination

with a practical application is noteworthy. Despite the use of similar combinations of strategies, the content exchanged is very diverse, as described in Section 5.3.

5.5 Pathways and firms' characteristics

The literature has pointed out that the growth of SMEs is influenced by firm's characteristics, such as formality and finance (Nichter, Goldmark 2005). In this thesis, issues of finance are incorporated in the discussion of CLEs triggered by lack of working capital and needing to access R&D investments. This section is centred on two other firm characteristics that influence the formation of different pathways: degrees of diversification of products and services (the resource-base(s)), and intensity of R&D activities. This analysis is based on interactions between resources, entrepreneurial decisions, business opportunities, and institutional frameworks. Dynamics between these four factors determine the type of product or service of a start-up. Firm24 provides a clear example of how crucial this interaction is and what impacts it can have on the start-up's pathway.

> The project was a bit more ambitious when we put it here [in the incubator]. It was not only in vitro [tests], but in vivo too. In fact we had access to a consultancy, to a document by a consultancy which showed that the business of in vitro tests to develop medicaments and cosmetics was promising and so on. Then we entered the market to do this. […] When we were to start the operational phase, one of the difficulties we had was, in fact, that everyone wanted us to do in vivo tests, not in vitro. Because, in Brazil, in vitro tests are still not recognised by the regulatory agencies. Hence, we needed a space to raise the animals and this space was something that was not allowed here, because it does not have the facilities to raise animals (§030). [As a consequence the start-up was transferred to another city, for a few years, until it moved back to the first incubator].

This example shows the extent to which market dynamics and regulatory frameworks barred the development of an innovation, despite the entrepreneurs' expertise and the internal capabilities of the start-up. In addition to this, the physical location of the business was determined by access to critical resources to develop a product that would be accepted on the national market (i.e., access to university laboratories and research groups).

In other cases, when regulatory frameworks did not impede product development, the interaction resources-entrepreneur-firm-market resulted in diversification of products around a core technological platform, for instance in the sector of medical engineering. As reported by Firm34, the launching of the first product, which was novel in the national market, profited from a quick and widespread introduction in the market and soon resulted in demands from buyers for variations of that product. "From this first product, with the same technology we made four products, and then there was more development" (§058). These cases illustrate what Nelson and Winter (1982) referred to as classes of technologies, which are developed according to assessments of their attributes and economic potential.

In Pathway 1, diversification is minimal or limited to the same resource-base. For instance, a start-up that produces women's blouses (Pathway 1) develops variations in models, fabrics, cuts, colours etc., but the final product is still women's blouses that will be commercialized through the same channels and possibly to the same target markets. In Pathway 2, due to stagnation in terms of firm evolution, diversification of products or services and dynamic interaction between the factors mentioned above hardly apply. The appraisal of internal capabilities and the external environment is mostly restricted to applying to public grants for technological development, with rare insertions in market networks and little internal structuration of the business. The resource-base is limited to R&D activities in a pre-market phase.

Diversification in Pathways 3 to 5 involves the establishment of new resource-bases, for the development of secondary products or services. In terms of potential, the advantage of diversification in Pathway 3 is specialization in one market or similar target markets with a range of products and services in different technological levels. It implies less governance efforts and some degree of continuity between the secondary product or service and the core because of overlaps between the two resource-bases. Furthermore, these are businesses in closer interaction with the local and micro-regional levels.

Pathway 4 has the advantage of favouring action in multiple markets at approximately the same level. The level of specialization may be lower in terms of diversification of products within the same or similar target markets though. There are more governance demands because the resource-bases are relatively independent between the products. However,

there is higher potential for growth, especially for those start-ups in which core and spin-off firms develop high R&D-intensive activities.

In Pathway 5, the immediate need to generate working capital and define a focus for the start-up seems to have failed to drive these businesses towards a well-balanced interaction between resources-entrepreneur-firm-market; so they present pathways marked by discontinuity and lack of innovation and added value. These are start-ups acting in the regional market, with low transaction power, what keeps them in a subordinate position in relation to a few buyers and business partners. This pathway uses many of its scarce resources to redefine the identity of the business and build new routines that have weak connections with the existing ones. Therefore, developing discrepant – or incompatible - resource-bases internally is the most costly evolutionary path for business start-ups.

5.6 Pathways and use of resources

Parallel to the analysis of CLEs and resource dynamics, this section examines patterns of resource-use in relation to pathways. The resources and services examined here are the same as those presented in Section 4.3, but here they are clustered per typical pathway.

In **Pathway 1**, managerial knowledge and information about the market are resources acquired by the entrepreneurs, specifically through networking in the business incubation setting. Managerial knowledge is a resource linked to the establishment of managerial routines to redesign or replace ineffective routines, and to deal with unexpected growth. Knowledge about the market is linked to refining the initial idea of the business and understanding market dynamics. There are also cases of under-utilization of resources constituting triggers to CLEs. These resources include scarce financial resources, installed production structures, expertise and relationships with employees. The under-utilization or misuse of these resources generates inefficient services by these start-ups, hindering growth. Some of these inefficient services are unhealthy sales, mal-definition of the market niche, and a mismatch between production capacity and ease in entering the market. However, once entrepreneurs become aware of how these resources can be deployed, a learning episode is triggered to change these inefficient routines.

Next, a set of resources is created. These are the design of a new business, trust, financial resources, infrastructure, managerial competences, marketing structure, technology, productive capacity, and networks with suppliers. Creation is the most important resource dynamic in this pathway. For some start-ups, designing the start-up was an episode of creation per se, and includes such processes as redesigning the production line of an acquired bankrupt start-up, or following all the procedures of setting up a business. One interesting resource dynamic is the creation of financial resources, which are not available in the financial market for start-ups, as these do not fulfil basic bank requirements to access credit. Services linked to the creation of financial resources are: setting up the production structure with partnerships to lower investment costs, and shortening the production cycle to generate working capital at a faster pace. Although general managerial knowledge may already be present, new facets have to be internally created to cope with specific triggers. Another important set of resources refers to the creation of production capacity. Services created by production capacity include the continuous training of workers, shortening of the production cycle through improvements in layout and coordination of tasks, and creating a balance between increased sales with limited availability of skilled labour.

The last use of resources is associated to loss. Business incubator facilities, buyers and managerial expertise are perceived as lost resources linked to services such as setting up conditions to function outside the incubator, dealing with price wars, and replacing human capital caused by the exit of associates.

For **Pathway 2**, investment capital, infrastructure and other facilities are the acquired resources. These are used to develop the start-up's core product and replace business incubator facilities. There are episodes of under-utilization of resources such as human capital and productive capacity, which are associated to the limited use of entrepreneurs' capabilities in previous jobs and to delayed access to R&D grants to develop the core product. Results showed, once more, that creation of resources is more important in triggering critical learning episodes than other types of resource dynamics. Conditions to access investment capital, a new business, business partnership, and productive capacity are created to overcome barriers to access grants, to develop new ideas, to combine

research and market competences and to establish internal conditions for production.

In **Pathway 3**, other types of resources are acquired. In addition to managerial knowledge, acquisition includes access to investment capital and to specific expertise. Investment capital is needed to develop new technology-based products. Acquiring specific expertise, here, is an exceptional case in which the start-up could hire external consultants in technology. Under-utilization of resources is rarely reported by start-ups in this pathway. One episode, for instance, showed that the start-up was focused on just one buyer when they could actually have reached out to a broader portfolio of buyers. As in Pathway 1, the realization of under-utilization triggered changes in the organizational routines in order to make more effective use of these resources.

Creation of resources is the most common type of resource dynamic. Created resources include managerial competences, a second product, new business, conditions to cope with regulations and strategies for competition. Most of the services associated with these resources refer to internal structuring of the start-up to attend to new business opportunities and growth demands. Again, the creation of resources combines internal capabilities (e.g., human resources management routines, productive capacity, and technological capacity) and external factors, such as opportunities and competition.

Analysis for start-ups in **Pathway 4** indicated that the acquired resources are knowledge about transformation of technology into products and access to finance and networks to develop the core product. Under-utilized services are technological potential and productive capacity, which render services in one market due to unawareness of the start-up's potential, and several problems caused by inefficient accounting. Creation of resources is, again, the most frequent type of resource dynamic. These resources include entrepreneurial interests, business partnerships, secondary service, and technology. Different services stem from these resources, such as setting up a business, and developing survival strategies.

Next, in **Pathway 5**, the acquisition of resources resembles Pathway 3, in which managerial knowledge and access to investment capital are highlighted. Also here, the services include the establishment of initial managerial routines and the development of the core product. However,

at the level of under-utilization and creation of resources, some differences are observed.

Under-utilized and created resources are balanced here, suggesting that under-utilization is a matter of concern in Pathway 5. Entrepreneurs reported under-utilization of productive capacity linked to insufficient sales when all associates became exclusively dedicated to the start-up, focusing on one big client, and distorting the focus to service provision instead of manufacturing. Sales efforts were also under-utilized by not focussing on the best market niche and by an unawareness of how long the sales cycle is.

Resources created in Pathway 5 are the design of a new business, managerial competences, technology, and production capacity. Although the type of resource is very similar to Pathway 1 in that they both include managerial competences and productive capacity, services are distinct. Here, services relate to developing new business branches, or to strengthening the second product that was initially developed for survival and later became the core business. Loss of resources relates mainly to human capital, due to joint venture breakdowns.

Overall, these results corroborate claims in the literature on dynamic capabilities about the "multiple paths (equifinality) to the same dynamic capabilities" (Eisenhardt, Martin 2000, 1109). A bottom-line process for this is using resources in multiple ways. This chapter shows that, more than influencing the development of internal capabilities, different uses of resources affect the formation of different resource-bases, which are critical to delineate the evolution of business start-ups.

5.7 Conclusion

The conclusion is organized around the following topics: methodological issues, explanatory factors for pathways, and the role of learning.

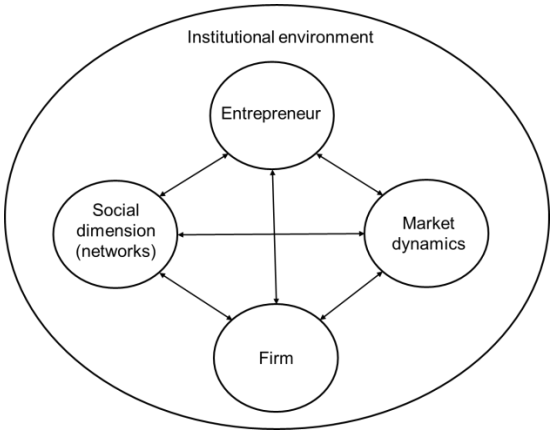
In relation to the methodology to identify typical pathways, the shift from a linear quantitative analysis of sequences of CLEs in relation to entrepreneurial and firm characteristics to an in-depth analysis of the interviews through grounded theory principles, provided a completely new set of results. These showed not only the role of critical learning episodes in the evolution of business start-ups but also led to the identification of typical pathways that aggregated cases in a counterintuitive manner. It was a surprise, for instance, to find biotechnology-based start-ups

clustered with typically low R&D-intensive start-ups in sectors like clothing and footwear. This is a shift from widespread perspectives that 'box' firms according to type of industrial activity or economic sector. This does not imply, however, that these categories do not matter. Alternatively, this study shows that the context and dynamics of business start-ups allows this alternative clustering of cases, since the initial routines will be similar between cases, almost independent of specific firm or market categorizations. Nevertheless, the extent to which the dynamics of firms beyond the start-up stage can be studied with the lenses used here remains an empirical question.

In relation to the formation of pathways, this chapter demonstrates that these evolutionary processes, in business start-ups, involve a wider set of factors than research and practice have classically assumed. Interactions between multiple factors found to determine pathways are diagrammed in Figure 5.7. It shows the four main sources of resources: entrepreneur, social networks, market dynamics and the firm[4]. Arrows indicate the interactions between these sources, which can also work as the source of the resource; i.e.; the creation of spin offs from the combination of entrepreneurs' expertise, start-ups' production and marketing knowledge and routines, and the social encounter between these two (or more) entrepreneurs. All these interactions are more or less embedded in an institutional environment, which is another source of resources (i.e., regulations that affect market dynamics, firm processes, entrepreneurial decisions, and social relations).

How do these interactions lead to different pathways? The argument starts by examining the resource-base required by the start-up. Depending on the type of resource, entrepreneurs will search to different sources for information, turning, for example, to business incubators for managerial training. Business incubators are part of the institutional environment, with other support institutions and governmental agencies. Furthermore, the institutional environment includes regulatory frameworks in the form of laws, surveillance regulations for public health and environmental issues, etc. Across pathways, it was shown that the institutional environment is a powerful source of incentives and constraints to business start-ups; therefore the nesting of other relations within it.

Figure 5.7
Key factors to define pathways



This general model explains Pathway 1 for the acquisition and creation of resources within the same resource-base. This resource-base is formed by the entrepreneur's expertise in that sector, access to equipment and facilities, guidance to acquire and create managerial competences that form the organizational routines, and a favourable institutional environment. Production technology and resource-specific networks are key resources especially in the beginning of this pathway. In this linear evolutionary path, when start-ups enter the market, the resource-base is reconfigured for the development of routines of sales and growth, from the interaction between firm factors and market dynamics.

Pathway 2 is also characterized by the acquisition and creation of resources directed to a single resource-base. Here, however, this resource-base is formed by the entrepreneurs' technological expertise, his or her networks with research centres, and R&D grants. The most important interactions are between entrepreneur, social networks, and the institutional environment. Few organizational routines are formed and the structure of the firm is limited. Market dynamics are expected to play a role at later stages, when the start-up may be acquired by a multinational company in that sector of activity.

This general model also applies to those business start-ups working on more than one resource-base. The three other pathways, then, are distinguished by the degree of overlap (*versus* discrepancy) between the

resource-base of core and secondary products or services. In Pathway 3 these two resource-bases are complementary, so acquiring and creating resources for the secondary product or service improves the resource-base of the core product or service. The complementarity of these resource-bases is seen in the interactions between entrepreneurial expertise in the sector, firm routines and infrastructure, social networks with professionals and support institutions in that sector, and market relations with suppliers of inputs that can be adapted to both resource-bases. In some cases, target buyers are similar for both core and secondary products or services. The main distinctions between these two resource-bases is the need for R&D grants or other forms of investment capital in the resource-base of the core product; and the stronger role of relations between firm and market in the resource-base of the secondary product or service.

Pathway 4 is characterized by independent resource-bases between core and secondary products or services. The resource-base of the core product or service is similar to that in Pathway 3, with entrepreneurial expertise in the sector, firm routines and structure, social networks with professionals and support institutions in the sector, and investment capital for R&D. The resource-base of the secondary product or service, in turn, involves, in addition to entrepreneurial expertise and social networks, the establishment of partnerships to create spin-offs. Firm routines and structures are externalized and socialized in cooperation with the business partner. These separate managerial structures are very simple at the beginning and become increasingly coordinated by the parties. Hence, partnerships play a critical role, since they reduce demands upon scarce internal resources, despite the augmented need for coordination (which represents another element of this resource-base).

Pathway 5, finally, just as Pathway 4, is characterized by independent resource-bases between core and secondary products or services. This means that the entrepreneurial expertise, the firm's routines and structure, the configuration of social networks, and the type of product development have to be split between core and secondary products and services. Other than in Pathway 4, there is great effort to develop both resource-bases internally. Given the scarcity of internal resources (people, machinery, infrastructure, etc.), and the immediate generation of working capital through the commercialization of the secondary product or service, the start-up cannot invest in the resource-base of the core

product. Therefore, the former becomes a barrier to the development of the latter. It is noteworthy, however, that this pathway does not signal a failure of the start-up, but its transformation into a business built on a different resource-base. This transformation is questionable from the point of view of added value, since this 'new core business' is less R&D-intensive than the initial idea.

This chapter also discussed the role of learning in these pathways. Based on the analysis of the empirical chapters and on the general model proposed, it seems that learning efforts and outcomes are more targeted in Pathways 1 and 2, since entrepreneurs focus in one resource-base. In consequence, organizational routines change in relation to the function of CLEs, but in essence they serve the same resource-base.

In the other pathways there are specific situations. Learning efforts and outcomes in Pathway 3 benefit the resource-bases of both core and secondary products and services, due to the overlap between them. This impacts on the formation of organizational routines that can be partly deployed by both core and secondary products or services. In Pathway 4, learning efforts are shared through business partnerships, which can be associated to the concept of strategic transactions[5] elaborated by Huet and Lazaric (2009). Organizational routines are separate for core and spin-off businesses. Contrary to that described above, learning efforts in Pathway 5 are incompatible with developing, internally, two different resource-bases. Inasmuch as knowledge, competences, networks, and market relations drift to a different resource-base, learning costs to develop such distinct organizational routines become incompatible with the start-up's scope.

In sum, results in this chapter corroborate Penrose's (1980 [1959], 70) claim that efforts to make full use of available resources are likely to generate alternative business trajectories:

> When, however, a firm embarks on a programme of diversification, new types of resources rendering services quite different from those required to produce its older products will be added to the firm's collection of resources, and the problem of 'balancing processes' may carry the firm off in entirely new directions.

In addition to this, the thesis shows that competences to make use of resources do not work in a vacuum. For instance, launching a new product changes the interactions showed in the general model, since under-

standings about the market will deepen, contents transacted in the entrepreneur's networks will change, the system of organizational routines will be reconfigured, and relationships with market dynamics will be shaped as interactions with buyers, suppliers and competitors take place.

Within the institutional environment, business incubators appear as a broker that facilitates access to resources, such as knowledge, facilities, market actors, financial actors, etc. In this regard, guidance and brokerage may influence what type of pathway the start-up will follow, either by focussing on the core idea, or developing complementary, independent or incompatible products or services.

Notes

[1] A rule of thumb for this number by Tachnick and Fidell (1996) is 50+8m (m=number of independent variables). Here, there should be at least 270 cases.

[2] Resource-base is defined here as the arrangement of interconnected resources that provides an array of specific services to the firm and shapes its patterns of interaction with the environment. Financial, social, and human capital are included, but the importance of each resource depends, in the first place, on specific CLEs, and, overall, on the firm's pathway. Examples of resources are technology base, production expertise, managerial competences, infrastructure, production inputs, and types of investment capital. Interactions with the environment include target markets, business partnerships, type of industrial activity, and knowledge-specific networks with support institutions.

[3] The motivation to start a business is commonly categorized in two groups: opportunity and survival (e.g., Berner, Gomez et al. 2008). Within the group of opportunity-driven entrepreneurs, which is the group investigated in this research, the literature has highlighted motivations such as increased income, wish for independence, following a family tradition (Grimm, Knorringa et al. 2012).

[4] The variables under the label of initial and current conditions are included here.

[5] In strategic transactions, the focus of the partnership is on innovation capacity, quality improvement and change of practices.

6 Evolution of business start-ups

This thesis investigates the micro-foundations of the theory of the firm, explaining the internal organization of business start-ups, the origin of the first routines, and exploring the nexus entrepreneur-firm-networks-market-institutions. This study claims that the emergence of entrepreneurial knowledge to a firm structure is grasped through the formation of organizational routines, which put in practice the outcomes of entrepreneurial learning to the service of the firm. Hence, once these routines are in operation, intra and inter-firm activities can be coordinated, and the production of goods and services that require multi-stage productive activities can take place. Therefore, in addition to engaging in market transactions, firms demand a great number of resources to set up their production-specific routines. At the same time that the firm's boundaries and internal structure are formed, and, in fact, as part of this process, the firm interacts with the external environment, exchanging and creating resources. In the long run, patterns in the internal dynamics of firms and in their interactions with the external environment will configure pathways, which are unique in their details, but which nevertheless share typical characteristics.

This concluding chapter summarizes the main contributions of this study to explaining the evolution of business start-ups, highlighting the role of agency and learning processes. It explores the empirically grounded theoretical and methodological advances of this study to a resource-based theory of the firm that is multidisciplinary and systemic: multidisciplinary because it combines the dynamics of individual learning typical of Organizational Psychology studies with organizational routines, typical of the Economics and Business Management literatures; systemic because it demonstrates how analyses at the individual and firm levels interact.

The chapter organizes a wide range of topics under eight main themes. First, it provides an overview of those key concepts that were elaborated upon in the introductory chapter. Then the research questions are resumed and the answers found are summarized. A long section discusses the contributions of this thesis to resource-based theories of the firm, followed by a section on the contributions of learning-based pathways to explain the evolution of business start-ups. Three issues related to the services provided by business incubators are discussed next. The chapter also includes a section on methodological contributions, contributions to development studies, and a last section about limitations and a research agenda around five key topics.

6.1 Revisiting the key concepts

This PhD thesis is built on the following key concepts: resources (including resource-base), firms, routines, critical learning episodes, and pathways (including typical pathways). Contrary to what is observed in the literature, there is no *a priori* dominant role of either environment or firm (management). Here, the knowledge about firms and their internal organization is grounded in entrepreneurs' narratives, which report how individual, firm, market and institutional factors intertwine and influence each other in the evolution of the business. The resulting complex and contingent configuration of factors shows that events or variables from each of these levels take a prominent role in different critical events through the evolution of the firm.

First, this thesis is about resources. In the Penrosian tradition, resources are anything that can provide services to the growth of the firm through managerial decisions. Further development of the resource-based approach introduced a dynamic perspective, in which resources can be substituted, recombined, and dropped, forming configurations of resources (e.g., Eisenhardt and Martin 2000). Following a similar line of argument, this study shows that different resources matter at different points of the firm's trajectory. These resources can be investment capital, social capital, human capital, physical capital, technology, information, knowledge, and so forth. However, these resources are not seen in isolation; instead, they are combined to form the resource-base of the firm. For instance, information can be acquired through social capital, and physical capital may result from investment capital, which can be combined with information and expertise to create a new product.

The definition of resource-base, in addition to help explaining how different types and uses of resources affect an individual firm's pathways, provides an answer to the critique that everything can be a resource (e.g., Kraaijenbrink et al. 2010). In fact, what the five typical pathways show is that inputs from different sources will work as resources if they matter to the resource-base of a specific firm. In sum, resources are those individual, firm, social, market and institutional inputs that fit the resource-base of the firm, or, otherwise, that are required to build a new resource-base. Hence, resources cannot be understood in isolation. In this study, they were contingent to CLEs, which could tackle one or more resource-bases, depending on the firm's pathway.

Second, this thesis is about firms. The resource-based theory defines firms as bundles of resources. As showed here, these resources, in addition to aiming at competitive purposes or specific needs that are intrinsic to the history of the firm (Penrose 1980 [1959], Kraaijenbrink et al. 2010), are necessary for the regular functioning of any business, i.e., business networks and general managerial knowledge. These are reflected in the organizational routines and characterize the internal organization of firms. In a similar way, those well-established routines control resources internally form the boundaries of firms, i.e., the identity of the firm. This conceptualization of firms in general and of start-ups in particular has change as an inherent attribute, and learning as its core process. Here, it was possible to trace the formation and transformation of business start-ups' boundaries and internal organization through CLEs. Each CLE showed how resources that are acquired, created, under-used or lost trigger change through new resource dynamics and integration to the resource-base of the firm. Since firms, and most of all business start-ups, are not closed systems, networking played a critical role in accessing and creating resources for change, and in the formation and maintenance of working routines, i.e., inter-organizational routines of cooperation.

Third, this thesis is about routines. As mentioned above, routines are patterns in the use of configurations of resources at the firm level. Although most of them are internal, there can be routines of an inter-organizational nature. As routines evolve and become coordinated and intertwined, they form systems of routines that are less susceptible to drastic changes. Furthermore, this study has demonstrated that routines can perform three roles. First, routines are the result of change, identified here through critical learning episodes. Successful repetitions of

learning outcomes create new routines or reshape existing routines and systems of working routines. Second, routines function as tools (or resources) for learning when the firm faces critical events. Third, they are a source of organizational change due to new needs out of their use, their obsolescence, and due to learning routines for continuous search. These functions are discussed in a separate section below.

Fourth, this thesis is about critical learning episodes. These are critical events from which the members of a start-up learn. Entrepreneurial agency is central to the perception of criticality that defines a critical learning episode, and to the selection of learning strategies to deal with it. Contributions of this concept in explaining evolution in business start-ups are discussed in a separate section below.

Fifth, this thesis is about pathways. Pathways correspond to the trajectory of changes in configurations of resources through arrangements[1] of CLEs. Therefore, pathways provide a longitudinal perspective on changes in a firm's system of working routines. An important contribution here is the demonstration that there is no ideal normative pathway, since interactions between individual, firm, networks, market and institutional factors vary in each CLE. Across a pathway, there is variation in relation to types and dynamics of resources[2], serving core and secondary products or services[3]. From these variations, those configurations of resources that effectively solve a trigger are more likely to be selected for application than other, non-critical, situations and regular routines. In this way, the new configuration in the system of working routines will characterize the firm for a period of time, until there is another critical event (i.e., rapid growth, switch of the core business, new technology, etc.). Nevertheless, this does not imply an extreme level of individual uniqueness. As empirically demonstrated in Chapter 5, individual firm's pathways can be aggregated in five typical pathways.

Sixth and last, this thesis is about typical pathways. A typical pathway aggregates firms that experience similarities between the attributes and dynamics of their individual pathways. This study claims that typical pathways are an *ex-post* concept, based on the history of the firm through critical learning episodes and the gradual formation of systems of organizational routines. It is noteworthy that the history of the firm, as seen in this study, includes path-breaking episodes, innovation, shocks, and learning routines (or routines of and for change). A separate section of this thesis is dedicated to discussing pathways and typical pathways.

6.2 Summing up the argument

This section resumes the research questions and discusses the extent to which they are answered in this study. The main research question asked ***How do learning-based pathways explain the evolution of business start-ups?*** The concepts in the analytical framework (Chapter 2) guided the empirical part of this study. Dynamics and relationships between these concepts were detailed in Chapters 4 and 5. Results showed *how* critical events promote major changes in organizational routines and, in the long run, shape the evolution of business start-ups. In sum, critical learning episodes and arrangements between them compose start-ups' pathways, which are aggregated in five typical pathways. This main question was unfolded into five sub-questions, three of which are briefly mentioned below.

The first research sub-question was ***What types of critical learning episodes characterize evolutionary pathways in business start-ups?*** As described in Chapter 4, critical learning episodes were categorized on the basis of their triggers, resulting in five main categories: entry and survival in the market (the most frequent), production issues, entrepreneur-specific issues, managerial issues and others. The internal dynamics of these CLEs confirmed the concepts related to learning dimensions (cognitive, behavioural and self-regulatory), and the non-perfect transfer of learning outcomes to the organizational level. Results led to a refinement to the concept of resource use, including creation and loss of resources as triggers to search. This finding contributes to understand the dynamics of innovation within business start-ups (see Section 6.3).

The second research sub-question was ***Are there typical pathways that could describe this evolutionary process for groups of businesses?*** As mentioned in the previous section and described in Chapter 5, analyses of the resource-bases of core and secondary products or services showed five typical pathways. The main factors affecting these pathways were the internal dynamics of CLEs (number, types and duration), entrepreneurial characteristics (i.e., entrepreneurial experience), firm characteristics (i.e., R&D-intensity), network dynamics (i.e., business partnerships), market dynamics (i.e., competition), and institutional arrangements (i.e., availability of R&D grants).

The third sub-question was ***What is the role of structural, agency and temporal factors in evolutionary pathways?*** A wide range of fac-

tors was considered at different stages of analysis to investigate this question (Appendix 7.1). Results for the dynamics of CLEs and pathways showed that none of these factors can be looked at in isolation. Findings showed the strong role of agency (e.g., Stack and Gartland 2003), even in the face of exogenous threats. Furthermore, agency has to be combined with the available resources and it is influenced by market and institutional dynamics, leaving little room for straightforward *ex-ante* conclusions about the consequences of any particular trigger.

The other two research sub-questions are discussed, respectively, in Sections 6.3 and 6.5. An important point to conclude the validity of the conceptual framework to explain the evolution of business start-ups lies in the ontological position of this research. It was clearly designed under a deductive approach, in which concepts from evolutionary economics, organizational psychology, social networks theory, and resource-based theory of the firm were related on the basis of their definitions and assumptions. As the study evolved, an inductive approach was called upon and led to novel results in relation to the identification of a typology of critical learning episodes, from which pathways and then typical pathways resulted. This shift confirmed most of the initial framework but also critically revisited it and also expanded parts of it, enriching classical concepts from these theories. Techniques of data analysis were characterized mixed methods and blurred the boundaries between commonly opposite approaches.

This research trajectory contributes to organizational studies that have claimed the importance of studying organizations as integrated systems of multiple levels, and the required multidisciplinary research to achieve this. More specifically, the main contribution of this study, in this area, is in filling the knowledge gap on bottom-up processes that explain the emergence of learning at the firm level (e.g., Klein and Kozlowski 2000).

6.3 Contributions to resource-based theories of the firm

Authors such as Wernerfelt (1984), Conner and Prahalad (1996) and Kraaijenbrink et al. (2010) state that Penrose's (1980 [1959]) theory of the growth of firms, although classic, is under-researched due to the challenges it imposes on traditional underlying assumptions in the resource-based theory of the firm. Conversely, critiques point out that the resource-based view shows vagueness and tautology of concepts, lacks

empirical grounding, and makes sustained competitive advantage in dynamic markets improbable (Eisenhardt and Martin 2000). Nevertheless, the resource-based theory has become the most influential theory in management studies for sustainable competitive advantage (Kraaijenbrink et al. 2010).

This section discusses the extent to which this thesis contributes to the conceptualization and dynamics of resources and services, framing these Penrosian concepts within an evolutionary perspective. It tackles issues of agency, knowledge and innovation, diversification, and competitiveness *versus* cooperation.

Types, sources of resources, and contingencies

Resources have multiple natures, often depending on their sources. They can be managerial competences developed according to business needs, technological knowledge acquired through the development of prototypes and final products, skilled labour, production know-how developed through setting up infrastructural facilities, financial resources generated through redesign of the production system, access to market networks in processes of trust-building with suppliers and buyers, and so forth. Some of these resources may have multiple sources. For instance, managerial knowledge may stem from previous entrepreneurial experiences, exchanges with business incubator's consultants, formal courses, and informal exchanges with other entrepreneurs. Another resource, which draws on multiple sources, is technology; it can be either developed internally, acquired from other producers, or co-created with other business start-ups. Other important sources of resources are institutions for R&D support, although these tackle specific groups of firms. In general, entrepreneurs collect knowledge from as many sources as possible and adapt and reassemble them according to their judgment and the firm's needs. Results confirm Casson's (2005) statement about the need of entrepreneurs to combine financial resources and organizational skills to start-up.

Furthermore, some 'classical' sources of resources seem to be replaceable, such as the role of entrepreneurial training in higher education institutions that appear to substitute entrepreneurship role models from family or friends. This approach relativizes the strong role of social capital in influencing entrepreneurship and introduces an empirical argument in favour of entrepreneurial education. It is noteworthy that one source

of role models does not perfectly replace the other. The point here is the common ground between these sources, since both foster entrepreneurial motivations, disclose business opportunities, and stimulate the formation of a cognitive framework for innovation. In conclusion, even initial resources as intangible as entrepreneurial role models do not have to be always tacit, and can be subject to learning. This is an argument in favour of the non-substitutability and multiple uses of resources (e.g., Eisenhardt and Martin 2000).

A central issue for business start-ups is guaranteeing the continuity of favourable exchanges of resources. This strongly depends on the maintenance of networks with resourceful actors, often through embeddedness and trust relationships (Granovetter 1985, Hormiga et al. 2011, Xu 2011). These networks may include university interns (Pathway 3), venture capitalists (mainly in Pathways 3 and 4), researchers (Pathway 2), business partnerships (Pathway 4), buyers, and suppliers (Pathways 1 and 5), etc. The recurrent exchange of resources through time is a key factor in these networks, as the longitudinal comparison in Chapter 4 showed. This thesis advances on the resource-based literature (e.g., Conner and Prahalad 1996) by nesting these firm processes of acquisition and creation of resources in the institutional environment of networks, support institutions (including business start-ups), research centres, sector-specific dynamics, funding and regulatory frameworks, amongst others. These explorations of the role of networks and networking activities answer the fourth research sub-question: ***What are the characteristics of networking dynamics that, beyond learning episodes, contribute to the evolution of business start-ups?***

However, the critique that anything can potentially be a resource remains open. Hence this study identified contingencies under which endogenous and exogenous inputs to the firm can actually function as resources. These contingencies operate at the level of critical learning episodes and at the level of pathways. Contingencies related to CLEs associate resource dynamics to triggers, and they refer to the four categories highlighted in Chapter 4: the need to acquire or create resources (the two most prominent), and the need to cope with under-utilization or loss of resources. These contingencies direct learning strategies, such as taking courses, studying technical manuals, acquiring expertise from other incubation actors, establishing business partnerships for product development, etc. Outcomes generated by each of these strategies, whilst be-

ing functional in providing resources to one start-up, might not be functional for most of the others. One implication of this contingent character of resource acquisition and creation is the formation of the firm identity and its patterns of interaction with the environment. Another implication tackles the importance of specific resource-bases to provide specific services to the firm. To the extent that these specific services are difficult to imitate by other enterprises, these specific resource-bases contribute to building the competitive advantage of each start-up (Best 1990, Eisenhardt and Martin 2000), to identify new business opportunities, and to innovate (Shane 2003, Gruber et al. 2012).

At the level of pathways, contingencies to search and select resources relate to the resource-base of the start-up. As argued in Chapter 5, the resource-base directs what kinds of resources are needed and who are the actors to provide them. For instance, production expertise is a resource common to all manufacturers. However, there will be differences in the need to attend to each resource-base. For instance, those in Pathway 1, engaged in low R&D-intensive activities, commonly acquire this expertise from other entrepreneurs or through trial-and-error; whereas those in Pathway 4 will establish partnerships to build on partial expertise and run a spin-off. Based on the cases here, it is unlikely that these inputs could be interchangeable between pathways without deep consequences for the evolution of these start-ups.

The role of entrepreneurial agency

Much of the theoretical development about the firm-organization talks on behalf of entrepreneurs, and are built on the basis of theory-driven assumptions and hypothesis testing, which tend to simplify complex dynamics. This thesis, in turn, offers an alternative approach, in which the role of agency takes central stage (e.g., Garud et al. 2010, Lazaric 2011). At the base of this study there is the assumption that start-ups will experience similar critical learning episodes in different ways. Agency plays a key role in terms of the perceptions, reactions and initiatives taken by entrepreneurs in relation to any event that hits their businesses. Therefore, critical learning episodes are subjectively defined and might not critical per se. This does not exclude the impact of external shocks upon the stability and survival of the start-up, since some events will affect the firm anyway (i.e., sectoral crises) (Pfeffer and Salancik 1978). The main

argument in this section is that agency will tell how also these triggers are dealt with by the firm, generating diverse reactions and outcomes.

Moreover, agency is at the core of organizational processes and can determine how competences will be developed and used. This alternative approach is supported by the literature on institutional entrepreneurship (e.g., Garud et al. 2007), and their few studies on organizations (e.g., Stack and Gartland 2003). This literature focusses on the core concept of path creation and the necessary embedded agency. The role of the entrepreneur is, thus, in breaking path dependence and creating new paths through the creation of new rules and their legitimation (Garud et al. 2007). Within institutional limits, and deploying the resources available, entrepreneurs will engage in search processes that change the current order, influencing the environment and consequently changing these limits and resources.

This study shows that the evolutionary pathways of business start-ups are an on-going process. They are in constant construction due to interactions between entrepreneurial agency, firm, networks, market and institutional factors. Thus, there are no pre-set paths to choose from. This conclusion challenges core assumptions in the literature. First, this study demonstrates that managerial competences are still in formation; therefore there is more uncertainty than predictability. Second, this raises questions about the role of strategic management thinking. The counterargument to the strategic management literature is built on the minimum control over the environment and the limited predictability of managerial actions (e.g., Zollo and Winter 2002, Eisenhardt and Martin 2000, Teece and Pisano 1994) in business start-ups. This counterargument is supported by not splitting start-ups into boxes of functions; this would result in an artificially fragmented picture of the scope and activities of these firms. Therefore, entrepreneurs gradually become managers during the start-up's pathway, as CLEs catalyse learning efforts to those most critical issues. This study, however, does not provide evidence about changes in the degree of control as the firm becomes more established and economically influential in its business networks.

Third, the role of the past, so controversial when one compares different theoretical approaches, is almost absent in business start-ups. In the resource-dependence theory and in the dynamic capabilities approach, past experiences are linked to bias in judgment and decision-making (of managers), and to constraints to current and future decision-

making (e.g., Pfeffer and Salancik 1978, Teece and Pisano 1994). Other approaches, such as studies on entrepreneurship, claim that past experience is an asset for reading the environment, identifying threats and opportunities, and building capabilities (e.g., Eisenhardt and Martin 2000, Hormiga et al. 2011, Niels Bosma, et al. 2002, Nichter and Goldmark 2005). This ambiguous take on past experiences seems to relate to the epistemological position of human cognition in these approaches. Individuals that only react to the environment may be more prone to path dependence in a restrictive or counter-productive way. Alternatively, results here show that most entrepreneurs apply their cognitive capacities to analyse, judge, and combine resources from their past experiences with new information about the environment, creating room for path-breaking. Hence, interactions between individuals and environment, if better balanced in theory, can achieve higher accuracy to explain social phenomena such as learning in organizations and the related processes of path dependence and path-creation.

Path breaking and path creation, then, link this study to the literature on innovation. Xu (2011) states that technology and organizations are designed in line with people's perceptions and frameworks. In addition to this, creativity and innovation require some balance between declarative and procedural knowledge (Lazaric 2008). If routines become crystalized, they may hinder the perception of threats from the external environment and the capacity to absorb new knowledge. This scenario of stability will only change if a situation of crisis challenges the agent's perception. Therefore, discontinuity and uncertainty, despite being more critical in small business than in large corporations (Hillman et al. 2009), can foster new configurations of resources that lead to innovative products or services.

An implication of this discussion is that the sustainability of the business start-ups depends on the entrepreneurial capacity to deal with discontinuous critical events, and create new resource configurations out of them.

Processes of emergence of learning at the organizational level

Recognizing the central role of agency creates the possibility of investigating the emergence of individual processes at the organizational level. This has implications for reconfiguring the resource-based view as a multilevel and systemic theory of the firm, as discussed below.

At the level of CLEs, there is an emergence of individual learning outcomes to organizational routines. As soon as a new resource is available and renders services to the start-up, these new services are found in the outcomes of critical learning episodes and applied with the purpose of solving a trigger. If these new services solve the trigger successfully, there will be a higher probability that they will be used again in the future (Lazaric 2008). These new resource configurations and services are incorporated into the system of organizational routines. This simplified sequence may suggest that needing to create resources to solve triggers is equivalent to creating a new service. However, not all new resources are immediately converted into services; this is especially true for those resources which lead to interpretative outcomes that change the understanding of the entrepreneur on specific issues (Penrose 1980 [1959]). These remain part of the current stock of knowledge for future use. One example of such resources is routines of learning (e.g., Miner et al. 2008).

At the level of pathways, these emergent processes appear in the exchanges of resources between CLEs. These webs of connections between resources resulting from different CLEs and the resource-base of core or secondary products and services showed that emergence processes happen beyond individual critical events. They are rather intertwined in resource configurations and the resource-base that characterize each start-up's pathway.

Pathways and diversification

This section sums up the argument that pathways are not synonyms for diversification, since there can be smaller scopes of diversification within the same pathway. For instance, firms in the clothing sector in Pathway 1 (direct production and commercialization of the core product or service) may diversify according to the season of the year, launching a summer collection that differs from the winter collection, without starting a new evolutionary pathway.

An interesting perspective is elaborated by Wernerfelt (1984), who explains diversification based on a resource-product matrix. This matrix reflects the diversification pattern of using a single resource for multiple markets, and it accounts for sequential entry in different markets, when the resource is well-developed in one market before entering others (an example of this is Pathway 3, for the complementary secondary product or service). An advantage of this approach is that it looks at diversified

firms as "portfolios of resources rather than portfolios of products" (Wernerfelt 1984, 178). This way, firms relate to each other in multiple ways, such as financial, joint cost subsidy etc.

Therefore, diversifying resource configurations (resource portfolios) affects the formation of different pathways when they are linked to resource-bases other than that of core product or service. The development of secondary products as vectors of change in pathways corroborates Penrose's (1980 [1959]) argument about the diversification of activities as a function of the internal resources of the firm to innovate. Firms will continually evaluate the profitability of their different activities in relation to external conditions and internal productive services. An implication of this argument is that, if this constellation of factors results in lower R&D-intensive products being more profitable and providing higher economies of scope than higher R&D-intensive products (for their financial and time costs), start-ups will follow the former pathway.

Competitiveness *versus* cooperation and growth

Competition and strategies to overcome it figure in this thesis as part of critical learning episodes; in the cases in which episodes of competition were perceived by the interviewees as events that demanded new or changed organizational routines. For instance, some critical learning episodes are triggered by the opportunistic behaviour of other entrepreneurs in the form of unfair competition; such as when the incubatee next door offers the same service for half the price and the focus-start-up thus loses its buyer. In this case, the consequences of opportunistic behaviours by competitors or former associates enter the analytical framework as triggers to a critical learning episode. It is noteworthy, however, that they do not receive any specific analysis beyond the overall analysis of critical learning episodes.

The creation of secondary products or services characterizes a dynamic capability of firms to reassemble their resources in order to develop a secondary product. When this secondary product or service is high R&D-intensive, some start-ups become potentially more competitive than others. For further studies on the competitiveness of business start-ups, it might be worthwhile to look at the development of secondary products or services as part of the dynamic capabilities of the firm, for the new configurations of resources that they represent. This links to the three main aspects of cooperation: acquisition, creation or deployment

of resources. Entrepreneurs engage in informal inter-organizational cooperation to learn from others' experiences, they seek formal cooperation to acquire resources (mainly knowledge) that will solve a critical learning episode or that benefit the start-up through trading contracts. Cooperation is an important strategy to innovate through the creation of new equipment and production inputs that demand complementary expertise distributed among different firms. In addition to this, cooperation appears in the deployment of business opportunities that require joint efforts in the form of spin-offs.

Another aspect with which this study contributes to resource-based theories relates to issues of growth. In general, growth is indicated by profit, number of employees, and other outcomes or performance measures (Cressy 2008 [2006], Niels Bosma, et al. 2002). Furthermore, these measures are commonly associated to chances of success. However, empirical data in this study indicate that these measures alone do not reflect an accurate picture of the evolution of business start-ups. Neither do they provide deep insights in understanding *processes*. For instance, in many cases reducing the number of employees was a positive indicator of sustainability, showing improved management of the break-even point and moving on from irregular peaks of sales followed by uneven numbers of employees. Therefore, given the instability of the firm's environment and variations in entrepreneurial decisions, other indicators of growth should apply, which might consider process variables, such as longitudinal measures of the break-even point, the establishment of partnerships with more stable firms, etc.

Concluding the argument

The advantage of studying business start-ups is to investigate the literature gap on the origins and evolution of routines (Zollo and Winter 2002). Moreover, this approach allows the investigation of how systems of routines are gradually formed across critical learning episodes. Since every firm needs routines to operate, this study also contributes to the literature of firms in relatively more stable environments. These general routines correspond to what Zollo and Winter (2002) call effective operating routines, those that guarantee the sustainability of the business after a learning episode.

Therefore, by focussing on micro processes of entrepreneurial learning, based on substantive empirical analysis of critical events at the firm

level, this thesis demonstrates some points of convergence between different branches of the literature on the theory of the firm. One of the implications of this study is that an integrative (e.g., Garrouste and Saussier 2005, Foss 1999) or synthetic (Casson 2005) theory of the firm would benefit greatly from empirically grounded analysis that recognises the active role of entrepreneurs' perceptions about the environment and of their actions upon it. In this regard, it is essential to recognize that there is more uncertainty in the external environment and in the outcomes of entrepreneurial decisions than the entrepreneur can predict. This integrative approach should consider:

- The role of (entrepreneurial) agency in deciding how to acquire or create and how to make use of resources (including how to negotiate contracts);
- The constraints to strategic management to explain the evolution of firms;
- The interactional nature of structure and agency, in which the environment is an input and feedback provider;
- Uncertainty as a pervasive aspect of the environment and of learning outcomes/resource-use outcomes;
- The importance of empirical research as a reality check of theoretical assumptions and claims;
- The inclusion of business start-ups as part of the picture, either as special cases of quasi-firms in face of the current theoretical and empirical apparatuses, or as a seedbed level of further and more complex organizational structures. The place of business start-ups in theories of the firm should not be taken for granted or simply neglected but should be rather explicitly recognised and deeply investigated. The justification for this claim derives from the differences between pathways, the evolution of which could be followed-up in advanced stages of these firms.

The first four points highlight the role of agency in shaping paths in real time (e.g., Garud and Karnoe 2003). Moreover, the underlying common idea that learning is inherently 'positive' is demystified here, since uncertain outcomes may be harmful to the firm (Bastos et al. 2004, Contu et al. 2003). In relation to other theories and approaches discussed in earlier chapters, three concluding points emerge:

- Theoretical approaches such as resource dependence theory and population ecology have predictive power in contexts in which the environment plays a central role in influencing firm formation and the establishment of internal routines. These result in reactions to environmental factors;
- Theoretical approaches such as resource-based theory and dynamic capabilities have predictive power in contexts in which firm dynamics play central a role in influencing the internal organization of the firm. Resulting routines will reflect managerial and other competences that increase the potential influence of the firm on the environment;
- Theoretical approaches such as human capital and social capital have predictive power in contexts in which individual decisions by entrepreneurs play a central role in acquiring, transforming and using resources to create or shape organizational routines. These will reflect cognitive and social learning processes that prove to be effective to the firm's functioning.
- In addition to contributing to the economic literature, this study also contributes to the psychological literature on natural learning in organizations. Delimiting natural learning events and identifying their impacts at the organizational level has been a gap in the literature for over a decade (e.g., Salas and Cannon-Bowers 2001). For multidisciplinary studies, this research connects psychological processes of learning to the role of agency in organizational dynamics, within the scope of business start-ups.

Overall, these concluding points indicate that the standpoint of each theory frames the organizational world with its own particular lenses, highlighting some factors and fading out others that are also (or as much as) elements of the phenomenon under investigation. The main advantage of these particular cuts is allowing in-depth examination of specific dynamics within sets of factors, developing parsimonious explanations from that epistemic position (Toulmin 2001). Nevertheless, the approach used here, empirically grounded in multiple cases, sheds light on integrative research (e.g., Casson 2005) to explain micro/macro relations that are embedded in agency and structure interactions (Barnes 2001). Multiple cases allow theory to emerge "by recognizing patterns of relationships among constructs within and across cases and their underlying logical arguments" (Eisenhardt and Graebner 2007, 25). This is a

recommended strategy to bridge qualitative evidence with deductive research.

6.4 Learning-based pathways and the evolution of business start-ups

Theoretical claims about the central role of learning processes in the evolution of firms have been around since the classic work by Nelson and Winter (1982). However, the explanation of how this core process in fact influences evolution has been an under-researched gap, or a 'black box' (Lundvall 2007). This section discusses the contributions of this study to filling in this gap, especially in relation to processes of variation and selection.

A first source of variation is learning outcomes at the end of individual learning processes. Such outcomes can be new interpretations, network configurations and working practices about new resources acquired or created by the firm. As discussed in Chapter 5, these outcomes may be those expected by the entrepreneurs, but often go beyond that. Therefore, variation results from deliberate action, uncertainty and chance (Dopfer 2005, Miner et al. 2008). Once available, these outcomes are applied to the firm's functioning and the successful ones will be repeated in other situations, until they become incorporated into the organizational routines.

In other words, the formation and reformulation of routines[4] results from the selection of learning outcomes. This process can be more or less deliberate for each routine, possibly depending on the (potential) impact of the new routine on the current system of routines. It can be expected that the higher the impact of the new routine, the more deliberate will be the process of use and evaluation of its effects in the current system of routines (Eraut 2004). Thus, the criticality inherent to critical learning episodes might require a stronger role of agency upon selecting learning outcomes. Conversely, daily learning through the repetition of tasks are more likely to refer to a small scale selection of adjustments in the current routines (Lazaric 2011, Feldman and Pentland 2003). In this case, the process underlying repetition is more likely to be intuitive cognition (Eraut 2004). This thesis contributes mostly to understanding deliberative processes. Nevertheless, indications of the intuitive cognition mode are found in some longitudinal analyses.

Two key elements of this change from the deliberative to the intuitive mode of cognition are examined in the empirical chapters: cognition and action (Eraut 2004). The former corresponds to cognitive learning strategies and new interpretations; the latter corresponds to behavioural strategies, new networks and methods. As stated by Cairns and Malloch (2011, 9), learning is an "outcome of an enabled active intentional interactional engagement in experience and thinking."

Cognition or cognitive processes play a role at the level of the entrepreneur, especially in relation to perceiving or seeking market opportunities (e.g., Zollo and Winter 2002, Aramand and Valliere 2012) and threats. However, they can only have value to the firm if systematically combined with the practical application of knowledge. Contrary to that which is theorized elsewhere (e.g., Zollo and Winter 2002), this thesis shows that these learning mechanisms are intrinsically related and it is the mutual feedback between cognitive and behavioural processes of acquiring, developing and applying knowledge that generates new knowledge and new methods. Within this interaction between cognition and action, the social aspect (networking) is the most important in terms of learning strategies. "A social perspective draws attention to the social construction of knowledge and of contexts for learning, and to the wide range of cultural practices and products that provide knowledge resources for learning" (Eraut 2004, 263).

Although all these factors affect learning, mostly in combination with each other, the extent of this effect is context-dependent. Hence, this study explores contexts at difference levels: critical learning episodes, business start-ups, and the institutional setting of business incubators. By studying the role of multiple factors in these contexts, this study enriches the literature on learning in evolutionary pathways.

Pathways, in turn, reflect the adaptation/innovation capacity of firms to endogenous and exogenous triggers through time. The former guarantees survival, whilst the latter reflects the capacity to run ahead of market trends and threats. Critical learning episodes are the unit of analysis of this adaptability/creativity process. The definition of pathways as arrangements of CLEs situated in the crossroad of entrepreneurial decisions, firm resources, social dynamics, and external environment in a given timeframe, provides a comprehensive perspective on evolutionary processes of business start-ups. As a consequence, there is a need for a

framework that considers complex interactions between these key factors. As stated by Van de Ven and Huber (1990, 215),

> [T]heoretically sound and practically useful research on change should explore the contexts, content, and process of change together with their interconnections through time. Just as change is only perceptible relative to a state of constancy, an appreciation of a temporal sequence of events requires understanding the starting (input) conditions and ending (outcome) results. In short, answers to both questions are needed to appreciate the inputs, processes, and outcomes of organizational changes being studied.

This claim for a process theory involves explaining sequences of observed events in terms of their generative mechanisms or laws, and the contingencies in which these mechanisms operate (Ven and Huber 1990). Process theory, then, permits the investigation of how organizational change emerges and evolves over time. This thesis builds theoretical arguments and propositions about a relatively short and intense period of organizational change in business start-ups' evolution. The empirical chapters explored these sequences of events and a wide range of mechanisms and contingencies associated to distinct evolutionary processes.

To conclude, the impacts of learning on the evolution of these business start-ups were aggregated in typical pathways. These show commonalities between evolutionary paths, for adaptation and/or innovation. At this level, emergent properties of this adaptability can be identified - for example dedication to the core product or creation of secondary products under different resource-bases.

Evolution in jumps versus incremental change

This section argues that there are evolutionary processes at the level of firms, since evolution is defined as "a qualitative, inherently discontinuous phenomenon" (Alcouffe and Khun 2004, 227). This is not to claim that the same characteristics of evolution from biological models apply to firms (Reydon, Scholz 2009), nor that the assumptions from the population ecology of firms are suitable to business start-ups – as critiques in Chapter 1 already argued. Nevertheless, this thesis concurs with Bataglia and Meireles' (2009) assertion that the evolution of firms is partly deterministic and partly stochastic. These aspects were discussed earlier in terms of path dependence and learning from the past *versus* path-

breaking and the creation of innovative pathways that bring in increased levels of variation and uncertainty. This approach is consistent with Schumpeter's theorization on the role of the entrepreneur in creating discontinuity for economic evolution (e.g., Alcouffe and Khun 2004, Landstrom 2008). As summarized below,

> economic evolution can only be explained by breaking away from the steady state framework that characterizes the economic circuit. [Schumpeter] pays special attention to the emergence of novelty, that is ascertained when major innovations materialize in the economy – e.g., discontinuity – producing a new state of equilibrium. It is striking that economic growth is not something that can characterize evolution because it involves only quantitative changes. 'While evolution is a qualitative, inherently discontinuous phenomenon, growth is nonetheless its pre-requisite.' (Alcouffe et al., 2004, p. 7) (Alcouffe and Khun 2004, 227).

In sum, in the long run, continuity and discontinuity feedback into each other in the evolution of business start-ups, or, as Miner et al. (2008) state, it is the balance between retention and variability of routines that keeps the value of prior knowledge while avoiding obsolescence. The main contributions of this study to the literature of learning through 'discontinuous events' (e.g., Cope 2003), 'change over stability' (e.g., Knight and Pye 2007), and rule change (Nelson and Winter 1982) is in showing how dynamics of critical learning episodes explain the evolutionary processes of start-ups that happen in jumps. This thesis redefines these trajectories as puzzles of factors composed of individual choices, local resources, social dynamics, and market and institutional conditions. By doing this, it offers an alternative explanation of processes of variation and selection at the firm level, in which organizational evolution is distinguished from biological evolution.

The last key point is that this study includes both low and high R&D-intensive start-ups. This expands the literature on evolutionary economics to include the local dimension of entrepreneurship, knowledge and innovation in the low end of R&D-intensiveness, since the literature has strongly focussed on high R&D-intensive activities (e.g., Nelson and Winter 1982, Garud and Karnoe 2003). This study claims that low R&D-intensive firms experience evolutionary processes that are as critical as those in high R&D-intensive start-ups, despite the distinct contents of these processes. Less R&D-intensive businesses may have little or no impact at the macro-economic level in terms of ground-breaking innova-

tion, but their internal evolution and market sustainability are crucial for endogenous local and micro-regional development, for the creation of jobs, enablement of an entrepreneurial culture, and the generation of income (e.g, Helmsing 2010, Mead and Liedholm 1998). Therefore, this study brings in development studies' concerns on the role of entrepreneurship, knowledge and innovation at the local and regional levels to the literature on evolutionary economics and theory of the firm (e.g., Landstrom 2008, Naudé 2008, Helmsing 2010).

Unpacking search processes

Search processes in high and low R&D-intensive start-ups can be very similar because of two interrelated reasons. First, the nature of search processes in start-ups; and second, the role of the entrepreneur in the process. Regarding the nature, this study confirms that search processes are irreversible, uncertain and contingent to the context (Nelson and Winter 1982). Furthermore, it shows how search can be defined as a learning process. Search is unpacked in endogenous and exogenous triggers, which can develop into either welcome (positive) or unwelcome (negative) outcomes. This is an *ex-post* assessment made by entrepreneurs, in the context of each business. Therefore, there can be more uncertainty than predictability in evolutionary processes than initially theorized by Nelson and Winter (1982). Two main sources of uncertainty are pointed out at the beginning of a search process: unforeseen exogenous triggers, and unforeseen endogenous triggers resulting from the implementation of critical decisions.

Another aspect of unpacking search is that it coalesces with learning processes as a function of the criticality of a trigger. Moreover, search can more easily be conceptualized as learning because of the limited scope of business start-ups, in which the entrepreneur or the team of associates have a central role in deciding upon search strategies. The first years of a business start-up are heavily marked by the close connection between entrepreneur and business, with the emotional and financial commitments that this connection entails (Cope 2003). Therefore, search in the first years is more an individual or team endeavour than an organizational routine or a task performed by a department within a bigger structure. This also adds some nuance to Nelson and Winter's (1982) factors that influence search strategy. The easy in achieving certain technical advances is more closely related to entrepreneurial characteristics,

such as the complementary expertise of the team of associates, than to calculated assessments of the payoff of R&D activities.

Given these conditions of limited resources in business start-ups, a search process that is interrupted before resulting in outcomes at the firm level is not associated to organizational learning[5]; inasmuch as daily learning of within-routines activities cannot be associated to search for the existence of a pre-set response protocol for known situations (e.g., Garud et al. 2011). Thus, not all search processes entail learning and vice-versa.

A central activity in search processes is networking. Exchanges with resourceful actors for social learning were central particularly in the first two years, after which their relative importance is gradually reduced over time to make place for other cognitive and behavioural learning strategies. At advanced stages, the start-up could rely more often on its own resources to search solutions for triggers. At the level of pathways, learning strategies related to networking predominate, indicating that networking is an essential learning strategy; yet it needs to be combined with others to be effective.

This prominent role of networking implies the relational ontology of path creation (Garud et al. 2010) for the impossibility of the entrepreneur to promote change by him or herself. A network of other actors is needed for entrepreneurial agency to be effective, supporting the concept of distributed agency developed by Garud and colleagues (e.g., Garud and Karnoe 2003, Garud et al. 2010). This concept states that different resources are in the hands of different actors, so that change can only take place when there is coordination between them to exchange resources. In business incubation settings, the incubator often mediates contacts and performs some level of coordination and brokerage in the network. This network configuration results in core-periphery relationships, in which the smaller scope and complexity of business start-ups becomes associated to a peripheral position that tends to direct search efforts towards more powerful actors in the network (i.e., business incubators and other support institutions).

Another key factor, inherent to the start-up phase and that constitutes a common ground between low and high R&D-intensive businesses, is shared overall goals. In the first three to five years, the characteristics of search processes between these types of firms are similar because virtually all the (scarce) resources of start-ups will be invested in setting up the

business and establishing the first routines, which tend to look alike, i.e., establishing a financial control mechanism, setting up production procedures, developing a business model, finding good suppliers and reaching out to reliable buyers. Therefore, although these routines will aim at different resource-bases, the entrepreneurial role in developing them is similar. Following the relational ontology of path creation (Garud et al. 2010), entrepreneurs of all types will be searching for similar resources from a relatively well-defined set of actors. If the issue is financial management, a consultant in finances or an accountant shall be the resourceful actor, independent of the intensity of R&D embedded in the product or service. However, at a more advanced stages of development, to the extent that firms' needs become more specific of a sector or product, the actors in the network, the content of learning and the types of routines will qualitatively increase the gaps between low and high R&D-intensive start-ups.

For the arguments drawn in this section, one can conclude that search needs to be investigated beyond outcomes measures (e.g., Metcalfe 2006) and mathematical models (e.g., Naudé 2008). Therefore, a methodological choice for a narrative approach (e.g., Langley 1999, Charmaz 2006) combined with the use of cross-sector analysis was an important strategy to describe *how* search takes place (e.g., Ven and Huber 1990). The generalization of this concept of search to other contexts, i.e., bigger enterprises or specific markets, is an empirical question. It is likely that more stable and complex organizational structures will constrain the fluidity of search within rules for search (or learning routines) in the working routines, making the process more dependent on the internal coordination of members and departments than on individual entrepreneurial initiatives. Also, these more structured organizational units might be more anchored in path-dependent processes to control uncertainty than open to path creation. This scenario increases challenges for search and, to a certain extent, increases the vulnerability of the business to external shocks due to lower flexibility (e.g., Lichtenstein and Lyons 2006, Lazaric 2008, van der Steen 2009).

Roles and dynamics of organizational routines

This section discusses the findings for the second key concept in evolutionary economics: organizational routines. Processes of change in routines have been under-researched and the available literature has fo-

cussed on contexts of gradual change within larger organizations (Lazaric 2011, Feldman 2000). Therefore, this study contributes to the literature by examining discontinuous change in small organizations, with almost no hierarchy, few or no previous routines, and a small number of employees, if they have any employees at all. Results have demonstrated that routines can perform three main roles in the evolution of start-ups: they can function as outcomes of change, as tools to manage change and as sources of change.

The ***first role*** corroborates the literature on evolutionary economics by demonstrating that organizational routines in start-ups illustrate the initial ways of doing things in a coordinated and predictable manner at the firm level (e.g., Nelson and Winter 1982, Lazaric 2011). This role is refined here by arguing that resource configurations are the substance of this coordination and they serve specific resource-bases. Furthermore, uncertainty in relation to learning outcomes prevents accurate predictions about the formation of specific routines. Rather, it seems to be more important to examine types and roles of routines that are crucial for start-ups. The focus of this first role becomes, therefore, the functionality of the new routines and their intertwined coordination with the current system of routines, which tends to become increasingly more complex.

The ***second role*** of routines, new in the literature, is in providing solutions for future critical learning episodes. This role signals the maturity, functionality and legitimization of the working routines in relation to their acquired normative roles, and the reliance of entrepreneurs on the ways that they do things. In this regard, routines become one of the endogenous resources to cope with triggers. The increased combination of extrinsic reflection and practical application in advanced stages of the start-ups' evolution supports this argument. Hence, established routines provide services (Penrose 1980 [1959]), such as interpretations about an episode in progress, protocols about who are the resourceful actors that can help solving a trigger, and working practices that can be successfully transferred to a new situation. Nevertheless, strong reliance on the current system of routines may signal path dependence on the internal resources and less efforts to invest in innovative ways of coping with triggers. This seems to be an expected evolutionary feature, since more complex and interdependent organizational routines will be more functional in deploying the resources available, with a higher probability that

they will be applied to solve triggers. This is an efficient way of deploying a firm's resources as it is cognitively less costly and performed more quickly (Lazaric 2008, Eraut 2004). Nevertheless, if automatic cognitive processing becomes prominent, the continuous assessment of effectiveness and corresponding adjustments to these routines may be hindered.

The ***third role*** of routines is triggering new critical learning episodes when they lose their functionality or when their execution creates new needs. This role can, to some extent, be associated to the constant need to understand, revise and adapt routines (Lazaric 2011). It also strongly corroborates claims on the changing character of routines (Feldman 2000, Feldman and Pentland 2003) that emerge from successive iterations and continuous evaluation of the resulting outcomes by the performing agents. In addition to corroborating this literature, the present study discloses which routines trigger changes by specifying the content of triggers. This brings in the potential to analyse chains of events based on the evolution of organizational routines.

In conclusion, it is noticeable that these roles are not exclusive or apart from each other. The same routine can perform different roles in different stages of the evolution of a start-up, depending on the interactions between intra-firm capabilities, market dynamics, and institutional settings. Therefore, the formation and transformation of routines is part of the "normal job" (Casson 2005, 340) of entrepreneurs.

Deepening the discussion about the dynamics of routines, this study also identified qualitative changes in groups of routines[6] (Chapter 4). It has demonstrated that the content of routines related to entering and surviving in the market show more drastic changes in the first and second years. This leads to the conclusion that these very first routines are more subject to deep changes due to their thinness and looser character in comparison to routines in later stages of the start-up's development. This result may substantiate what, in an evolutionary perspective, has been called the 'valley of death' of start-ups (e.g., Cressy 2008 [2006]). These routines are marked by more temporary and even experimental features. However, as they are socialized, legitimized, intertwined, and interdependent, they will gradually become less subject to drastic changes by new learning outcomes, and will tend to operate more cohesively as a system of routines. This increasingly constrained flexibility to change has been attributed to established cognitive frameworks, memory automatisms typical of procedural knowledge (Lazaric 2008), path-dependence

processes, increased organizational complexity (mosaic of organizational routines), institutional or cognitive inertia (e.g., Huet and Lazaric 2009), and interdependence between working routines that may give preference to continuous gradual changes (as those described by Feldman 2000).

Pathways

This section discusses the role of pathways in this learning-based approach to the evolution of business start-ups. The link between pathways and learning is at the base of the concept, since critical learning episodes are the building blocks of pathways. The link between pathways and evolution, in turn, is multi-layered. First of all, the five typical pathways show that firms evolve in different ways, and the dynamics of resources are at the bottom of differentiated evolutionary paths. Since pathways are not accurately predictable (and, therefore, susceptible to strict planning), they are constantly under some probability of change, conditional to changes in the internal or external environments of the firm. Therefore, pathways are not instruments to predict the evolution of start-ups; they provide an analytic tool to investigate how critical events affect the resource-base of firms towards path dependence or path-breaking.

One of the key dynamics within pathways, which influences the evolution of firms the most, is networking. It is through networks that entrepreneurs exchange resources and learn. Studies on the growth of small enterprises have extensively claimed that networks are critical to help entrepreneurs access market actors and insert their businesses in sustainable market activities (e.g., Nichter and Goldmark 2005, Gelderen et al. 2006). For instance, having initial networks with market actors is critical to those start-ups in Pathway 1, for the direct production (need for suppliers) and commercialization (need for buyers) of the product or service. Initial networks with research centres and universities mark the beginning of all high R&D-intensive start-ups for access to technological development.

In addition to the influence of initial networks, and because evolutionary pathways are marked by change, expansions in these networks influence the creation of secondary products or services. Business incubators can play a central role in setting up networking activities that foster value adding alternatives to business start-ups, influencing further developments of their pathways. Some of these events involve graduated entrepreneurs, financial institutions and investors[7]. In addition to delib-

erate initiatives to expand networks, there is the informal dynamism of networks, once the start-up is acting in the market. Through first sales and the initial consequences of growth, business opportunities are identified and created, which may affect decisions to invest in new resource-bases that will change the firm's pathway. This process of establishing weak ties with resourceful actors as a source of new information, innovation and further access to other new market actors is well-documented in the literature (e.g., Granovetter 1983, Cross and Prusak 2002, Xu 2011).

In addition to the exchange of resources, two other aspects of these networking dynamics that impact on the formation of pathways are isomorphism and embeddedness. As start-ups become more embedded in business and market networks, ties with resourceful actors will become stronger and the resemblance between start-up and other businesses in the same market niche will increase, because of isomorphic effects. Strong ties are important for trust, long term relationships (e.g., Granovetter 1973, Granovetter 1983), and reduction of risk (Xu 2011), but they increase the amount of redundant information, narrowing the flow of new ideas for innovation, and the possibilities to renew cognitive frameworks to interpret and deal with critical events (Granovetter 1983, Xu 2011). Furthermore, isomorphic processes, which are advantageous for facilitating interactions since rules of exchange, norms and incentive structure are shared (e.g., Gössling 2007), can, for the same reasons, create a lock-in situation that hinders the perception of opportunities out of the well-known environment. In sum, deliberately engaging in these networking processes might be a strategic decision to insert the business in the market; the challenge, then, is in expanding the diversity of these relationships, letting weak ties bring novelties.

It should also be clear that these pathways do not correspond to sequential phases in the evolution of business start-ups. It is likely that many start-ups, especially those that are low R&D-intensive, remain in the same pathway also in advanced stages, with some diversification within the existing resource-base. Therefore, these pathways may run independently for many start-ups. Nevertheless, the concept of pathways does not entail complete independence. Hypothetically, start-ups may move from Pathway 1 to 3 or 4, if in later stages they develop secondary products that require a different resource-base. However, this transition between pathways has constraints, since some of them are logically impossible. For instance, a start-up in Pathway 2 will not move to Pathway

1, since the core product requires several years to be developed. Furthermore, structural constraints may hold back other transitions: for instance, the lack of a local research centre may prohibit access to technology that would add value to a low R&D-intensive business. Thus, these pathways apply to the first three to five years of operation and may not reflect advanced stages in the evolution of these same start-ups.

6.5 Business incubators: invisible services

The evolution of business start-ups is marked by high rates of failure in the first three to five years (e.g., Kelley et al. 2010, Nichter and Goldmark 2005, SEBRAE 2007, Naudé 2008, Cressy 2008 [2006]), for reasons such as lack of access to needed resources (e.g., Mead and Liedholm 1998) and mal-management of available resources (e.g., SEBRAE 2007). Efforts to tackle these difficulties and support growth pathways have been developed by business development services (DCED 2001) and, more specifically, by business incubators (e.g., Lichtenstein and Lyons 2006, Lalkaka and Shaffer 1999) across the world.

The structure of this thesis clearly shows that it did not examine the issue of business incubation programmes as a whole; rather, business incubators are treated as an institutional setting that facilitates entrepreneurial learning. This reflects the fifth research sub-question: ***How can business incubators provide a learning setting for entrepreneurs?*** This question relates to claims from the innovation framework (OECD and Eurostat 2005), and SEBRAE's policies in Brazil. It is by opening networking opportunities between entrepreneurs and resourceful actors that business incubators facilitate the acquisition of critical resources, such as knowledge, technology, and innovation cooperation. Business incubators, therefore, are re-conceptualized as learning settings that provide resources mostly through brokerage roles. They facilitate the endogenous creation of resources through formal training and social learning. Through brokerage, business incubators provide access to external resources from support and market networks.

This section discusses the role of the main categories of services provided by business incubators. The first two services, operational and strategic, are well-known in the literature (Altenburg and Stamm 2004, Lalkaka 2001). The third highlights those 'invisible' services that are

commonly overlooked by incubators' managers and other institutional partners.

The role of operational services

Many entrepreneurs enrol in business incubation programmes in search for a reduction of fixed costs. All except one incubator in this study had systems of sharing the costs of facilities such as office space, secretary, telecommunications, internet, meeting room, kitchen, and so on. These can represent impeding costs in the first years if the entrepreneur has to bear them on his or her own. In fact, for some start-ups, although operational services are not listed amongst the most important ones in the long run, these services are acknowledged as crucial for survival in the first two years, specifically during the 'valley of death' period (Cressy 2008 [2006]). In conclusion, although basic operational services may not be at the core of evolutionary pathways, they provide a safe ground for those pathways to be built upon.

The role of strategic services

Lichtenstein and Lyons (2006) claim that business incubators promote quantitative and qualitative changes in entrepreneurs' competences to run their businesses. These competences, in Brazilian incubators, are predominantly managerial due to the underlying assumption based on results of surveys by SEBRAE (e.g., SEBRAE 2007), which indicate that the main bottleneck for business start-ups is a lack of managerial competences. These competences are characteristic of moderately dynamic markets, in which managers are expected to "develop efficient processes that are predictable and relatively stable with linear steps, beginning with analysis and ending with implementation" (Eisenhardt and Martin 2000, 1110). However, since business incubators are becoming increasingly technology-driven, this model is starting to fail for some of the start-ups. For instance, a lack of expertise in high R&D-intensive activities and high-velocity markets has impacted on the assessment of entrepreneurs about the effectiveness of services provided by business incubators.

The contribution of this study to this debate argues that managerial competences will only influence the evolution of start-ups if delivered in a timely manner and contingent to the start-up's needs, especially during critical learning episodes. The ideal configuration of resources to develop managerial competences, therefore, would combine regular training in

general issues with specific strategic guidance in face of critical learning episodes. This study provides an analytical framework that might be useful to incubators' managers and consultants, in relation to paying close attention to the current critical learning episodes, the needed resources, and the possible developments guided by a grounded analysis of the resource-base of the start-up and the costs of learning. Hence, the effects of these consultancies upon the evolution of start-ups can be leveraged by matching learning contents with the firm's context and needs.

It was discussed in Chapter 5 that the content of learning varies between pathways. Some of these contents refer to cooperation, which requires trust and information sharing. This implies a different balance between selective cooperation and competition. For instance, those engaged in Pathway 4 (creation of spin-offs) clearly learn more on sharing competences and managing multiple business structures. However, they may not need much learning about the specific processes taken up by the business partner. Differently, when start-ups work more in isolation, such as in Pathway 1 (direct production of the core product or service), there is intensive learning of internal managerial routines and of marketing strategies to rapidly insert the product in the market. There is also emphasis on learning about how to deal with competitors, since most of these businesses operate in competitive markets. The latter learning concern is irrelevant for start-ups in Pathway 2 (dependence on R&D grants), in which learning is focussed on technology development, and competitors often do not exist. Therefore, part of the strategic services of business incubators should include recognition of these different learning needs across pathways. It is important to emphasize that it is not the case of creating a rank of learning contents, since these are contingent to the learning demands characteristic of each pathway, and, more specifically, of each critical learning episode.

An important point here is that the agency of the entrepreneur prevails in judging whether the content of these consultancies is adequate meet to the scope and current needs of the firm. One cannot assume that the consultant, however close he or she is to the business, is part of the internal resources. This increases the role of mutual trust and exchange of information. Furthermore, recognizing the role of agency opens room to acknowledging informal learning processes, which can be more influential in entrepreneurial formation than formal processes (e.g., Eraut 2004), as discussed in the next sub-section.

A key strategic service is the role of business incubators in providing guidance that prevents foreseeable critical issues. These can be characteristic of a certain sector, or be inherent to the smallness of business start-ups, stem from a lack of entrepreneurial experience, or relate to the typical pathway that is being followed by the business. In general, strategic services could help entrepreneurs focussing on business opportunities of higher added-value based on the internal capacities of the firm and the resources available in the entrepreneur's network. One outcome could be, for instance the search for partnerships with other businesses for product development (Huet and Lazaric 2009). Nevertheless, a precondition for this is that the business incubator is well-connected to support institutions and market actors. An isolated business incubator has little to offer in terms of strategic services that would contribute to the learning and evolution of a start-up (e.g., Bollingtoft and Ulhoi 2005).

Therefore, in the learning-based approach proposed here, business incubators have a critical role to play in providing access to experts, which will increase the range of options to deal with critical events. In Dopfer's (2005) terms, the strategic services provided by business incubators offer variation of actions and provide support to select the most suitable one(s). This point strongly impacts, for instance, on the provision of strategic services to high R&D-intensive start-ups whose products are supply driven. Strategic guidance could, then, bring the demand element into the development of the product, guiding these start-ups towards more sustainable pathways, other than dependence on R&D grants, characteristic of Pathway 2.

In addition to consultancy, another strategic service provided by business incubators that indirectly influences the evolution of business start-ups is the image of the incubator, or its reputation (Hormiga et al. 2011). In general, it seems that trust in the seriousness of the incubator by internal and external actors is passed onto the incubatees and eases their entrance in the market. This positive image can be attributed to the incubator itself, for having a reliable selection process and examples of successful graduates in the market; or can be attributed to the university or research centre to which the incubator is associated.

In some sectors, mainly in high R&D-intensive areas, borrowing this image provides a comparative advantage when entering the market. Buyers, suppliers, and also investors bet on the start-up's potential on the

basis of the positive image of the incubator or the research institution. It was found that the selection process per se already functions as a quality seal for start-ups (e.g., McAdam and Marlow 2007), which incorporate this information in their portfolios as an indicator of credibility and trustworthiness. However, one important nuance of the use of this image is that incubators are also places for beginners and this may impact negatively on start-ups experiencing fast growth.

Another function of the selection process that may easy the learning costs in start-ups' pathways is the interesting concept of collective profile, found in a few business incubators. This refers to complementary expertise within the team of associates, advised for from the very beginning of the application process and sometimes used as a selection criterion for new incubatees. This way, individual competences are deployed right from the start, and gaps in managerial or technological expertise can be minimized.

Invisible services: informal dynamics in business incubation settings

This section draws on services that are superficially referred to by the literature, underreported by incubators' managers and highlighted by entrepreneurs' narratives as the second most important service provided by business incubators. They are all network-based and, due to their customized, strategic, and uncertain character, do not characterize a regular strategic service. These services are not provided evenly to all incubatees and their results are not translatable into targets or other specific measures. This intangibility may explain why they tend to be overlooked or undervalued as sporadic punctual support. The purpose here is, therefore, to make these 'invisible' services visible by discussing how they link to evolutionary processes. Three main types of such services are detailed: information brokerage, promotion of cooperation *versus* competition, and collective learning environment. These networking-based services support the redefinition of business incubators as information brokers (Cross and Prusak 2002) and providers of an environment of intensive learning (Abbad and Borges-Andrade 2004).

Information brokers are powerful actors in dealing with structural holes in a business incubation network. These actors connect different groups – which tend to be internally homogeneous – and bridge access to information that informs new ideas (Burt 2004). By bridging groups,

business incubators connect the group of incubatees to governmental agencies through the circulation of calls for grants, to graduated firms through business cafes, to experts through regular seminars. This way, business incubators keep communication flowing between start-ups and consultants, SEBRAE, research institutes, banks, investors, and other actors (e.g., Lalkaka 2001). Here, the incubator's manager is the central actor, since he or she is the trusted person by all the others. It is through these trust-based relationships that information brokerage is realised. Most of the entrepreneurs recognize this role and attribute much of the success or failure of the incubator to the performance of its manager in brokering information and connecting them to resourceful actors (Corradi 2012).

Managers are also held responsible for the internal relational dynamics between incubatees, so that the incubator can range from a lively environment of exchanges and cooperation, to a long corridor of closed doors and limited exchanges, or even to an environment of competition between start-ups in the same or similar sectors. Evidence suggests that issues of **cooperation *versus* competition** relate to the frequency in which managers are changed by administrative institution (university, municipality, research centre, etc.). Overall, business incubators with a high turnover of managers signalled fewer interactions between incubatees and more episodes of competition between them. The best practice cases report an environment that promotes cooperation for innovation and growth, some kind of community of practice in which information is exchanged, in contrast with an individualist view of one's own business (Corradi 2012).

This cooperative approach impacts the cognitive frameworks of entrepreneurs, even after leaving the incubator. This type of organizational culture influences strategies to divide labour, share space and information, and lower the hierarchical distance between entrepreneurs and employees. In addition to this, start-ups in the technology and communication sector often use a promotion policy of prizing outstanding employees or interns with partnership in the business, characterizing entrepreneurship in small enterprises (e.g., Carrier 1994). All these cooperative practices contribute to cost reduction (i.e., shared fixed costs, lowered turnover of interns and employees), and increased collective decision-making (i.e., brainstorming for product design and innovation).

A negative aspect of these invisible services that may lead to more critical learning episodes of competition depends on the type of business that is incubated. Episodes of unfair competition took place between similar start-ups that were neighbours in the incubator. This has implications for the selection process of business incubators and for the distribution of these businesses inside the incubator's facilities. This means that competition can be inadvertently promoted by the incubator, as a counter-service to entrepreneurs, as pointed out in the literature (e.g., McAdam and Marlow 2007).

Despite the risk of competition when incubatees operate in the same field, best practice incubators could manage the internal dynamics to deploy the capabilities of these firms and increase innovation through cooperation well. This environment of healthy exchanges between incubatees, incubator's manager, graduates, consultants and other service providers is characteristically conducive to growth (Nichter and Goldmark 2005). The role of incubators, therefore, expands from a service provider to individual firms to a public goods provider, in the sense described by Altenburg and Stamm (2004). This business environment, with intensive cooperative exchanges, would then characterize the most strategic service that business incubators can provide: a **collective learning environment**, or, at least, a setting for inter-organizational learning (UNIDO and Leuven Centre for Global Governance Studies 2011, Hormiga et al. 2011).

Interactions between incubatees in the incubation setting showed the establishment of multi-relational networks across all pathways. These are networks in which actors establish multiple types of relationships between them (Boissevain 1974), strengthening their connections and increasing the variety of resources they exchange. Transactional contents ranged from informal exchanges of information to formal business partnerships for product development or trade. Informal exchanges of information take place in corridor talks, participation in seminars, courses and meetings, and through information brokerage by the incubator's staff about what different start-ups are developing. In these environments, entrepreneurs manage their networks based on their perceptions, experiences, and exchanges with other actors, and guided advices from incubators' consultants and managers. All these bits of information have the potential to affect evolutionary paths, for instance, towards innovation (Xu 2011). Hence, incubators that provide a rich learning environ-

ment make more resources available to their incubatees, increasing the variety of options and the support for the selection of the best alternatives. It is within this collective learning environment, in which formal training is combined with social learning (Bandura 1986) and informal institutions (Sanjaya Lall 2002), that business incubators work as socially constructed communities of practice (Cairns and Malloch 2011).

6.6 Methodological contributions

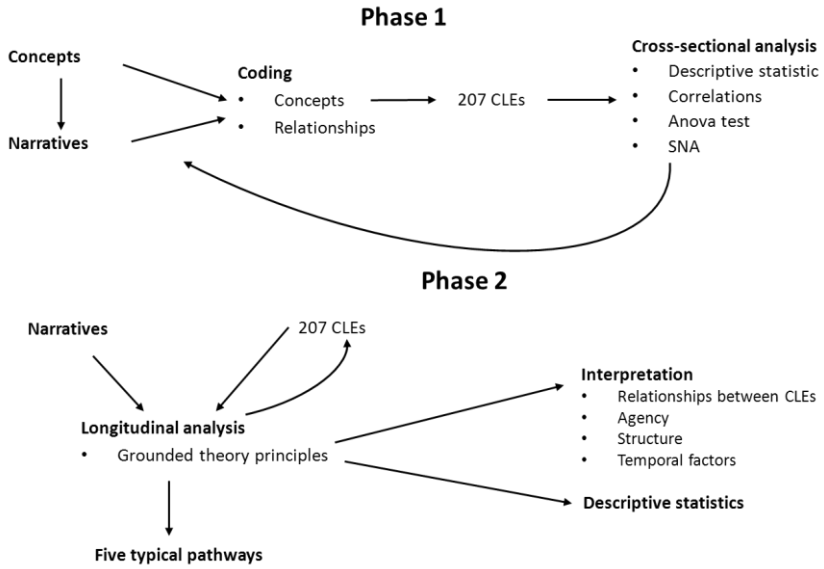
Some of the methodological contributions of this study were briefly mentioned in previous sections. Here, they are summarized around two key arguments: studies of organizational processes and mixed methods. A general contribution of this research has been in developing and testing a methodology to describe context-dependent processes of change in organizations (e.g., Glick et al. 1990), specifically in relation to the measurement of learning outcomes at the organizational level (Moraes and Borges-Andrade 2010). To do so, it made use of grounded theory principles (e.g., Strauss and Corbin 1998), which guided the elaboration of 'theoretical questions' about process, variation and connections between concepts that compose the analytical framework.

> Process data collected in real organizational contexts have several characteristics that make them difficult to analyze and manipulate.' First, they deal mainly with sequences of "events": conceptual entities that researchers are less familiar with. Second, they often involve multiple levels and units of analysis whose boundaries are ambiguous. Third, their temporal embeddedness often varies in terms of precision, duration, and relevance. Finally, despite the primary focus on events, process data tend to be eclectic, drawing in phenomena such as changing relationships, thoughts, feelings, and interpretations (Langley 1999, 691-692).

The exploratory technique of retrospective semi-structured interviews with entrepreneurs successfully served the purpose of collecting process data through narratives of critical events in the start-ups' storyline. These interviews placed the key agents (entrepreneurs) at the centre of processes of routine formation and change (Feldman 2000). In addition to this, this study corroborates the use of narratives in process studies (Langley 1999) and the relevance of investigating multiple cases to develop organizational theory (Eisenhardt and Graebner 2007).

The methodology combined deductive and inductive orientations (e.g., Creswell 2009) for data analysis, with results from one method feeding the following stage of data analysis, in the other method (Figure 6.1). This use of mixed methods studies (e.g., Creswell 2009) differs from the most common designs that fraction sections of the research in quantitative *versus* qualitative parts, which the result that the different phase of analysis have little connection between them.

Figure 6.1
Diagram of the mixed-methods approach



The initial analytical framework for defining the key factors involved in the evolution of business start-ups, provided an overall idea of the concepts and processes under investigation. At that stage, the concept, properties and dynamics of critical learning episodes at the firm level were unknown, and the idea of pathways was not yet developed into a full concept. Anchoring the entrepreneurs' narratives in theoretical landmarks, such as the beginning, duration and conclusion of critical learning episodes, provided rich material with which to investigate these specific events and their impacts on organizational routines. Successive analysis of each interview revealed types and properties of critical learning epi-

sodes, which led to refinements of the original conceptual framework (i.e., inclusion of creation and loss of resources as triggers to change).

In addition to this, variations in CLEs provided inputs to descriptive quantitative analyses, and disclosed relevant relationships between variables. These quantitative results, in turn, generated further questions that were investigated through a qualitative examination of relationships between critical learning episodes. As a result of this inductive approach, the concept of typical pathways emerged. This matching of techniques, including efforts to triangulate results, supported the investigation of "questions about what the causes or consequences are of the events within the process pattern" (Ven and Huber 1990, 214).

This particular methodological trajectory was suitable to the exploratory nature of this study, for which little methodological benchmarking could be found. In this regard, the methods used here might contribute to future studies of processes in organizations, since this mixed-methods approach allowed cross-cutting and in-depth longitudinal perspectives; the former for the description of parts of micro-processes of learning and resource use and the latter for the description of evolutionary processes.

6.7 Contributions to development issues

Local enterprises, because of their scope and connections to the local or regional resources, are central actors in promoting endogenous development, consistent with local availability and their capacity to use these resources (e.g., Helmsing 2001). Even in resource-poor regions, start-ups can be adaptive and actively contribute to the resilience of the region (Helmsing 2010) by strategically combining scarce resources in innovative ways. In the Brazilian case, there have been several efforts to ease the formalization of business start-ups and to provide them support (ANPROTEC and MCT 2012, Brasil 2008, Brasil 2005). Nevertheless, cross-country comparisons by the Global Entrepreneurship Monitoring (Kelley et al. 2010) argue that, in Brazil, indicators are low for innovation and the nascent entrepreneurship rate. Hence, this study explores how entrepreneurs create new configurations of resources in two resource-rich regions in Brazil.

First of all, this study corroborates the literature about the difficulties faced by business start-ups in the first two years of operation (Cressy

2008 [2006]) and the importance of business development services, such as business incubators, to provide the needed support (Bollingtoft and Ulhoi 2005). Similarities between critical learning episodes amongst very distinct profiles of entrepreneurs and start-ups suggest the existence of some common critical events that affect these new businesses. Moreover, these are, most of the times, not linked to financial constraints, corroborating the literature that claims the higher importance of learning needs in business start-ups (e.g., Casson et al. 2006). It is based on these learning needs that fundamental differences are identified; they are inherent to the resource-base of each start-up and the corresponding need for specific resources from entrepreneurs, networks, firms, the market and institutions. In this regard, this study contextualizes firm dynamics, and provides a better understanding about the impacts of pressure to survive in comparison to business opportunities that are more conducive to high value adding activities.

These contributions are all centred on learning processes, with business incubators working as learning settings that combine both formal and informal learning processes. The main advances in knowledge due to this learning-based investigation of the evolution of business start-ups are:

- Acknowledgement of the role of agency: the entrepreneur is the central actor in business start-ups processes. Here, beyond the theoretical discourse, entrepreneurs' voices provided information, explained relationships between concepts in the analytical framework, and pointed out the key factors affecting the evolution of their firms. This way, this thesis links theories of the firm to the entrepreneurship and economic development literature (e.g., Naudé 2011), beyond the analysis of impacts of isolated individual characteristics of entrepreneurs on firm growth (e.g., Nichter and Goldmark 2005);
- Bottom-up process and multilevel analysis: this research started from the micro level of individual learning and moved up to the organizational level of routines, and then, learning-based typical pathways. Analyses explored how these levels connect to each other, feedback each other and impact evolutionary paths;
- Methodological alternative: the use of mixed methods to develop theory and provide an empirical ground to propositions was a successful strategy to grasp the dynamics of the evolution of business start-ups

during the most unstable years, in which conventional performance measurements alone produce limited insight;

- Multiple factor perspective: this is the most ambitious of these contributions to development studies, since it requires detachment from one-factor explanations, and the recognition of the contingent importance of each factor to the critical episode or to the typical pathway that is in place. Although some studies point out the heterogeneity within the small enterprises sector and the need for well-targeted strategies to achieve small enterprise growth (e.g., Nichter and Goldmark 2005), little theory is found to support this perspective. At the level of development literature, this aspect reflects the framework of multi-actor governance to strengthen local capabilities (Helmsing 2010). This study advances the debate by providing some evidence for a multi-layered explanation of business start-ups' dynamics, though, given the scope of the thesis, it raises more questions than answers.

Two other contributions to development studies relate to R&D-intensiveness. This study indicates that the main differences between low and high R&D-intensive start-ups, at least in what concerns their evolutionary pathways, are their network profiles and investment needs. For the start-ups in this study, those at the low R&D-intensive end aim at the local and (micro-)regional markets, whereas those at the high end target the national and international levels. The former receives considerably less financial and institutional support than the latter, despite their role in creating local jobs and promoting economic dynamism in resource-poorer regions. There is unequal geographical distribution of resources, which impacts on what knowledge and networks are available to which business start-ups. Ultimately, this impacts on intra- and inter-regional levels of development and on the growth potential of different types of businesses. This argument connects the learning-based pathways developed in this thesis to the literature on local economic development, and leads to further considerations.

Targeted policies to reduce inequality should aim at low R&D-intensive start-ups and count on the participation of local and regional business support networks. For instance, specific programmes for capacity building and aggregation of value to low R&D-intensive products would contribute to increasing local labour capabilities and the competitiveness of these firms (e.g., Cairns and Malloch 2011). Local govern-

ments and state level institutions acquire special relevance in stimulating and strengthening local economic development through low R&D-intensive start-ups (Naudé 2011).

The advantages of supporting these firms are that they are comparatively less demanding in terms of resources and have a more immediate impact on local economic dynamics, since most of them follow Pathway 1 (direct production and commercialization of the product or service). This might generate positive externalities if analysed in the selective spatial closure perspective (Helmsing 2010), in which local resources are territorially integrated to develop local suppliers and consumption markets. In the long run, by attracting other institutions, regional innovation systems (e.g., Naudé 2011) could develop, such as research centres to stimulate actions towards the high end of R&D-intensiveness.

The last contribution to development studies tackles the role of business incubators in local economic development. The business incubation movement in Brazil has increasingly turned its attention to high R&D-intensive activities, in alignment with the National Policy for Productive Development and the National Action Plan for Science, Technology and Innovation (2007-2010) (ANPROTEC and MCT 2012). To accomplish this new orientation, this thesis points out the need to acknowledge the central role of learning processes and networking dynamics within business incubation settings. At the policy design level, the definition of innovation needs to be accurate and explicitly include frequent situations in which process and product innovations coalesce, as happens in business start-ups in which entrepreneurs combine technological, productive and managerial roles, capabilities and networks.

Within business incubation settings, fostering formal and informal learning processes is crucial for the effectiveness of incubators' services. Exchanges with consultants, other incubatees, and the central role of network brokerage by incubator managers to link start-ups to external actors should be recognized as part of a package of services. This implies that a network perspective replaces the view of business incubators as providers of services to individual firms. Seeing the incubator in this social learning environment, as defined here, seems to be more appropriate to ensuring positive impact on economic development dynamics, since it acknowledges learning and social capital in the development of individual and collective capabilities. A first step in this direction is guaranteeing that business incubators managers embrace this role as facilitators of

learning and network brokers between entrepreneurs and resourceful actors.

6.8 Limitations and research agenda

This thesis was intrinsically motivated by a need to expand knowledge about learning in business start-up's contexts. This drive to open up avenues of multidisciplinary research resulted in contributions to theory and method in the areas of theory of the firm, local economic development, organizational psychology, and organizational studies in general. However, the price of broadening an area of study is a lack of depth in specific topics. This is also the case here. This section explores some key limitations of this study and proposes a research agenda to tackle these limitations and advance research in micro-processes of economic development.

Starting with the limitations, the most important one is the lack of non-incubation comparative cases to check the generalizability of the results. Since this study claims that resources are distributed among different actors and entrepreneurs have to deal with this embedded agency to set up a new firm, it is likely that institutional arrangements outside the business incubation system will impact access to different resources, and, thence, generate different pathways. Issues of generalization are compromised also by the small number of cases and the methodological option for resource-rich regions for data collection and grounded theory principles for data analysis. Another limitation is imposed by the close attention to the specific power of support institutions upon business incubators and business start-ups, such as the impact of national R&D policies on innovation practices.

For a research agenda, from the several topics that could be raised from the limitations, the propositions and the contributions to theory and method, the following items are highlighted:

- **Advance of knowledge about learning processes in business start-ups**: the literature on multilevel organizational phenomena distinguishes between learning processes of composition *versus* compilation (Klein and Kozlowski 2000), which, to a great extent, correspond here to the process of continuous *versus* discontinuous learning from the individual to the organizational level. These processes refer, respectively, to adding similar competences and multiplying diverse

competences. It is an interesting topic of research to investigate the extent to which these processes impact on innovation in business start-ups. Would these learning processes relate to specific types of search (explorative *versus* exploitative) for technological development (Xu 2011)? Moreover, how would these dynamics of exploration and exploitation affect evolutionary processes such as the generation of variation and the replication of the best variations in multiple contexts? What kinds of combinations between cognitive and behavioural processes would be involved? This last question would require discussions on deliberate *versus* non-deliberate learning (Lazaric 2011) and types of cognitive processing (Eraut 2004) to investigate associations between learning strategies and type of knowledge production. The last point in this agenda tackles further investigation of learning routines: how are these types of routines formed? How do they influence engagement in innovative activities, the use of specific combinations of learning strategies, and the configuration of new routines? What is the balance between institutionalized practices of learning (learning routines) and actual organizational change?

- **Deepening understandings about the role of business incubators**: since this study did not include an assessment of the impacts of specific services provided by business incubators upon the evolution of business start-ups, studies in which the incubator is the focus-organization could show what types of services are more influential in start-ups' pathways. In addition to this, such studies could reveal how the institutional environment of business incubators affects their role as information broker. This type of design would change the focus from the entrepreneur to the incubator's staff team and how it manages social capital potentials and dynamics (e.g., Hormiga et al. 2011).
- **Testing the generalization of results**: the key research agenda here is on comparative studies. It would be very interesting to compare resource-rich and resource-poor regions, considering the sector of activity of the firm, R&D-intensiveness, and comparison with cases outside business incubation programmes. At the entrepreneurial level, since the profile of entrepreneurs here differs from the general profile in relation to some key attributes (i.e., entrepreneurial experience and professional experience), it is worth investigating if the types and frequencies of critical learning episodes apply to this general profile. In a similar way, would this structure of five pathways fit the evolution of

business start-ups in resource-poorer regions, and even in different countries? Would the country-level development path (i.e., efficiency-driven group *versus* innovation-driven group as defined by GEM (Kelley et al. 2010) impact on the types and dynamics of pathways? Inter-regional and country-level comparisons might shed some light on the robustness of findings at these many levels.

- **Expansion of this analytical framework**: a key point in this agenda is further theorizing on the relationships described in this study. This research opened questions and elaborated propositions that might be worth in-depth investigation in order to come to a more comprehensive explanatory scheme. In addition to these theoretical advances, this analytical framework could be expanded to link evolutionary pathways to performance measures (e.g.: revenues and number of employees), investigating impacts of the former onto growth indicators when the start-up becomes established in the market. A last point on this agenda is linking discontinuous learning to continuous accumulation of knowledge and small scale adjustments in working routines (e.g., Feldman 2000)[8]. This connection was beyond the scope of this study, but in-depth single case studies may disclose fruitful knowledge about feedbacks between these two types of learning.

  Follow-up studies: longitudinal case studies, beyond the start-up phase, could disclose how the initial organizational routines studied here evolve into coordinated systems of routines. Potential contributions of this type of study are describing processes of socialization and legitimation of routines amongst employees, and the likely reduction of flexibility to change because of the higher costs of learning and incorporation of learning outcomes to the working system of routines.

Notes

[1] The word 'arrangements' is an inclusive term involving sequences, independence, and concomitance of CLEs in a firm's pathway.

[2] Variation, here, differs epistemologically from the literature on dynamic capabilities. Instead of conceiving product diversification as a result of strategic management of opportunities and threats, this thesis claims that variations in types and uses of resources, which materialize in products and services, result from interactions between new and existing information and routines, through active

combinations of sources of resources that can break path dependence and lead to a new resource-base (innovation). The key difference is, therefore, the substitution of a prescriptive approach to an analytical one.

[3] Although these categories of products and services resemble the distinction between single *versus* multiproduct firms (Bataglia and Meirelles 2009), this study focusses on how the former result from resource configurations and organizational routines. Thus, instead of relying on assumptions from organizational strategy and their expected long lasting results, this study reflects the changing nature and the cognitive elements in developing more than one resource-base.

[4] An important remark is that the types of routines studied here differ from those in the literature for their simplicity and lack of connection to a pre-existing system of routines, given the stage of evolution and the scope of business start-ups. Interactions between learning and organizational routines were studied by Zollo and Winter (2002), for instance. However, these authors focussed on process R&D, restructuring and re-engineering, and post-acquisition and integration. These routines are so complex and connected to the working system of routines that they account for meta-routines when compared to the routines in this thesis.

[5] Note that some degree of individual learning is likely to happen, but of the type that does not translate into organizational routines – labelled by different authors as single-loop learning or low-level learning (e.g., Rousseau 1997, Argyris and Schon 1978, Fiol and Lyles 1985).

[6] This differs from longitudinal, in-depth case studies applied elsewhere (e.g., Feldman 2000).

[7] Data from the interviews with incubators' managers and secondary material, i.e., press releases, websites, and reports.

[8] Or, as labeled by other branches of the literature, to processes of socialization of knowledge (e.g., Bastos et al. 2004), cumulative learning (e.g., Helmsing 2001), entrepreneurial learning (e.g., Cope 2003), organizational learning systems (Shrivastava 1983), and so forth.

Appendices

Note: Appendices are provided in separate files.

Appendix 1
Outline of the interviews with the entrepreneurs

Appendix 2
Profile of business incubators' (BI) managers

Appendix 3
Business start-ups' general profile

Appendix 4
Classification of market and economic activities according to the product

Appendix 5
Codebook from Atlas.Ti

Appendix 6
Two-step cluster analysis for critical learning episodes

Appendix 7
Codebook for SPSS and correlation matrices

Appendix 8
List of routines, per category

Appendix 9
Diagrams of individual pathways

Appendix 10
Two-step cluster analysis for pathways

Appendix 11
Business start-ups per typical pathway

References

Abbad, G. and J.E. Borges-Andrade (2004) 'Aprendizagem Humana Em Organizações De Trabalho (Human Learning in Work Organisations)', in J.C. Zanelli, J.E. Borges-Andrade and A.V.B. Bastos (eds) *Psicologia, Organizações E Trabalho no Brasil,* (1 edn). pp. 237-275. Porto Alegre (Brazil): Artmed Editora.

Acs, Z.J. and D.B. Audretsch (eds) (2003) *Handbook of Entrepreneurship Research: An Interdisciplinary Survey and Introduction.* Vol. 1. Boston / Dordrecht / London: Kluwer Academic Publishers.

Albert, P., M. Bernasconi and L. Gaynor (2004) *Incubators in Evolution: Strategies and Lessons Learned in Four Countries.* Athens, Ohio: NBIA Publications.

Alcouffe, A. and T. Khun (2004) 'Schumpeterian Endogenous Growth Theory and Evolutionary Economics'*, Journal of Evolutionary Economics* 14: 223-236.

Almeida, M. (2005) 'The Evolution of the Incubator Movement in Brazil'*, International Journal of Technology & Globalisation* 1(2): 258-273.

Altenburg, T. and U. Eckhardt (2006) 'Productivity Enhancement and Equitable Development: Challenges for SME Development', COMPID - Combating Marginalization and Poverty Through Industrial Development, pp. 99. Vienna: UNIDO - United Nations Industrial Development Organization.

Altenburg, T. and A. Stamm (2004) 'Towards a More Effective Provision of Business Services', pp. 27. Bonn: German Development Institute.

ANPROTEC (2008) 'Associação Nacional Das Entidades Promotoras De Empreendimentos Inovadores', pp. 33. Brasília, Brazil: ANPROTEC.

ANPROTEC (2007) 'Aventura do Possível', pp. 42. Brasília: ANPROTEC.

ANPROTEC (2007) 'Panorama 2007'. Brasília: ANPROTEC.

ANPROTEC (2006) 'Panorama 2006'. Brasília: ANPROTEC.

ANPROTEC (2005) 'Panorama 2005', No. 15, pp. 1ANPROTEC.

ANPROTEC (2004) 'Panorama 2004', No. 23, pp. 1ANPROTEC.

ANPROTEC (2003) 'Panorama 2003', No. 83, pp. 1ANPROTEC.

ANPROTEC and MCT (2012) 'Estudo, Análise e Proposições sobre as Incubadoras de Empresas no Brasil – Relatório Técnico', pp. 24 p. Brasília: ANPROTEC, MCT.

Aramand, M. and D. Valliere (2012) 'Dynamic Capabilities in Entrepreneurial Firms: A Case Study Approach'*, Journal of International Entrepreneurship* 10: 142–157.

Aranha, J.A.S. (2008) 'Incubadoras', in S.R.H. Parolin and M. Volpato (eds) *Faces to Empreendedorismo Inovador,* (1 edn). Vol. 3. pp. 37-67. Curitiba, PR: FIEP - Federação das Indústrias do Estado do Paraná.

Argyris, C. and D.A. Schon (1978) *Organizational Learning.* MA: Addison-Wesley: Reading.

Audia, P.G. and C.I. Rider (2005) 'A Garage and an Idea: What More does an Entrepreneur Need?'*, California Management Review* 48(1): 6-28.

Bandura, A. (1986) *Social Foundations of Thought and Action.* Englewood Cliffs: Prentice-Hall.

Barnes, B. (2001) 'The Macro/Micro Problem and the Problem of Structure and Agency', in G. Ritzer and B. Smart (eds) *Handbook of Social Theory,* pp. 339-352. London: Sage.

Bastos, A.V.B., S.M.G. Gondim and E. Loiola (2004) 'Aprendizagem Organizacional Versus Organizações Que Aprendem: Características E Desafios Que Cercam Essas Duas Abordagens De Pesquisa'*, RAUSP - Revista de Administração da Universidade de São Paulo* 39(3): 231-241.

Bataglia, W. and D.S. Meirelles (2009) 'Population Ecology and Evolutionary Economics'*, Management Research* 7(2): 87–101.

Berner, E., G.M. Gomez and P. Knorringa (2008) 'Helping a Large Number of People Become a Little Less Poor: The Logic of Survival Entrepreneurs'. Paper presented at the UNU-WIDER Workshop 'Entrepreneurship and Economic Development' edn. Helsinki, 21-23 August.

Best, M.H. (1990) *The New Competition: Institutions of Industrial Restructuring.* Cambridge: Polity Press.

Boissevain, J. (1974) *Friends of Friends: Networks, Manipulators and Coalitions.* New York: St. Martin's Press.

Bollingtoft, A. and J.P. Ulhoi (2005) 'The Networked Business Incubator - Leveraging Entrepreneurial Agency?'*, Journal of Business Venturing* 20: 256-290.

Borman, W.C., D.R. Ilgen, R.J. Klimoski and I.B. Weiner (2003) *Handbook of Psychology - Industrial and Organizational Psychology.* Vol. 12. EBSCOhost: John Wiley & Sons, Inc.

Bosma, N., M.v. Praag, R. Thurik and G.d. Wit (2002) 'The Value of Human and Social Capital Investments for Business Performance of Start-Ups'. Discussion paper edn. Tinbergen Institute.

Brasil (2008) 'Lei Complementar Nr. 128, De 19 De Dezembro De 2008' Presidência da República - Casa Civil - Subchefia para assuntos jurídicos.

Brasil (2006) 'Lei Complementar Nr. 123, De 14 De Dezembro De 2006', No. 123, pp. 40. Brasília: Presidência da República - Casa Civil - Subchefia para assuntos jurídicos.

Brasil (2005) 'Decreto Nº 5.563, De 11 De Outubro De 2005'. Casa Civil. <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/Decreto/D5563.htm>.

Brasil (2005) 'Lei N. 11.196 De 21 De Novembro De 2005'. temporary measure, Casa Civil. <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/lei/L11196.htm>.

Brasil (2003) 'Plano Plurianual 2004-2007: Mensagem Presidencial'Budget and Management Planning Ministry of Brazilian Government.

Burt, R.S. (2004) 'Structural Holes and Good Ideas'*, American Journal of Sociology* 110(2): 349-399.

Cairns, L. and M. Malloch (2011) 'Theories of Work, Place and Learning: New Directions', in M. Malloch, L. Cairns, K. Evans and B.N. O'Connor (eds) *The Sage Handbook of Workplace Learning,* (1 edn). pp. 3-16. London: Sage Publications Ltd.

Carrier, C. (1994) 'Intrapreneurship in Large Firms and SMEs: A Comparative Study'*, International Small Business Journal* 12(3): 54-61.

Casciaro, T. and M.J. Piskorski (2005) 'Power Imbalance, Mutual Dependence, and Constraint Absorption: A Closer Look at Resource dependence Theory'*, Administrative Science Quarterly* 50: 167-199.

Casson, M. (2005) 'Entrepreneurship and the Theory of the Firm'*, Journal of Economic Behavior & Organization* 58: 327-348.

Casson, M., B. Yeung, A. Basu and N. Wadeson (eds) (2006) *The Oxford Handbook of Entrepreneurship*. New York: Oxford University Press Inc.

Chandler, A.D., P. Hagstrom-Jr. and O. Solvell (eds) (1998) *The Dynamic Firm: The Role of Technology, Strategy, Organization and Regions*. Oxford, England: Oxford University Press.

Chandra, A. (2007) 'Business Incubation in Brazil: Creating an Environment for Entrepreneurship'. Working Paper edn.

Charmaz, K. (2006) 'Chapter 2. Gathering Rich Data', in Charmaz (ed.) *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis,* (1 edn). pp. 13-41. London, Thousand Oaks, New Delhi: Sage Publications Ltd.

Conner, K.R. and C.K. Prahalad (1996) 'A Resource-Based Theory of the Firm: Knowledge Versus Opportunism'*, Organization Science* 7(5): 477-501.

Contu, A., C. Grey and A. Örtenblad (2003) 'Against Learning'*, Human Relations* 56(8): 931-952.

Cook, S. and D. Yanow (1993) 'Culture and Organizational Learning'*, Journal of Management Enquiry* 2(4): 373-390.

Cooke, P. and K. Morgan (1998) *The Associational Economy: Firms, Regions and Innovation*. Oxford: Oxford University Press.

Cope, J. (2003) 'Entrepreneurial Learning and Critical Reflection: Discontinuous Events as Triggers for 'higher-Level' Learning'*, Management Learning* 34(4): 429-450.

Corradi, A.A. (2012) 'Informal Networks in Business Development Services: Case Studies from Two Brazilian Business Incubators', in K. Kitaoka, A. Marx, J. Fuentes and C. O'Reilly (eds) *Networks for Prosperity. Connecting Development Knowledge Beyond 2015,* pp. 113-121. Vienna, Austria: UNIDO - United Nations Industrial Development Organization / Leuven Centre for Global Governance Studies.

Cressy, R. (2008 [2006]) 'Determinants of Small Firm Survival and Growth', in M. Casson, B. Yeung, A. Basu and N. Wadeson (eds) *The Oxford Handbbok of Entrepreneurship,* Vol. Chapter 7. pp. 161-193. Oxford: Oxford University Press.

Creswell, J.W. (2009) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. (3 edn) Los Angeles, USA: Sage Publications.

Cross, R. and L. Prusak (2002) 'The People Who make Organizations Go - Or Stop'*, Harvard Business Review* (June): 5-12.

DCED (2001) 'Business Development Services for Small Enterprises: Guiding Principles for Donor Intervention', pp. 15, DCED (The Donor Committee for Enterprise Development).

Delmar, F. and P. Davidsson (2000) 'Where do they Come from? Prevalence and Characteristics of Nascent Entrepreneurs', *Entrepreneurship & Regional Development: An International Journal* 12(1): 1-23.

Dopfer, K. (2005) *The Evolutionary Foundations of Economics*. Cambridge (UK): Cambridge University Press.

Dopfer, K. (2004) 'The Economic Agent as Rule Maker and Rule User: Homo Sapiens Oeconomicus', *Journal of Evolutionary Economics* 14: 177–195.

Dopfer, K., J. Foster and J. Potts (2004) 'Micro–meso–macro', *Journal of Evolutionary Economics* 14: 263-279.

EC, IMF, OECD, UN, World Bank (Dec. 2009) *System of National Accounts 2008*. New York: European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank.

Eisenhardt, K.M. and M.E. Graebner (2007) 'Theory Building from Cases: Opportunities and Challenges', *The Academy of Management Journal* 50(1): 25-32.

Eisenhardt, K.M. and J.A. Martin (2000) 'Dynamic Capabilities: What are they?', *Strategic Management Journal* 21(10-11): 1105–1121.

Eraut, M. (2004) 'Editorial: The Practice of Reflection', *Learning in Health and Social Care* 3(2): 47-52.

Eraut, M. (2004) 'Informal Learning in the Workplace', *Studies in Continuing Education* 26(2).

Etzkowitz, H., J.M.C.d. Mello and M. Almeida (2005) 'Towards "Meta-Innovation" in Brazil: The Evolution of the Incubator and the Emergence of a Triple Helix', *Research Policy* 34(4): 12-411-424.

FAPESP (Last updated 2012) 'PIPE-FAPESP' (a webpage of FAPESP). Accessed July/05 2012 <http://www.fapesp.br/58#1>.

Farbman, M. and A. Lessik (1989) 'The Impact of Classification on Policy', in A.G.e. al. (ed.) *Small Enterprises, New Approaches,* pp. 105-122; VI. The Hague: Ministry of Foreign Affairs, Directorate General International Cooperation.

Feldman, M.S. (2000) 'Organizational Routines as a Source of Continuous Change', *Organization Science* 11(6): 611-629.

Feldman, M.S. and B.T. Pentland (2003) 'Reconceptualizing Organizational Routines as a Source of Flexibility and Change', *Administrative Science Quarterly* 48(1): 94-118.

FINEP (Last updated 2012) 'Prime' (a webpage of FINEP). Accessed May 2012 <http://www.finep.gov.br/programas/prime.asp>.

Fiol, C.M. and M.A. Lyles (1985) 'Organizational Learning', *The Academy of Management Review* 10(4): 803-813.

Flick, U. (2007) *Designing Qualitative Research.* Vol. 1. Los Angeles; London; New Delhi; Singapore: Sage Publications Ltd.

Foss, N.J. (1999) 'The Theory of the Firm: An Introduction to Themes and Contributions (Second Draft, September 1998)', in N.J. Foss (ed.) *Theories of the Firm: Critical Perspectives in Economic Organisation,* (1 edn). Vol. 1. pp. 60p. London: Routledge.

Franco, J., M.F. Pereira, M.G.B. Oshita and K.K. Uchida (2009) 'Evolução do Número De Incubadoras De Empresas no Brasil E Sua Distribuição Regional: Uma Análise Através do Modelo Log-Linear De Taxas De Crescimento', *Locus Científico (ANPROTEC)* 3(4): 107-114.

Garrouste, P. and S. Saussier (2005) 'Looking for a Theory of the Firm: Future Challenges', *Journal of Economic Behavior & Organization* 58: 178-199.

Garud, R., R.L.M. Dunbar and C.A. Bartel (2011) 'Dealing with Unusual Experiences: A Narrative Perspective on Organizational Learning', *Organization Science* 22(3): 587–601.

Garud, R., C. Hardy and S. Maguire (2007) 'Institutional Entrepreneurship as Embedded Agency: An Introduction to the Special Issue', *Organization Studies* 28: 957-969.

Garud, R. and P. Karnoe (2003) 'Bricolage Versus Breakthrough: Distributed and Embedded Agency in Technology Entrepreneurship', *Research Policy* 32: 277-300.

Garud, R., A. Kumaraswamy and P. Karnoe (2010) 'Path Depedence Or Path Creation?', *Journal of Management Studies* 47(4): 760-774.

Gelderen, M.v., R. Thurik and N. Bosma (2006) 'Success and Risk Factors in the Pre-Startup Phase', *Small Business Economics* 26: 319-335.

Giuliani, E. (2007) 'The Selective Nature of Knowledge Networks in Clusters: Evidence from the Wine Industry', *Journal of Economic Geography* 7: 139–168.

Glick, W.H., G.P. Huber, C.C. Miller, D.H. Doty and K.M. Sutcliffe (1990) 'Studying Changes in Organizational Design and Effectiveness: Retro-

spective Event Stories and Periodic Assessments', *Organization Science* 1(3): 293-312.

Gössling, T., L. Oerlemans and R. Jansen (eds) (2007) *Inside Networks: A Process View on Multi-Organisational Partnerships, Alliances and Networks.* Cheltenham (UK), Northampton, MA (USA): Edward Elgar.

Gössling, T. (2007) 'Inside Relationships: A Review of Institutional Approaches Towards Multi-Organisational Partnerships, Alliances and Networks', in T. Gössling, L. Oerlemans and R. Jansen (eds) *Inside Networks: A Process View on Multi-Organisational Partnerships, Alliances and Networks,* pp. 13-44; 2. Cheltenham (UK); Northampton (USA): Edward Elgar Publishing.

Granovetter, M. (1973) 'The Strenght of Weak Ties', *American Journal of Sociology* 81: 1287-1303.

Granovetter, M. (1985) 'Economic Action and Social Structure: The Problem of Embeddedness', *American Journal of Sociology* 91(3): 481-510; 481.

Granovetter, M. (1983) 'The Strength of Weak Ties: A Network Theory Revisited', *Sociological Theory* 1: 201-233; 201.

Greckhamer, T., M. Koro-Ljungberg, S. Cilesiz and S. Hayes (2008) 'Demystifying Interdisciplinary Qualitative Research', *Qualitative Inquiry* 14(2): 307-331.

Grimm, M., P. Knorringa and J. Lay (2012) 'Constrained Gazelles: High Potentials in West Africa's Informal Economy'. Working Paper, n. 537 edn. The Hague: ISS.

Gruber, M., I.C. MacMillan and J.D. Thompson (2012) 'From Minds to Markets: How Human Capital Endowments Shape Market Ppportunity Identification of Technology Start-Ups', *Journal of Management* 38(5): 1421-1449.

Hager, P. (2011) 'Theories of Workplace Learning', in M. Malloch, L. Cairns, K. Evans and B.N. O'Connor (eds) *The Sage Handbook of Workplace Learning,* (1 edn). London: Sage Publications Ltd.

Hannan, M.T. and J. Freeman (1977) 'The Population Ecology of Organizations', *American Journal of Sociology* 82(5): 929-964.

Helmsing, A.H.J. (2010) 'Perspectives and Practices of Local Economic Development: A Review'. Work in Progress edn. The Hague: ISS.

Helmsing, A.H.J. (2001) 'Externalities, Learning and Governance: New Perspectives on Local Economic Development', *Development and Change* 32: 277-308.

Hernández, P.P. and A.M. Estrada (2006) 'Análisis del sistema de incubación de empresas de base tecnológica de México', I Congreso Iberoamericano de Ciencia, Tecnología, Sociedad e Innovación CTS+I, 19th-23rd June 2006.

Hillman, A.J., M.C. Withers and B.J. Collins (2009) 'Resource Dependence Theory: A Review', *Journal of Management* 35(6): 1404-1427.

Hodgkinson, G.P. and M.P. Healey (2008) 'Cognition in Organizations', *Annual Review of Psychology* 59: 387-417.

Hogg, M.A. and G.M. Vaughan (2010) 'Chapter 2. Social Thinking', in M.A. Hogg and G.M. Vaughan (eds) *Essentials of Social Psychology,* (1 edn). pp. 24-61. Harlow, UK: Pearson Education Ltd.

Hormiga, E., R.M. Batista-Canino and A. Sánchez-Medina (2011) 'The Impact of Relational Capital on the Success of New Business Start-Ups', *Journal of Small Business Management* 49(4): 617-638.

Huet, F. and N. Lazaric (2009) 'The Difficult Creation of Novel Routines: Persistence of Old Habits and Renewal of Knowledge Base in French SMEs', in M.C. Becker and N. Lazaric (eds) *Organizational Routines: Advancing Empirical Research,* (1 edn). pp. 248-276. Cheltenham, UK; Northampton, USA: Edward Elgar.

IBGE (2008) 'Indicadores De Desenvolvimento Sustentável - Brasil 2008', Estudos & Pesquisas - Informação Geográfica, No. 5, pp. 472. Rio de Janeiro: IBGE (Instituto Brasileiro de Geografia e Estatística), Ministry of Planning, Budget and Management.

IBGE, Directory of Research, Coordination of Industry (2010) 'Pesquisa De Inovação Tecnológica: 2008', pp. 164. Rio de Janeiro: IBGE (Instituto Brasileiro de Geografia e Estatística), Ministry of Planning, Budget and Management.

IBGE, Directory of Research, Coordination of Industry (2008) 'Pesquisa Industrial 2008', No. 1, pp. 186 p. Rio de Janeiro: IBGE.

IBGE, Directory of Research, Coordination of National Accounts,System of National Accounts (Last updated 2009) 'IBGE-Cidades@'. Accessed September 2010 <http://www.ibge.gov.br/cidadesat/topwindow.htm?1>.

IBGE, Directory of Research, Coordination of Services and Commerce (2003) 'As Micro E Pequenas Empresas Comerciais E De Serviços no Brasil 2001', Estudos e Pesquisas - Informação Econômica, No. 1, pp. 102 p. Rio de Janeiro: IBGE (Brazilian Institute of Geography and Statistics).

IBM Corp. (Released 2011) 'IBM SPSS Statistics for Windows' (Version 20.0) Armonk, NY.

Imasato, T. (2005) 'Incubadoras De Empresas: Panorama Brasileiro E Potenciais Para Pesquisa'*, Revista Eletrônica de Gestão Contemporânea* 1(1): 13-1.

Jelinek, M. and J.A. Litterer (1995) 'Toward Entrepreneurial Organizations: Meeting Ambiguity with Engagement'*, Entrepreneurship Theory and Practice* 19(3): 137-168.

Johanson, J. and L. Mattson (1991) 'Interorganizational Relations in Industrial Systems: A Network Approach Compared with the Transactions-Cost Approach', in G. Thompson, J. Frances, R. Levacic and J. Mitchell (eds) *Markets, Hierarchies & Networks: The Coordination of Social Life,* pp. 256-264; 21. London, Newbury Park, New Delhi: The Open University.

Kelley, D.J., N. Bosma and J.E. Amorós (2010) 'GEM - Global Entrepreneurship Monitor - 2010 Global Report' Babson College, United States; Universidad del Desarrollo, Chile; London Business School, England.

Kenworthy, T.P. and W.E. McMullan (2010) 'Theory morphing vs. theory testing: Human capital in entrepreneurship', International Council for Small Business (ICSB). World Conference Proceedings, Washington: International Council for Small business (ICSB) pp1-36.

Klein, K.J. and S.W.J. Kozlowski (eds) (2000) *Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions and New Directions.* (1 edn) San Francisco: Jossey-Bass.

Knight, L. and A. Pye (2007) 'The Search for Network Learning: Some Practical and Theoretical Challenges in Process Research', in T. Gössling, L. Oerlemans and R. Jansen (eds) *Inside Networks: A Process View on Multi-Organisational Partnerships, Alliances and Networks,* pp. 163-191; 8. Cheltenham (UK), Northampton (USA): Edward Elgar.

Knight, L. and A. Pye (2004) 'Exploring the Relationships between Network Change and Network Learning'*, Management Learning* 35(4): 473-490.

Kozlowski, S.W.J. and B.S. Bell (2003) 'Work Groups and Teams in Organizations', in W.C. Borman, D.R. Ilgen, R.J. Klimoski and I.B. Weiner (eds) *Handbook of Psychology - Industrial and Organizational Psychology,* Vol. 12. pp. 334-367. EBSCOhost: John Wiley & Sons, Inc.

Kraaijenbrink, J., J. Spender and A.J. Groen (2010) 'The Resource-Based View: A Review and Assessment of its Critiques'*, Journal of Management* 36: 349-372.

Kraiger, K. (2003) 'Perspectives on Training and Development', in W.C. Borman, D.R. Ilgen, R.J. Klimoski and I.B. Weiner (eds) *Handbook of Psychology - Industrial and Organizational Psychology,* Vol. 12. pp. 171-186. EBSCOhost: John Wiley & Sons, Inc.

Lalkaka, R. (2001) "Best practices' in business incubation: Lessons (yet to be) learned', International Conference on Business Centers: Actors for Economic & Social Development, 14-15 November 2001. European Union - Belgium Presidency.

Lalkaka, R. and D. Shaffer (1999) 'Nurturing entrepreneurs, creating enterprises: Technology business incubation in Brazil', International Conference on Effective Business Development Services, 2nd-3rd March 1999.

Lall, S., QEH Working Paper Series. 2002. Social Capital and Industrial Transformation. Working paper edn. http://www3.qeh.ox.ac.uk/RePEc/qeh/qehwps/qehwps84.pdf: QEH Working Paper Series.

Landstrom, H. (2008) 'Entrepreneurship Research: A Missing Link in our Understanding of the Knowledge Economy'*, Journal of Intellectual Capital* 9(2): 301-322.

Langley, A. (1999) 'Strategies for Theorizing from Process Data'*, Academy of Management Review* 24(4): 691-710.

Lazaric, N. (2011) 'Organizational Routines and Cognition: An Introduction to Empirical and Analytical Contributions'*, Journal of Institutional Economics* 7(2 (Special issue on business routines)): 147-156.

Lazaric, N. (2008) 'Routines and Routinization: An Exploration of some Micro-Cognitive Foundations', in M.C. Becker (ed.) *Handbook of Organizational Routines,* (1 edn). pp. 205-227. Cheltenham (UK), Nothampton (USA): Edward Elgar.

Lichtenstein, G.A. and T.S. Lyons (2006) 'Managing the Community's Pipeline of Entrepreneurs and Enterprises: A New Way of Thinking about Business Assets'*, Economic Development Quarterly* 20: 377-386.

Lundvall, B. (2007) 'National Innovation Systems - Analytical Concept and Development Tool'*, Industry and innovation* 14(1): 95-119.

Luthans, F., C.M. Youssef and B.J. Avolio (2007) *Psychological Capital: Developing the Human Competitive Edge.*

Madsen, H., H. Neergaard and J.P. Ulhøi (2003) 'Knowledge-Intensive Entrepreneurship and Human Capital'*, Journal of Small Business and Enterprise Development* 10(4): 426-434.

Malecki, E.J. (1993) 'Entrepreneurship in Regional and Local Development', *International Small Business Journal* 16(1 & 2): 119-153.

McAdam, M. and S. Marlow (2007) 'Building Futures Or Stealing Secrets? Entrepreneurial Cooperation and Conflict within Business Incubators', *International Small Business Journal* 24(4): 361-382.

Mead, D.C. and C. Liedholm (1998) 'The Dynamics of Micro and Small Enterprises in Developing Countries', *World Development* 26(1): 61-74.

Metcalfe, J.S. (2006) 'Entrepreneurship: An Evolutionary Perspective', in M. Casson, B. Yeung, A. Basu and N. Wadeson (eds) *The Oxford Handbook of Entrepreneurship.* (2008 [2006] edn). Vol. Chapter 3. pp. 59-90. Oxford: The Oxford.

Michor, L., R. Harms, E. Schwarz and R. Breitenecker (2010) 'Configuration of new ventures and SMEs: A literature review of empirical research', The Eighteenth Annual High Technology Small Firms Conference, 27-28 May, 2010. University of Twente - Enschede - The Netherlands pp1-20.

Miner, A.S., M.P. Ciuchta and Y. Gong (2008) 'Organizational Routines and Organizational Learning', in M.C. Becker (ed.) *Handbook of Organizational Routines,* (1 edn). pp. 152-186. Cheltenham, UK; Northampton, USA: Edward Elgar.

Moraes, V.V. and J.E. Borges-Andrade (2010) 'Aprendizagem Relationada Ao Trabalho', *Revista Psicologia: Organizações e Trabalho* 10(2): 112-128.

Naudé, W. (ed.) (2011) *Entrepreneurship and Economic Development.* (1 edn) London: Palgrave McMillan/UNU-WIDER (World Institute for Development Economics Research of the United Nations University.

Naudé, W., (2008) 'Entrepreneurship in Economic Development'. Research Paper edn. Helsinki, Finland: UNU-WIDER - United Nations University, World Institute for Development Economics Research.

Nelson, R.R. and S.G. Winter (1982) *An Evolutionary Theory of Economic Change.* Cambridge (Massachusetts-USA); London (United Kingdom): The Belknap Press of Harvard University Press.

Nichter, S. and L. Goldmark (2005) 'Understanding Micro and Small Enterprise Growth', No. 36, pp. 77p.USAID: United States Agency for International Development.

Nienhüser, W. (2008) 'Resource Dependence Theory: How Well does it Explainbehavior of Organizations?', *Management Revue* 19(1+2): 9-32.

OECD (2010) 'The OECD Structural and Demographic Business Statistics (SDBS)'. OECD (Organization for Economic Cooperation and Development). (Online statistics).

OECD (2010) 'SMEs, Entrepreneurship and Innovation', OECD Studies on SMEs and Entrepreneurship, pp. 224 p. Paris, France: OECD Publishing.

OECD and Eurostat (2005) 'Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data', No. 3rd ed., pp. 163 p. Paris, France: OECD.

Pantoja, M.J. (2004) 'Estratégias De Aprendizagem no Trabalho E Percepções De Suporte À Aprendizagem Contínua - Uma Análise Multinível', Brasília: University of Brasília.

Pantoja, M.J. and J.E. Borges-Andrade (2004) 'Contribuições Teóricas E Metodológicas Da Abordagem Multinível Para O Estudo Da Aprendizagem E Sua Transferência Nas Organizações', *RAC (Revista de Administração Contemporânea)* 8(4): 115-138.

Penrose, E.T. (1980 [1959]) *The Theory of the Growth of the Firm.* (2 edn) Oxford: Basil Blackwell.

Pfeffer, J. and G.R. Salancik (1978) *The External Control of Organizations: A Resource Dependence Perspective.* New York, NY: Harper & Row.

Praag, C.M.v. (1999) 'Some Classic Views on Entrepreneurship', *De Economist* 147(3): 311-335.

Provan, K.G., A. Fish and J. Sydow (2007) 'Interorganizational Networks at the Network Level: A Review of the Empirical Literature on Whole Networks', *Journal of Management* 33(3): 479-516.

Reydon, T.A.C. and M. Scholz (2009) 'Why Organizational Ecology is Not a Darwinian Research Program', *Philosophy of the Social Sciences* 39(3): 408-439.

Riding, R.J. and S.G. Rayner (1998) *Cognitive Styles and Learning Strategies: Understanding Style Differences in Learning and Behaviour.* (1 edn) London: David Fulton Publishers.

RMI and SEBRAE-MG (2008) *Histórias De Sucesso 2: Empresas Graduadas Das Incubadoras Mineiras.* Vol. 2. Belo Horizonte: Rede Mineira de Inovação (RMI); Serviço de Apoio às Micro e Pequenas Empresas de Minas Gerais (SEBRAE/MG).

RMI and SEBRAE-MG (2007) *Histórias De Sucesso 1: Empresas Graduadas Das Incubadoras Mineiras.* (1 edn) Belo Horizonte, Brazil: Rede Mineira de

Inovação (RMI); Serviço de Apoio às Micro e Pequenas Empresas de Minas Gerais (SEBRAE-MG).

Rousseau, D.M. (1997) 'Organizational Behavior in the New Organizational Era'*, Annual Review of Psychology* 48: 515-546.

Salas, E. and J. Cannon-Bowers (2001) 'The Science of Training: A Decade of Progress'*, Annual Review of Psychology* 52: 471-499.

Salimath, M.S. and R. Jones III (2011) 'Population Ecology Theory: Implications for Sustainability'*, Management Decision* 49(6): 874-910.

Scott, J. (2005) *Social Networks Analysis: A Handbook*. (2 edn) London, Thousand Oaks, New Delhi: Sage Publications.

SEBRAE (2011) 'Taxa De Sobrevivência Das Empresas no Brasil', Coleção Estudos e Pesquisas, pp. 30 p. Brasília: SEBRAE (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas).

SEBRAE (2007) 'Fatores Condicionantes E Taxas De Sobrevivência E Mortalidade Das Micro E Pequenas Empresas no Brasil - 2003-2005', pp. 56. Brasília-DF, Brasil: SEBRAE - Serviço Brasileiro de Apoio às Micro e Pequenas Empresas.

Shane, S.A. (2003) *A General Theory of Entrepreneurship: The Individual-Opportunity Nexus*. Cheltenham [etc.]: Edward Elgar.

Shrivastava, P. (1983) 'A Typology of Organizational Learning Systems'*, Journal of Management Studies* 20(1): 7-28.

Stack, M. and M.P. Gartland (2003) 'Path Creation, Path Dependency, and Alternative Theories of the Firm'*, Journal of Economic Issues* 37(2): 487-494.

Strauss, A. and J. Corbin (1998) *Basics of Qualitative Research*. (2 edn) Thousand Oaks/London/New Delhi: Sage Publications, Inc.

Stretton, H. (1999) *Economics: A New Introduction*. London, UK: Pluto.

Tabachnick, B.G. and L.S. Fidell (1996) *Using Multivariate Statistics*. New York: Harper Collins.

Teece, D.J. and G. Pisano (1994) 'The Dynamic Capabilities of Firms: An Introduction'*, Industrial and Corporate Change* 3(3): 537-556.

Thompson, G., J. Frances, R. Levacic and J. Mitchell (1991) *Markets, Hierarchies and Networks : The Coordination of Social Life*. London: Sage Publications.

Toulmin, S. (2001) 'Chapter 2: How Reason Lost its Balance', 'Chapter 2: How Reason Lost its Balance', *Return to Reason,* pp. 14-28. Harvard University Press.

UNDP (2004) 'Unleashing Entrepreneurship. Making Business Work for the Poor', Report to the Secretary-General of the United Nations, pp. 32. New York: United Nations.

UNIDO and Leuven Centre for Global Governance Studies (2011) 'Networks for Prosperity: Achieving Development Goals through Knowledge Sharing', pp. 172p. Vienna, Austria: UNIDO (United Nations Industrial Development Organization).

United Nations, S.D. (2008) 'International Standard Industrial Classification of all Economic Activities - Revision 4', Statistical papers, No. Series M n.4/Rev.4, pp. 291. New York: United Nations.

van der Steen, M. (2009) 'Uncovering Inertia: Ambiguity between Formal Rules and Routines of Interaction', in M.C. Becker and N. Lazaric (eds) *Organizational Routines: Advancing Empirical Research,* (1 edn). pp. 159-184. Cheltenham (UK); Northampton (USA): Edward Elgar.

Ven, A.H.v.d. and G.P. Huber (1990) 'Longitudinal Field Research Methods for Studying Processes of Organizational Change'*, Organization Science* 1(3): 213-219.

Vromen, J. (2011) 'Routines as Multilevel Mechanisms'*, Journal of Institutional Economics* 7(2 (Special issue on business routines)): 175-196.

Walker, R.A. (2000) 'The Geography of Production', in E. Sheppard and T.J. Barnes (eds) *A Companion to Economic Geography,* pp. 536-8. Malden/Oxford/Victoria: Blackwell Publishing Ltd.

Warr, P. and J. Downing (2000) 'Learning Strategies, Learning Anxiety and Knowledge Acquisition'*, British Journal of Psychology* 91: 311-333.

Wasserman, S. and K. Faust (2006) *Social Network Analysis: Methods and Applications.* Cambridge, New York: Cambridge University Press.

Wernerfelt, B. (1984) 'A Resource-Based View of the Firm: Summary'*, Strategic Management Journal* 5(2): 171-181.

Witt, U. (2000) 'Changing Cognitive Frames – Changing Organizational Forms: An Entrepreneurial Theory of Organizational Development'*, Industrial and Corporate Change* 9(4): 733-755.

Xu, Y. (2011) 'A Social-Cognitive Perspective on Firm Innovation'*, Journal of Strategic Innovation and Sustainability* 7(1): 11-27.

Zollo, M. and S.G. Winter (2002) 'Deliberate Learning and the Evolution of Dynamic Capabilities'*, Organization Science* 13(3): 339-351.

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Declaration

This thesis has not been submitted to any university for a degree or any other award.