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Paths of Innovation of Catching-up: the Dynamics of Build-up of Technological Capacities in Small Companies Participant of the Goat Husbandry Productive Chain

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Abstract

This research seeks to examine the nature and the dynamics of the paths in terms of timing and speed of build-up of technological capacities in small companies of the goat husbandry productive chain in the state of Ceará - Brazil. They were still verified the influence in the acceleration of the innovative paths (catching-up) of contextual factors and technological external links between the companies and the organizations of the institutional link of the productive chain. For the operation of the study it was used the methodological scope of comparative case study. The results characterized a discontinuity along a previously continuous process of low development of technological capacities, evidencing the implications of contextual factors in the acceleration of the dynamics of the build-up of technological

capacities. It became notable the role of external and open sources between the company and its context, enabling the easier development and circulation of innovations, building and improving the knowledge bases and innovative competences of the companies.

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ABSTRACT

This research seeks to examine the nature and the dynamics of the paths in terms of timing and speed of build-up of technological capacities in small companies of the goat husbandry productive chain in the state of Ceará - Brazil. They were still verified the influence in the acceleration of the innovative paths (catching-up) of contextual factors and technological external links between the companies and the organizations of the institutional link of the productive chain. For the operation of the study it was used the methodological scope of comparative case study. The results characterized a discontinuity along a previously continuous process of low development of technological capacities, evidencing the implications of contextual factors in the acceleration of the dynamics of the build-up of technological capacities. It became notable the role of external and open sources between the company and its context, enabling the easier development and circulation of innovations, building and improving the knowledge bases and innovative competences of the companies.

INTRODUCTION

Starting from the beginning of the 1990's, with the coming of the Knowledge and Learning Economy paradigm, several studies based on the discussion of the strategic role of the innovation and development of technological capacities, being those based in the Dynamic Capabilities approach, when emphasizing the change of the paths, in terms of timing and speed of technological build-up through the underlying learning processes and to the implications of that process for the innovative performance (LALL, 1987).

The companies need to engage in deliberate processes of technological learning to develop its internal knowledge bases and accumulate technological capacities. Such learning processes, both intra and/or inter-company developed through internal sources and external technological links, are understood here as inputs that facilitate the build-up of technological competence along time, influencing, finally, the competitive capacity of those companies (ZOLLO; WINTER, 2002; BELL, 2006)

This technological capacity is defined by Bell and Pavitt (1993) as being the necessary resources to generate and manage the dynamism and the technological changes, being these resources incorporate in individuals, through their aptitudes, knowledge and experiences; and also in organizational systems.

On the other hand, and in the context of the companies of emergent economies (latecomers), Bell and Pavitt (1995) and their followers made an important contribution for the understanding of the process of construction of technological capacities by discussing about the challenges inherent to the transition processes that some companies should confront to improve their knowledge bases. For that, the authors related a set of organizational and institutional factors that can influence the learning of the companies during this transition stage.

In that ambit, they become notable the studies that focused the influence of a organizational and institutional base in the development of technological capacities (DANTAS; BELL, 2006; DUTRENIT, 2007); others that investigated the influence of different factors, such as: the corporate leadership and the institutional apparatus (political, economical and market rules, etc.) in the development of the learning processes (LEONARD-BARTON, 1995; KIM, 1997; VERA-CRUZ, 2000).

Other studies considered exclusively the influences of external sources of learning in the development of dynamic capacities by evidencing the technological connections in certain institutional arrangements involving the companies and other organizations of the technological infrastructure (VEDOVELLO, 1995).

The following must be highlighted: the studies about the catching-up perspective in the acceleration of paths of build-up of technological capacities, starting from the amplification of a knowledge base (BESSANT, 2005; NELSON, 2007); including small and medium size companies (ROMIJN; ALBALADEJO, 2000).

As argued by Figueiredo (2001) there is a need for expansion of empiric studies for different types and sizes of companies, in order to generate knowledge on the process of build-up of technological capacities. This research joins in this study field, differing when focusing an important sector to Brazil: the one of the agribusiness and in the context of small companies, participant of the goat husbandry productive chain of the Northeast area of Brazilian.

The Northeast area of Brazil appears with great potential about the exploration of that activity, dashing, however, in obstacles that limit its development. So that the goat husbandry in Brazilian Northeast becomes an economically maintainable business, it is indispensable that programs and politics are implemented aimed to the adoption and development of technologies economically viable to the area, as well as studies that evaluate the technological overview of the activity.

In this context, some studies presented contributions for the evaluation of technological level of small and medium size companies, participant of different productive chains (GEREFFI; KAPLINSKY, 2001; BAZAN; NAVAS-ALEMAN, 2004; HUMPHREY; SCHMITZ, 2007). Others were specifically developed in companies participant of the goat husbandry productive chain (COSTA, 2007; CORDEIRO; CORDEIRO, 2008).

These studies, however, didn't analyze the nature of the paths and the speed measured in years of build-up of technological capacities. Also, there are no consolidated studies that approach the influence of the technological learning links originating from external sources and contextual factors inherent to the productive chain in the catching-up of the paths of build-up of technological capacities of the companies. This research differs when approaching these aspects above mentioned, tends as intention to contribute for the progress of the knowledge in this area.

1. ANALYTICAL BASIS OF STUDY

This section articulates the analytic base, enlightening the existent gaps and positioning the research according to the precedent literature.

1.1 Nature of the paths and dynamics of the build-up of technological capacities in small companies, participant in the goat husbandry productive chain

Literature points out that one of the main characteristics of latecomers refers to its deficiencies of resources or technological capacities. The technological capacity of companies is characterized as an inventive activity or systematic creative effort to obtain new knowledge, including the stock of resources that allows the companies to develop different and innovative production activities, among different complexity degrees and in elapsing of the technological border. These capacities are accumulated in different dimensions, among these: human resources; physical, organizational and managerial systems; arrangements and internal and external connections to the companies (KEESING; LALL, 1992; BELL; PAVITT, 1993).

In consonance with the innovation concept according to the Oslo Manual (OECD, 2002), the definition of build-up of technological capacities contemplates, therefore, the speed of different types of paths that the companies take, in elapsing of a period of time, to catch-up or to overtake different stages and degrees of complexity of the international technological border (BELL; PAVITT, 1993).

Considering the objectives of this work, it still becomes notable the open innovation approach that has been moving focus to the role of external sources, accentuating the notion of “porous” and open border between the company and its external environment, allowing the easier circulation of innovations, sustaining and renewing the knowledge bases and innovative competences of the companies (CHESBROUGH; SCHWARTZ, 2007).

Christensen and Raynor (2003) differentiated the disruptive innovation from the sustaining innovation. The disruptive innovation has as base an asymmetry of the motivations between the leader companies and the new ones, according to the markets already explored and/or those potential ones. These first ones, by having the resources allocated to sustain the innovations, strengthening their leadership positions already established at certain markets, in general are not motivated to defend the potential markets, sources of disruptive innovations, which, when are explored by the new companies, open spaces and qualitatively different opportunities. Among the motivations, the authors mention: the focus in development strategies, the role of the corporate leadership and the organizational and managerial capacities.

Contrasting previous studies that raised a constant process, more or less continuous, of technological change, other researches, above all, developed them in the context of the latecomers, they focalized the evidence of transitions in elapsing of a scale of time characterized by the emergency of discontinuities (BESSANT, 2005; BELL, 2006; SCHMITZ, 2007). Those transition processes presented paths that travel new catching-up directions and of overtaking of the technological border, creating, in consequence, technological windowing for new companies (PEREZ; SOETE, 1988).

In this sense, the notion of technological border will not be understood here lineally, with a starting point and another of arrival, but as a “context” and/or a flowing area to be explored by new incoming companies, as for instance, the latecomers, through the development of continuous and/or discontinuous innovations, characterizing the periods of transitions (LEE; LIM, 2001; HOBDAV, RUSH; FIGUEIREDO, 2010).

This way, it is considered that the build-up of production capacities is constituted as the base for the development of innovative capacities in the companies, however, and in spite of those capacities co-exist, the build-up of those two capacities is not a linear process. In certain periods, characterized as of transition, the levels of build-up of capacities are progressively developing in a continuous or discontinuous way, depending on the strategies that distinguish the company in the local and/or global market (BELL; PAVITT, 1995; SCHMITZ, 1995; BAZAN; NAVAS-ALEMAN, 2004).

In those terms and considering the Dynamic Capabilities approach, different strategies are used by the companies to strengthen their performance through innovation (TEECE *et al.*, 1990).

According to Freeman (1974) the companies can be positioned strategically for the innovation combining six different forms, alternatives or not: i) the “offensive” strategy is adopted by a company that seeks the leadership in the market and in technology; ii) the “defensive” strategy is adopted by companies that invest intensively in research; iii) the companies that adopt the “imitative” strategy react to the innovations, but stay at the market through copies with some modifications of the project of the competitors; iv) the “dependent” strategy concerns the companies that are institutional or economically bound to other; v) in the case of the traditional strategy the company spares technological innovations when meeting in sectors that don’t demand changes; vi) at last, the “opportunist” strategy, where the company explores market niches.

In that same discussion line, it becomes notable that the studies on the management of productive chains moved the focus from operational perspectives to strategic perspectives, involving the questions relative to the development of the capacity of establishing long term relationships with strategic partners in the search of innovative solutions. The development of collaborative capacity, learning and innovation generated in these connections between the stakeholders and the company and between this and other organizations of the institutional link of the chain can compose a differentiating competence for the company (DYER; SINGH, 1998).

The works of Humphrey and Schmitz (2000) emphasized that the upgrading of the local companies can be structured starting from the relationships of these last ones with the Global Value Chain, and these opportunities vary in agreement with the form as the involved companies are organized and governed in the context of the chain. In that investigation line, some studies pointed out that the perspective of the Global Value Chain, when focusing the discussion on the influence of the entails in global levels, does not present enough explanation for the emergency of innovative capacities between the small and medium companies, participants of the local chain.

In that context, the political decision makers have been proposing programs in the sense of aiding these companies to reach their development, tends as base the idea that the local sources of competitiveness should be strengthened. Therefore, they are privileged the approaches based on the synergy of the relationships through the organization of different types of organizational arrangements, among these, the productive chains (GEREFFI; KAPLINSKY, 2001; SCHMITZ; STRAMBACH, 2009).

This way and considering the context of the small companies of the goat husbandry productive chain, different sources and factors can characterize transition stages and influence in the variation of the continuity of the build-up of technological capacity, being that related to the specific strategic efforts of the companies of building these capacities. Among those sources and factors they are pointed out those related to

the mechanisms and links of technological learning that the companies are engaged, facilitating to build and accumulate their own technological capacities.

1.2 The technological links of external learning underlying the build-up of technological capacities in small companies of the goat husbandry productive chain

In this study it will be considered the perspective of the technological learning that defines it as a deliberate process in which knowledge and competence are acquired by the individuals and converted, through them, to the organizations, influencing, finally, in the evolution of dynamic capacities (BELL, 1984; ZOLLO; WINTER, 2002).

Based on Cohen and Levinthal (1990) and Figueiredo (2010), the processes of technological learning refer to the different sources and factors, and could happen through intra-managerial mechanisms and inter-managerial mechanisms through the establishment of external technological links between the companies and other agents in the “context” in which those operate (MAGGIONI; RICCI, 2002).

Studies as, for instance, the ones of Vedovello (1995) analyzed the sources and external mechanisms through the exam of the links of learning between companies and their technological infrastructure, understood as a group of institutional arrangements tends as main objective to facilitate the spreading of technologies and knowledge and, like this, to support the companies to develop their technological capacities. Those institutional arrangements include a diversity of mechanisms and processes, which serve as support to the provision of services, such as: technical attendance, certification, consultancy and training, research contracts.

On the other hand and in the context of the latecomers, Bell and Pavitt (1995) made an important contribution for the understanding of the process of construction of technological capacities, when they discuss on the inherent challenges to the transition stages that some companies should confront to enlarge their knowledge bases.

For that, the authors related a group of organizational and institutional factors that can influence the learning development, originating from of external sources, characterizing a transition from the routine levels to the innovative levels of build-up of the technological capacities of the companies. This discussion will be articulated in the next section.

1.3 The influence of contextual factors in the development of learning and in the acceleration of the paths of build-up of technological capacities in small companies, participant in the goat husbandry productive chain

Bell and Pavitt (1995) and their followers generated a range of knowledge about how latecomers transit between the operation of their basic capacities and the construction of intermediate and advanced innovative capacities, aiming at the acceleration to catch-up or overtake the technological border.

Considering the process, usually discontinuous, of technological development of the latecomers, those authors placed in discussion those transition processes, enhancing the importance of a set of organizational and institutional factors that can influence the learning development of the companies and affect the acceleration of the build-up of technological capacities, among these: the inequality in the knowledge base, the profile of the activities of research and development (R&D), the options of technological strategies that are open for the companies, the impact of the context in the technological

strategies and in the process of creation of knowledge, and the national capacity of science, technology and innovation (BELL; PAVITT, 1995; BELL, 2006).

Authors as Kim (1997); Vera-Cruz (2000) and Dutrenit, (2007) have been discussing on the understanding of how the companies, along the time, used different sources and learning factors to establish a base of technological knowledge that did not exist previously, characterizing, therefore, a transition period in a certain scale of time.

Other developed empiric studies tend as focus the small and medium companies improved the knowledge on the influence of different factors in the development of technological capacities by emphasizing the relationship between the local producers and the role of the organizational supports and of the public institutional apparatus (KEESING; LALL, 1992; MEYER-STAMER, 2004).

Considering the context of companies from productive chains, some studies included in that discussion the role of external sources in the analysis of the learning dynamics and the technological capacities (NADVI; SCHMITZ, 1999; GEREFFI; KAPLINSKY, 2001; HALDER, 2004); others verified specifically the connections between the companies and the research and development (R&D) of collaboration (ZYLBERSZTAJN, 1993; OAKLEY, 2007).

Considering the objectives of that research, still becomes notable the studies that had as base the catching-up perspective by demonstrating how the companies accelerated their catching-up paths and overtaking of the technological border, emphasizing the analysis of organizational and contextual factors that happened in the amplification of their knowledge bases, among these: the changes happened in the institutional apparatus; the emergency of new markets and technologies; new political rules, changes in the Management model and organizational architectures (BESSANT, 2005; NELSON, 2007).

The evidences on the catching-up processes in the studies accomplished in latecomers of the Asian Southeast ally to this investigation line, when they focalize the attention in the construction of innovative technological capacities starting from the successes obtained at the international market (AMSDEN 1989; LEE; LIM, 2001).

The mentioned studies present important contributions for the evaluation of the technological level of companies. However, these studies did not weave a long term evaluation of the evolution of those technological indexes. Also, they did not focus the analysis on the influence of the contextual factors and of the technological links of learning, originating from of the external sources in the acceleration of the build-up of technological capacities on small companies in productive chains.

This research differs when approaching the relationships among those aspects mentioned above, seeking to contribute for the progress of the knowledge in the area, once it looks for to examine, through a study of comparative case, the dynamics of the paths in terms of timing and speed of technological build-up in small companies of the productive chain of the goat husbandry dedicated to the creation of dairy goats in the state of Ceará, located in the Brazilian Northeast. They are still verified the influence in the catching-up of build-up of innovative capacities of the contextual factors and of the external technological links between the companies and the organizations of the institutional link of the productive chain.

It is presupposed that, in the context of the latecomers, the development of innovative capacities is in build-up process, many times characterizing transition periods influenced by different contextual factors and external technological links of learning. In the Northeast area of Brazil these innovative capacities will be built. In this sense, the participant companies of the goat husbandry productive chain of Ceará have a shallow level of technological capacity. In these terms, the following questions emerge:

- How it is possible to differentiate the paths of technological build-up in the small companies under study in terms of direction and speed along the analyzed period?
- Which contextual factors and which types of external technological links of learning were identified? How can those external technological links and the contextual factors identified explain the differences (if such differences exist) in the catching-up of technological capacities of the companies under analysis?

The relationship among the constructs that base the guide questions of this research is represented in the analytic model presented in Chart 1 to proceed:

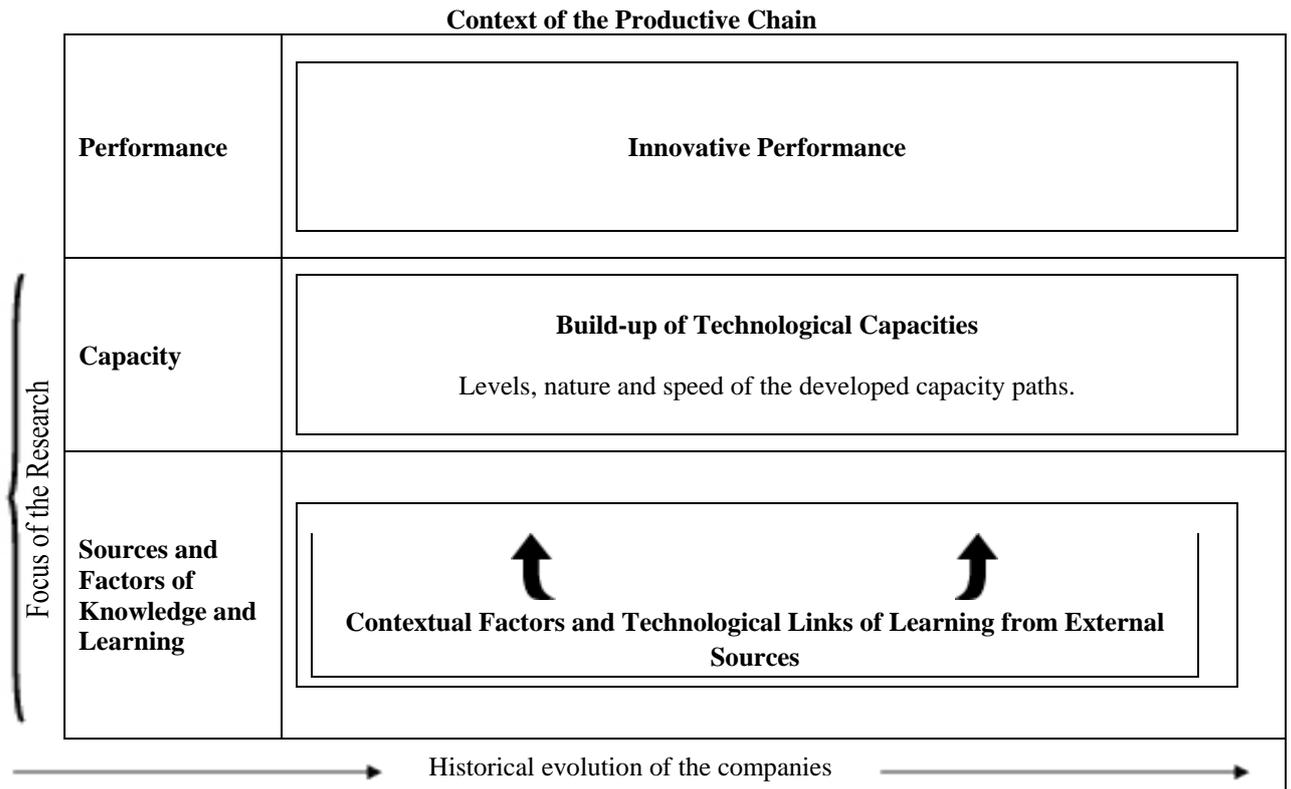


Chart 1: Analytical Model

Source: Adapted from Figueiredo, 2010.

In the next section it is presented the operation of the constructs related in Chart 1 and which will be examined by this research.

2. CONSTRUCT OPERATION

2.1 Characterization of technological capacities in small companies, participant in the goat husbandry productive chain

There are several methods for the analysis of the innovative performance of companies. Bell and Pavitt (1995) presented a taxonomy to understand the construction process of technological capacities in industrial companies. This method allows identifying the profile of technological capacities in different levels of different types of companies.

Considering the context approached in this study – small companies participant of the goat husbandry productive chain – and with the purpose of describing the paths of build-up of technological capacities took place an adaptation of the original models used by Lall (1987), Bell and Pavitt (1995) and Figueiredo (2001).

The adaptation of the method to the reality in study happened through the gathering of secondary data and documents compiled in the literature and in the databases of specialized institutions. It was still used the collection through primary data obtained by the composition of a panel of 12 (twelve) specialists of the sector and by the accomplishment of interviews with those specialists.

Given the specificities of the companies under study and considering the context of the goat husbandry productive chain, the adapted model (Table 1) for this research was constituted by 6 (six) levels of competences for 3 (three) technological functions, among these: Management the Productive Unit; Articulations in the Context of the Productive Chain and Handling and Organization of the Production. This last function involved three processes: nutrition, sanitation and reproduction. The levels represent the complexity degrees reached for the execution of specific activities.

	Levels of Technological Capacity	Technological Functions and Related Activities		
		<i>Management of Productive Unit</i>	<i>Handling and organization of production related to the processes of Nutrition / Sanitation / Reproduction</i>	<i>Articulations in the Context of the Productive Chain</i>
	6 – International Border of Innovation (Frontier Pushing)	Management of the enterprise with the development of an agricultural system based on complex, radical and open innovations for the technology transfer in global levels	Development of complex original researches for the world, aimed to the nutritional, sanitary and reproductive handling and for the genetic improvement of the animals in R&D laboratories and/or associated to international centers.	Integration among global productive chains – places focused in new alternative businesses, complementary to goat husbandry.
Innovative Performance	5 – Advanced Innovative	Organizational management and development of an agricultural system seeking radical improvements. Development of individual controls of zoo-technical and genealogical electronic data of the performance of the herd with the implant of subcutaneous chips; Development of good practices concerning the facilities engineering, seeking the well-being of the animals and innovative management of the environment.	Development of equipments and researches seeking new and advanced bio-techniques for production of victuals or appropriate alimentary supplement to specific needs of herds; for prevention and original diagnoses of diseases; and for the establishment of innovative reproductive handlings of multiple ovulations of females seeking genetic improvement of animals.	Integration among productive chains, partnerships and active and consolidated participation among suppliers, universities, R&D institutes and public and private organizations. Increasing and conquests of new markets.

Innovative Performance	4 – Intermediate Innovative	Organizational management and innovative development of agricultural system, processes and products through zoo-technical and genealogical individual controls of the productive and reproductive performance of the herd and of the resources and inputs of the property through specific software. Increasing and original actions for environmental control.	Development of specific equipments and of a forage and water plan for the alimentary handling in agreement with a group of innovative criteria. Sanitary and reproductive handling based on the development of new researches, bio-techniques, kits and specific methods for the prophylaxis and diagnosis of diseases, seeking the increment of the productivity of the herd.	Integration of the links in elapsing of the chain between the companies and other organizations of the institutional apparatus. Active participations in technical meetings of class associations and in local and national events. Increasing and conquests of new markets.
	3 – Basic Innovative	Organizational management of property seeking the amplification of production scale, with development of new processes and products. Development of systematic controls of technical attendance with genealogical and zoo-technical accompaniment of the herd and accomplishment of medium prediction of inputs consumption. Environmental control of the property.	Development of forage and water resources for the preparation of the feeding in the own company through the adaptation of specific equipments with the addition of appropriate mineral supplement; automated systems for water supply and sanitary control for specific and frequent periods along the year. Reproductive handling with the creation of genetically superior breeders and sows.	Articulations among the links of the productive chain, through systematic contacts between the companies and the other organizations of the influential institutional apparatus in the productive chain. Active participations in technical meetings of class associations and in local events. Effective participation in new markets niches.
Productive Performance	2 – Advanced Routine	Management of the property and zoo-technical and genealogical accompaniment of the herd through technical attendance and accomplishment of predictions of inputs consumption. Concerns about environment.	Handling of feeding with voluminous and concentrated with the addition of basic mineral supplement. Sanitary handling through the quarantine system for the recently-acquired animals and accomplishment of prophylaxes of the main ecto and endo-parasitosis. Covering station, with natural reproductive handling controlled to avoid exhaustion of breeders.	The connections and the contacts between the companies and the organizations of the institutional link intensify in amount, but they are still disjointed. Participation in local markets.
	1 – Basic Routine	Mechanisms of property management and basic annotations related to the general control of the herd. Technical attendance in incipient level.	Feed handling of the herd accomplished only with what is available in the property. Sanitary handling in basic level (ex.: separation of sick animals) and actions of control of endo and ecto-parasites, usually answering to an endemic situation. Reproductive handling based on natural covering.	There is no idea of productive chain. The connections and contacts between companies and organizations of the local institutional apparatus are incipient and sporadic.

Table 1 - Model of analysis of technological capacities for small companies, participant in the goat husbandry productive chain. Source: Adapted from Lall (1987); Bell and Pavitt (1995) and Figueiredo (2001) based in field research.

The companies build and accumulate their technological capacities based on dynamic processes of acquisition and development of technological capacities through different sources and factors. Those constructs will be operate in the next section through the characterization of the criteria and models for the analysis of contextual factors and technological links of external learning influent in the acceleration of the build-up of technological capacities.

2.2 Characterization of the contextual factors and technological links of external learning influent in the acceleration of the paths of technological capacities in small companies of the goat husbandry productive chain

As previously discussed, certain organizational and institutional factors challenge and stimulate the latecomers to improve their knowledge bases, seeking to the construction of innovative capacities and the acceleration to catch-up and/or overtake the technological border (BELL; PAVITT, 1995; VERA-CRUZ, 2000; LEE; LIM, 2001; KIM, 1995), including companies participant of productive chains (SCHMITZ, 2007; GEREFFI; KAPLINSKY, 2001; HALDER, 2004).

Following this investigation line, this research integrates the evidences about the different Contextual Factors inherent to the goat husbandry productive chain and that are being activated by the companies under study.

The identification of Contextual Factors was based in the organization of a set of data and content analyses (BARDIN, 2004) obtained from the compilation of the documental literature, as well as from the interviews and observations accomplished *in loco* during the empiric study. According to the content analysis undertaken in the operation of those constructs, it is presupposed that when they are activated by the companies, the Contextual Factors characterize a transition stage, impelling them to develop a knowledge base that did not exist before, tends as objectives to build their innovative capacities. These factors, evidenced in Table 2 to proceed, are related to the institutional link in the context of the goat husbandry productive chain (MDS, 2010).

Contextual Factors	Politics and Government Programs	
	New Institutional Markets	
	Entrepreneur Class Associations	

Table 2: Contextual factors

Source: Elaborated by the author from content analysis obtained in the documental literature and in the accomplished interviews.

On the other hand, it was observed that those contextual variables were stimulating the companies to establish a group of Technological Links of Learning originating from External Sources, being these established with certain organizations of the institutional link of the goat husbandry productive chain: i) CAPRILEICE (*Associação dos Criadores de Caprinos Leiteiros do Ceará* – Association of Dairy Goats of Ceará); ii) government agencies, such as the Department of Agrarian Development through EMATERCE (*Empresa de Assistência Técnica e Extensão Rural do Ceará* – Company of Technical Attendance and Rural Extension of Ceará); iii) the state and federal universities of Ceará; iv) a public R&D institute linked to EMBRAPA Caprinos (*Empresa Brasileira de Pesquisa Agropecuária* – Brazilian Agricultural Research Corporation).

This way, this research presupposes that the Technological Links of External Learning between the companies and the organizations of the institutional link of the productive chain are decisive elements in the analysis about the amplification of the knowledge bases of the companies when they influence the dynamics of the catching-up

of build-up of technological capacities. In Table 3, to proceed, it comes an adaptation of the model for the description of the Technological Links of External Learning, based on the one developed by Vedovello (1995).

Nature of the technological links of external learning	
<i>Informal Links</i>	<ol style="list-style-type: none"> 1. Informal contacts with researchers / entrepreneurs / technicians of government agencies; 2. Access to specialized literature; 3. Access to the research of specific departments; 4. Participation in seminars and conferences; 5. Access to equipments of university and/or research institutes (EMBRAPA) and/or of the companies; 6. Participation in specific educational and training programs; 7. Other informal connections (specify).
<i>Human Resource Links</i>	<ol style="list-style-type: none"> 8. Involvement of universities' students in projects; 9. Recruitment of recently graduate; 10. Recruitment of scientists and more experienced engineers; 11. Training programs formally organized to assist the needs of human resources; 12. Other connections of human resources (specify).
<i>Formal Links</i>	<ol style="list-style-type: none"> 13. Consulting developed by researchers or consultants; 14. Analyses and tests (technical rehearsals); 15. Services of collection updating (technical norms applied, patents); 16. Technical response (diagnoses of problems in process and product); 17. Establishment of research contract (such as software development); 18. Establishment of joint research; 19. Other formal connections (specific).

Table 3: Nature of the technological links of learning, originated from external sources between the companies and the organizations of the institutional link of the goat husbandry dairy productive chain. Source: Adapted from Vedovello (1995).

Besides the links, the model elaborated by Vedovello (1995) also examines the aspects that permeate those links: nature of the links, their frequency, the results and the benefits that emerge from them. Those criteria and aspects are classified according to the levels elaborated in Table 4, to proceed.

Levels of classification of the technological links of external learning	
<i>In Terms of Frequency</i>	F1 - Up to 02 (two) times a year; F2 - 03 (three) to 06 (six) times a year; F3 - once a month; F4 - once a week or more.
<i>In Terms of Obtained Results</i>	R1 - Verbal Advice; R2 - Supply of information; R3 - Reports; R4 - Implementation of specific processes; R5 - Design specifications; R6 - Prototypes; R7 - Patents; R8 - Other (specify).
<i>In Terms of Reached Benefits</i>	B1 - None; B2 - Small benefit; B3 - Moderate benefit (complementally); B4 - Great benefit (crucial).

Table 4: Levels and criteria used for the classification of the technological links of external learning between the companies and the organizations of the institutional link of the dairy goat husbandry productive chain. Source: Adapted from Vedovello (1995).

In the next section, the empiric context in which this research was developed is described.

3. EMPIRIC CONTEXT OF THE RESEARCH

The goat husbandry carries out important social functions in some areas of the world when contributing with the subsistence of less favored populations, including in that context the Northeast area of Brazil. In other areas of countries like Australia and New Zealand, among other of the European continent like France, Italy and Greece, using appropriate and advanced technological systems, the goat production has guaranteed economical return.

China, India and Pakistan, followed by Australia, have the largest goat herds, with, respectively, 17,33%; 14,59%, 6,58% and 7,33% of the world herd. Brazil has 1,10% of the goat herd, in spite of possessing, mainly in the Northeast area, same edaphoclimatic conditions, and even superior, to the ones in the countries that are the larger breeders of the species. The Northeast area of Brazil deserves prominence about the exploration of goat husbandry, with more than 08 (eight) million heads, what represents about 90% of the total national goat herd (IBGE, 2009; FAO, 2009).

According to Holanda Jr. (2006) since the second half of the 1990's, the goat husbandry productive chain, especially the milk segment (Chart 2) was established as priority for the development of the agricultural system of the Brazilian Northeast.

Considering that institutional context, "PAA Leite" stands out (*Programa de Incentivo à Produção e Consumo de Leite* – Incentive Program to Production and Consumption of Milk). It is classified as a modality of PAA (*Programa de Aquisição de Alimentos* – Victuals Acquisition Program) developed with resources of MDS (*Ministério do Desenvolvimento Social e Combate à Fome* – Ministry of Social Development and Hunger Combat) and MDA (*Ministério do Desenvolvimento Agrário* – Ministry of Agrarian Development), as an instrument of public politics of the Federal Government countersigned in Law 10.696, of July 2, 2003, that has been stimulating the production of goat milk with the opening of new institutional markets.

Based in PAA and in the local ambit, the Government of the State of Ceará started, in 2007, the "Incentive Program to Production and Consumption of Goat Milk" in the State (SDA, 2010). The program has as objective to support, provide and diffuse raising techniques of milk goat husbandry, seeking the improvement, economical viability and management of the activity, guaranteeing the participation of local producers in "PAA Leite" government programs.

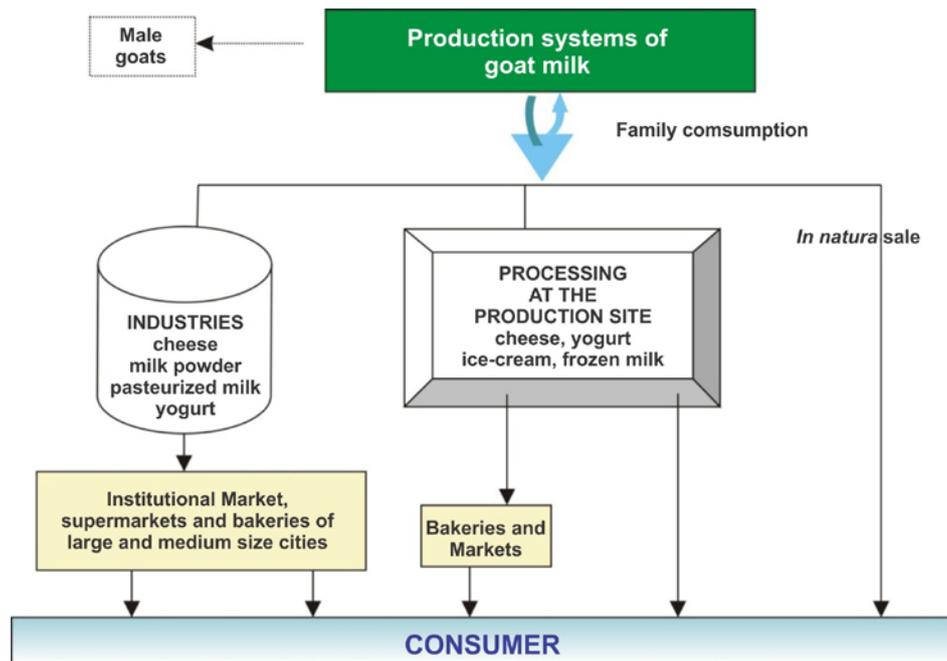


Chart 2: Commercialization flows of the dairy goat productive chain in Brazil.
Source: Holanda Jr. (2006 p.18)

To reach those objectives, since 2007 the companies participant of the goat husbandry productive chain inaugurated the activities of CAPRILEICE (*Associação dos Criadores de Caprinos Leiteiros do Ceará – Association of Dairy Goats of Ceará*), which has among its objectives to motivate, strengthen and develop the dairy activity in every territory of the state of Ceará

4. DESIGN AND METHOD OF THE RESEARCH

The methodological scope of this study was the comparison between two case studies, using several techniques of gathering and triangulation of information (YIN, 2001). For the choice of the cases, they were used as selection criteria the small companies associated to CAPRILEICE.

For the gathering of data, they were accomplished interviews with semi-structured scripts with the owners of the companies, with the purpose of knowing the historical evolution of the company. At this time, the development stages of the companies were from 2000 to 2010. Later, the observations and interviews proceeded based on the scripts and evaluation forms of functions/processes/levels related to the technological capacities under study.

For the mapping and analysis of the contextual factors and for the analysis of the nature and levels of the external technological links, systematic observations were accomplished and interviews in the companies and in the organizations of the institutional link of the goat husbandry productive chain.

This collected material was analyzed based on the Thematic Analysis technique, which is in the group of Analysis of Content techniques (BARDIN, 2004). For the final analysis, the obtained evidences were described comparatively, related and organized in charts and tables, allowing the reconstruction of the technological paths, according to the typology described in Table 1, with the identification of nature, timing and speed necessary to accumulate the different levels of technological capacity. In a second

moment, the analytic evidences were presented concerning the influences of the contextual factors (Table 2) and identified technological links and external learning (Tables 3 and 4) in the acceleration of the build-up of technological capacities of the companies under study.

5. ANALYSES AND DISCUSSIONS

A comparative analysis will be presented in this section, based on the discussion of the joined results evidenced in companies Alpha and Beta.

5.1 Comparative analysis of the nature and dynamics of the paths of build-up of technological capacities

According to Table 1 the development speed of technological capacities in the companies can be referenced in the scale of time established for each one of the analyzed functions, handlings and processes.

The function **Management of Productive Unit** in the two companies is presented in a comparative way in Chart 3. Starting from the obtained results it was verified that the companies, in spite of they have followed paths with similar directions, accumulated technological capacities with dynamics and speeds in a different time scale.

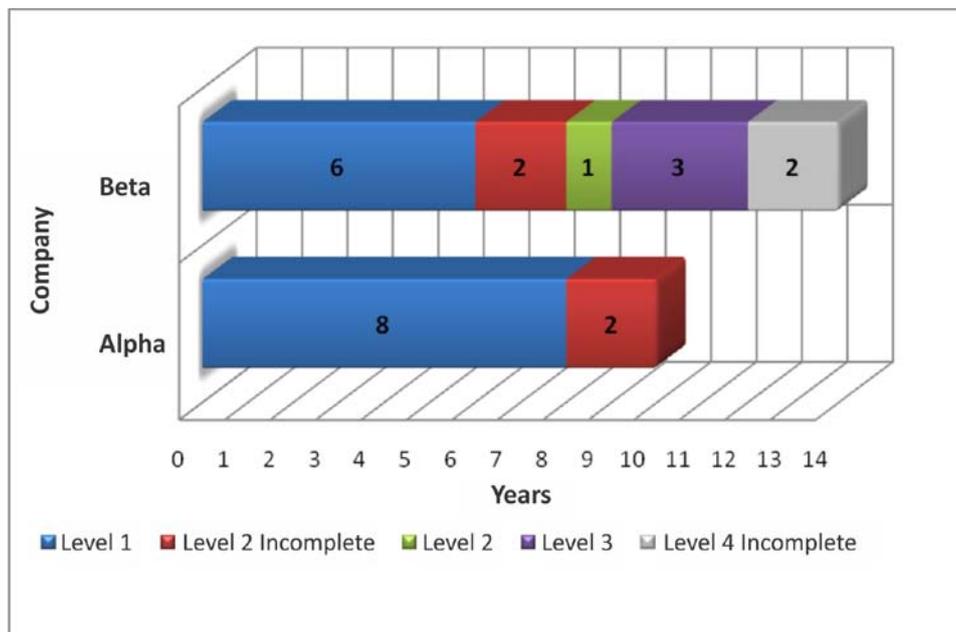


Chart 3: Time and Speed of build-up of technological capacities for the function Management of Productive Unit in the companies in study.

Source: Elaborated by the author based on data obtained through research.

The analysis of the data evidences that the companies began their activities at level 1 – Basic Routine. However, while company Alpha took eight years to leave level 1, company Beta reached level 2 – Advanced Routine – faster, in six years. However, reaching level 2 happened in the same way in both companies, being executed for 02 (two) years in an incomplete way, when developing different management techniques, accomplishing, for instance, the prediction of consumption and inputs in the property.

While company Alpha stayed stagnated in level 2, company Beta has been varying its permanence time and change scale in different levels in the function

Management of Productive Unit, having developed since 2005 to level 3 – Basic Innovative –, in which stayed for three years.

In the current stage, that comprises from the end of 2006 up to 2010, company Beta accomplishes, for two years, activities regarding level 4 – Intermediate Innovative – of the function Management of Productive Unit. It characterizes the catching-up of its technological paths.

About the processes of **Nutrition** handling, they also began at level 1 – Basic Routine – in both studied companies. Analyzing the evolution in terms of speed of that function, it is verified that until the end of the second historical stage the paths have been developed in a similar way, as it can be observed in Chart 4.

So much company Alpha as Beta stayed at level 1 for four years, passing to level 2 – Advanced Routine – with the performance of all the referred activities. In the current stage, it is observed, however, that company Alpha is at level 2 for six years, the same time that company Beta took to differ and to move forward to level 3 – Basic Innovative.

This differentiation in the speed happened in the scale of the four years that separates company Beta from company Alpha. On this time company Beta accelerated when developing technological capacities that allowed the passage between levels 3 – Basic Innovative – and 4 – Intermediate Innovative – in a simultaneous way, with the accomplishment of activities referring those two levels at the same time, among these: the development of a forage plan for preparation of feeding, involving the adaptation of equipments.

The accomplishment of those activities of nutritional handling characterized the permanence between levels 3 – Basic Innovative – and 4 – Intermediate Innovative – in a simultaneous way, being level 4 accomplished in an incomplete way for three years. In 2009, incremental improvements in the rural facilities, with the development of an automated system for water supply to the animals, configured the accomplishment of level 3 – Basic Innovative – in a complete way.

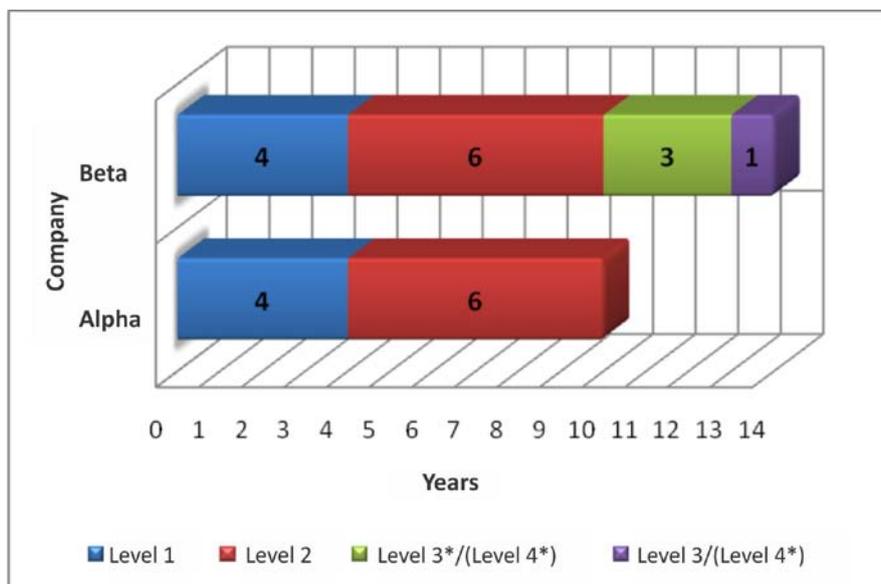


Chart 4: Time and Speed of build-up of technological capacities for the function Nutrition in the companies in study.

Source: Elaborated by the author based on data obtained through research.

NOTE 1: * = It refers at a level accomplished incompletely

NOTE 2: Level X/(Level Y) = Levels accomplished simultaneously

On the other hand and according to Chart 5, differences are noticed, but, above all, similarities when analyzing the paths of build-up of capacities referred to the function **Reproduction**. While company Alpha began its activities at level 2 – Advanced Routine –, Beta began its path accomplishing the activities referred to level 1 – Basic Routine –, taking eight years to move forward to the next level.

However, the progress of company Beta to the next level can be related to the interest of the corporate leadership of investing in species with larger genetic value.

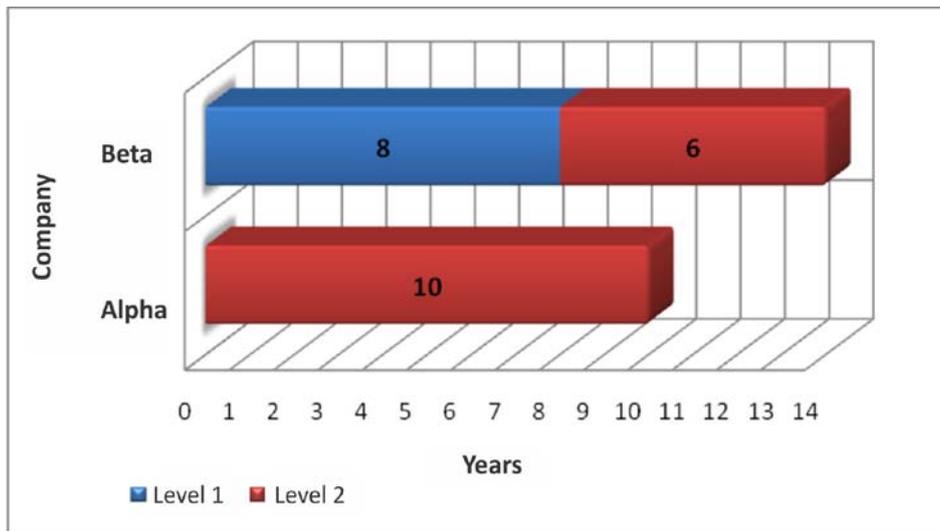


Chart 5: Time and Speed of build-up of technological capacities for the function Reproduction in the companies in study.

Source: Elaborated by the author based on data obtained through research.

Regarding the processes of Sanitation handling, those have also been presenting different build-up speeds, as it can be observed in Chart 6. While company Alpha began its path with the accomplishment of all the activities referred to level 1 – Basic Routine –, company Beta made it in an incomplete way, being, in the beginning of its path, capable to accomplish only one of those activities of its productive routine.

As previously evidenced, the different initial speeds between the companies can be explained by the fact that company Beta was founded by an entrepreneur who didn't have previous experience with the development of agricultural businesses. He didn't have, therefore, specific tacit knowledge to provide abilities to start the business in a more advanced level.

There are, thus, indications that this data is underlying to the evidence of the differences in terms of time and speed that each one of the companies took to accumulate capacities in the function Sanitation. It was verified that company Alpha developed faster than company Beta: company Alpha took five years to move forward from level 1 to level 2 – Advanced Routine –, while company Beta took six years to accomplish the same path.

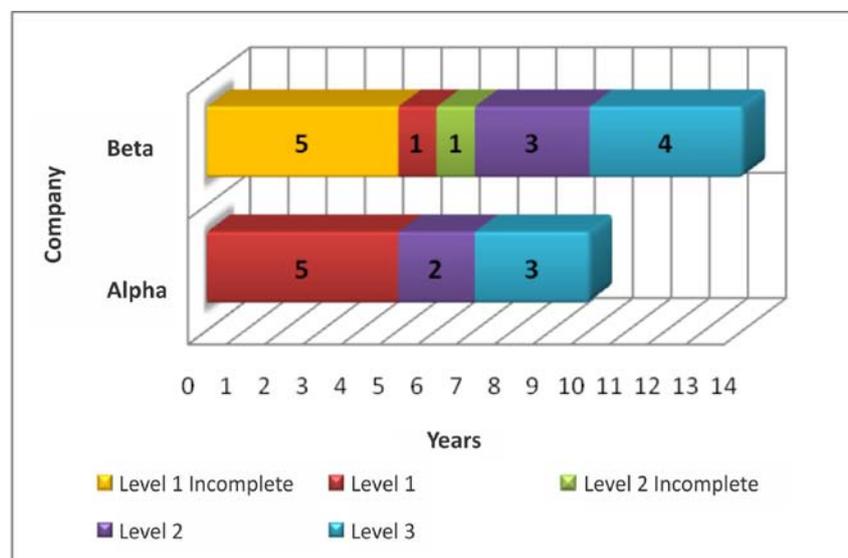


Chart 6: Time and Speed of build-up of technological capacities for the function Sanitation in the companies in study.

Source: Elaborated by the author based on data obtained through research.

In the same way, the progress from level 2 to level 3 – Basic Innovative – happened faster in company Alpha than in company Beta, taking the first half of the necessary time by the second to reach the innovative levels. In spite of the differences in the paths in terms of speed, it is highlighted, however, that in the last period analyzed, both companies developed activities referred to level 3 – Basic Innovative – of the function Sanitation.

Finally, about the processes referred to the **Articulations in the Context of the Productive Chain** (Table 5) they stand out for both companies that didn't exist in their Initial Stages the idea of productive chains, the connections between these and the organizations of the institutional link were incipient and sporadic. In elapsing of the Intermediate Stage with the amplification of the contacts network, the dynamic operation of those contextual connections varied and intensified, moving between level 2 – Advanced Routine – and level 3 – Basic Innovative.

Historical Evolution	Comparison of the Build-up of Technological Capacities for the Articulations in the Context of the Productive Chain		
	<i>Company ALPHA</i>	<i>Company BETA</i>	
Current stage (2007 – 2010)	Levels of build-up of technological capacity moving between Basic Innovative (3) and Intermediate Innovative (4)	Levels of build-up of technological capacity moving between Basic Innovative (3) and Intermediate Innovative (4)	
Intermediate stage (2004 – 2006)	Levels of build-up of technological capacities moving between Advanced Routine (2) and Basic Innovative (3)	Levels of build-up of technological capacities moving between Advanced Routine (2) and Basic Innovative (3)	
Initial stage (2000 – 2003)	Basic Routine level (1) of build-up of technological capacity	Basic Routine level (1) of build-up of technological capacity	

Table 5: Comparison of the dynamics of build-up of technological capacities of companies Alpha and Beta, for the processes Articulations in the Context of Productive Chain, from 2000 to 2010.
Source: Elaborated by the author based on data obtained through research.

Starting from the end of 2006 both companies influenced by the activation of the Contextual Factors (Table 2) began a period, characterized as of transition, when building a new knowledge base through the effectuation of a group of Technological Links of Learning, originated from External Sources.

The positioning of the companies in the Current Stage related to the processes Articulations in the Context of the Productive Chain, described in Table 5, coincided with the beginning, in 2007, of the activities of the class association – CAPRILEICE, denoting that these developed its institutional articulations strategically planned, in the attempt of integrating different links in the context of the productive chain, aiming at the increment of innovations.

On the other hand, it is noticed that when comparing the paths of functions of handlings and contextual processes to each other and in spite of both companies under study have accumulated technological capacities as they reached superior levels, they are noticed differences of speeds, with discontinuity in the scales of time analyzed, so much between the companies as between the technological functions inside the companies, revealing that the process of build-up of technological capacities is idiosyncratic (BELL; PAVITT, 1995; BESSANT, 2005; SCHMITZ, 2007). In this study, this idiosyncrasy can be referred in the analysis of the influence of the several external connections of underlying learning to the build-up of technological capacities of the companies.

6.1 Analysis of the influence of the technological links of external learning and of the contextual factors in the catching-up of the paths for the build-up of technological capacities

The focus in development strategies and the abilities of the corporate leaderships related to the knowledge developed through the connections and direct contacts in private contexts – such as the class associations – “the know who”, composed a differentiating competence for the companies under study (DYER; SINGH, 1998).

In this sense, and according Table 6 bellow, the Contextual Factors (Table 2) propitiated the effectuation of a group of Technological Links of Learning originated from External Sources between the companies and the organizations of the institutional link of the productive chain.

Nature and levels of the technological links of learning originated from external sources	
<i>Informal Links</i>	Frequency (F) Results (R) Benefits (B)
Informal contacts with researchers of EMBRAPA R&D institute	F1 R2 B2
Informal contacts with researchers and teachers of Veterinary and Administration at UECE (<i>Universidade Estadual do Ceará</i> – State University of Ceará) and Animal Science at UFC (<i>Universidade Federal do Ceará</i> – Federal University of Ceará)	F2 R1; R2 B3
Access to researches accomplished in the university courses of Veterinary (UECE), Animal Science (UFC) and Administration (UECE)	F1 R1; R2; R3 B3
Participation in seminars, conferences and fairs	F2 R1; R2; R4
Technical visits and access to equipments of universities, research institutes and other companies	F1 R1; R2; R4; R5 B3; B4
Participation in specific educational and/or training programs with the supplying companies, with the government organs, such as SDA (<i>Secretaria de Desenvolvimento Agrário</i> – Department of Agrarian development) through EMATERCE and with the class association – CAPRILEICE	F2; F3 R1; R2; R3; R4; R5 B3; B4
Access to specialized literature	F4 R2; R4; R5 B3
<i>Human Resources Links</i>	
Involvement of university students in projects	F2 R1; R2; R3 B3
Recruitment of recently-graduated	<i>Absent</i>
Recruitment of scientists and more experienced engineers	<i>Absent</i>
Training programs formally organized to assist the needs of human resources	F2; F3 R1; R2 B3
Involvement of human resources in programs of technical attendance through EMARTECE, CAPRILEICE and through supplying companies	F2; F3 R1; R2; B3; B4

<i>Formal Links</i>	
Consulting developed by researchers or consultants	F2; F3 R1; R2; R3; R4 B3; B4
Analyses and test (technical rehearsals)	F1 R4 B3
Services and collection updating (applied technical norms and patents)	F1 R4; R5 B4
Technical responses (diagnosis of problems in process and product)	F2 R2; R4; R5 B4
Establishment of research contracts (such as software development)	<i>Absent</i>
Establishment of joint research	<i>Absent</i>

Table 6: Nature and levels of the technological links of external learning between companies Alpha and Beta and the organizations of the institutional link of the goat husbandry productive chain.
Source: Adapted from Vedovello (1995) according to data of the empiric research.

These results presented in Table 6 have as discussion base the perspective of the strategic management of productive chains when focusing the influence of the different contextual factors in the development of technological capacities, starting from the establishment of the technological links of learning between the local producers and the supports and organizational and institutional apparatus. On the other hand, these processes characterize a transition period during which companies have evolved from production levels to those more innovative with the amplification of their knowledge bases (KEESING; LALL, 1992; MEYER-STAMER, 2004).

In this transition period, the levels of build-up of capacities were progressively developing in a discontinuous way, based on the options of technological strategies that were open and they distinguished the companies in the markets, as well as, the implications of the institutional context in the process of creation of already existent knowledge (BELL; PAVITT, 1995; BAZAN; NAVAS-ALEMAN, 2004; FIGUEIREDO, 2010).

Based on that discussion, some analytic themes were stood out of the content analysis related to the different combinations of the strategic positioning that the companies used to improve their innovative performances. Among those they became notable three main strategic forms: the “imitative” through which the companies reacted to the innovation through adaptations of water and forage equipments and of the processes of handling and management. And the “dependent” and “opportunist” strategies, which are being used thoroughly by both companies, tend in view the exploration of niches of the Institutional Markets starting from the possibilities emerged with the Government Program of Victuals Acquisition (FREEMAN, 1974; TEECE *et al.*, 1990).

According to evidences, those innovation strategies happened in the build-up of the technological capacities of the companies Alpha and Beta with the acceleration of the catching-up paths when developing activities that move through the innovative levels for several functions and processes (LEE; LIM, 2001; HOBDDAY, RUSH; BESSANT, 2004).

FINAL CONSIDERATIONS

The study here presented is based on primary and secondary empiric evidences through extensive field work. That method generated a considerable amount of data, information and evidences, so much qualitative as quantitative, fundamental for the articulation of the analyses and the nuances and variations of the processes of development of dynamic capacities in the companies under study.

In that ambit, the results obtained about speed rate will allow the managers to have empiric examples that explain the differences found among the companies in the way and time necessary for the build-up of its technological capacities, supporting its strategic decisions about periods and expectations to reach an innovative performance.

On the other hand, this research also gathered evidences about the implications of the contextual factors in the acceleration of the build-up of innovative capacities in the companies under study. Those factors also propitiated the companies to execute a group of technological links of learning with the organizations of the institutional link of the productive chain.

According to the evidences found, those external technological links and the contextual factors characterized a discontinuity along a process previously continuous of low development of technological capacities, through the emergency of a transition period in the last historical stage analyzed (2006-2010), when building a knowledge base that didn't exist before. Those processes highlighted the role of the external and open sources between the company and its context, allowing the easier development and circulation of innovations.

The results evidenced that the external links and the contextual factors stimulated the build-up of technological capacities, suggesting that the organizations of the institutional link of the productive chain can work as "technological gatekeepers" providing new knowledge to the companies. In that sense, it is considered that the strategies used by the companies happened in the development of innovations and in the acceleration of the catching-up paths in the sense of reaching the existent technological border.

On the other hand, they were observed in elapsing of the scale of time analyzed, instabilities in the strategic management of the knowledge of the companies when they limit the build-up of technological capacities, being that limitation related to its low capacities about the conversion of knowledge obtained through external sources, as well as to the difficulties of the companies to integrate the different knowledge bases acquired with those already existent, allowing the dynamic co-evolution of the learning processes.

In the ambit of the strategic management of the productive chain, the analysis also suggests that the technological connections between the companies and the organizations of the institutional link should be considered as a central subject in the design and in the implement of government politics for the development of industrial competences, mainly in the ambit of small and medium companies.

That study contributed, therefore, to enlarge and to clarify the understanding on the development of dynamic capacities, above all, when related to the external technological connections among the organizations of the institutional link and the small companies, participant in the dairy goat husbandry productive chain in the state of Ceará – Brazil. Thwarting certain negative and pessimistic generalizations related to the technological development of small companies, the evidences of that study showed a promising field.

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