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THE LEARNING PROCESSES UNDERLYING IN THE ACCUMULATION OF TECHNOLOGICAL CAPABILITIES: A CASE STUDY IN THE PRODUCTION CHAIN OF THE CAPRINECULTURE

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1. Abstract

The importance of creativity and innovative technological capabilities for the competitiveness of the companies in emerging economies (latecomers) has been much emphasized. Several studies were based on the discussion of the strategic role of the innovation and the development of technological capabilities, being those based on the approach of “dynamic capabilities” when focusing the constant change of the paths, in terms of timing and speed, of technological accumulation through the learning processes underlying those paths. In that perspective, this article analyzes the implications of the learning processes underlying in the dynamics of the accumulation of technological capabilities in companies participant of the caprineculture productive chain, tends as base the following questions: Which levels and types of technological capabilities do the companies under study present? Which are the implications of the learning processes underlying in the accumulation of the technological capabilities? For the operation of this study of exploratory-descriptive character and qualitative nature it was used the methodological mark of the case study. The collection and analysis of the data started from the collection and compilation of documents and interviews, using semi-structured scripts, tends as base the thematic analysis of contents, referring to the following technological functions: Management of the Productive Unit, Nutrition, Health and Reproduction. The results described four competence levels (routine, innovative basic, intermediate and advanced innovator) for the four studied technological functions, also evidencing the practical implications of different learning processes about the accumulation of the technological capabilities in the company under study. It is still notable the contribution of the article when adapting the analytic structures for accumulation of technological competences and learning processes in the context of small and average companies – participant of the agribusiness sector productive chain.

Key-words:

Technological capabilities; learning process; caprineculture.

2. Introduction

Starting from the beginning of the 1990's, with the coming of the paradigm of knowledge and learning economy, the importance of creativity and innovative technological capabilities was emphasized for the competitiveness of the companies in emerging economies (latecomers). In that context, several studies were based on the discussion about the strategic role of the innovation and the development of technological capabilities, being those based on the approach of “dynamic capabilities”, when emphasizing the constant change of the paths, in terms of timing and speed, of technological accumulation through the learning processes underlying those paths (Lall, 1987; Leonard-Barton, 1990; Kim, 1997; Dutrénit, 2000; Figueiredo, 2003; Bell, 2006).

Several studies approached both accumulation processes and technological learning also verifying the implications in the organizational performance. Such works were accomplished in sectors like metal-mechanic (Büttenbender, 2001); steel (Figueiredo, 2003); technologies of information and communication (Marins, 2005), among others. According to Figueiredo (2003) there is a need of expansion of the empiric studies for different types of companies, in order to generate knowledge about the process of accumulation of technological capabilities. The present work aligns in that study field, differing when focalizing an important sector to Brazil, the agribusiness, and in the context of the small and average companies (SACs) participants of the caprineculture productive chain.

Caprineculture has been occupying a prominence position among the activities of the agricultural sector in the last decades. China, India, Australia and Pakistan have the largest herds of goats, with, respectively, 17,33%, 14,59%, 7,33% and 6,58% of the world flock. Brazil stops 1,53% of the ovinos plantel and 1,10% of the goat herd, in spite of possessing, mainly in the Northeast area, soil and climatic conditions equal, or even superior,

to those of larger countries breeders of these two species (IBGE, 2009; Nogueira Filho & Alves, 2002; FAO, 2009).

In the Northeast area of Brazil the size of the goat herd is more than eight million heads, what represents more than 90% of the totality of the national goat herd. In spite of that expressiveness, the area doesn't present, however, use of all of its production potential (IBGE, 2009; Nogueira Filho & Alves, 2002). In this sense, and so that the exploration of the caprineculture becomes a profitable and economically maintainable activity for the Northeast area, it is necessary the implementation of actions that motivate the development of the activity and that consider aspects as innovation and learning (Nogueira Filho & Alves, 2002; Campos, 2004).

3. Objective

Several studies presented contributions for the evaluation of the technological level in the area of caprineculture (EMBRAPA, 1989; Campos, 2003; Campos, 2004; Costa, 2007; Khan, Costa, Lima, Silva & Ximenes, 2009). These studies, however, didn't establish a specific relationship between level and technological dynamics observed and the learning processes developed by the appraised company.

In that way, this article seeks to contribute in that sense, once it has as objective to analyze the implications of the learning processes underlying in the dynamics of the accumulation of technological capabilities in companies participant of the caprineculture productive chain, tends as base the following questions: Which levels and types of technological capabilities do the companies under study present? Which are the implications of the learning processes underlying in the accumulation of the technological capabilities?

To do so, the present work uses the qualitative approach as research method. That choice is due to its specific relevance for the study of social relationships (Flick, 2004), in that the researchers have the possibility "to study the things on their natural sceneries, trying to understand, or to interpret, the phenomena in terms of the meanings that people give to them" (Denzin & Lincoln, 2006, p. 17). Godoy (1995) confirms this statement when telling that researches with this kind of approach have the natural atmosphere as direct source of data, using a descriptive character and an inductive focus to understand the meaning of things.

Multicase study was chosen as strategy of qualitative research by its adaptation to the research situations in that "the researcher has little control on the events and when the focus is in contemporary phenomena inserted in some context of the real life" (Yin, 2004, p. 19).

In the study of cases, the data collection instruments can be diversified, what gives flexibility to the analysis (Yin, 2004). So, for us to obtain high reliability, during the execution of this study several techniques of collection of information were used, such as informal and deepened interviews. Such semi-structured interviews were accomplished with the managers of four companies, participant of the caprineculture productive chain. Those interviews were accomplished with the purpose of proceeding the investigation of the learning processes and mechanisms (external acquisition, internal acquisition, socialization and code), as well as of the levels of technological capacity regarding the management activities of the productive unit, nutrition, health and reproduction.

It is worth to point out that the four analyzed companies, empiric field of this study, were selected among the ones which integrate CAPRILEICE (Associação dos Criadores de Caprinos Leiteiros do Estado do Ceará – Breeders Association of Dairy Goats in the State of Ceará), all of them located in the metropolitan area of the city of Fortaleza in the Brazilian State of Ceará. For the choice of those companies it was used as criteria: the participation of the same ones in the referred association, and also the accessibility to the same ones and their owners' authorization in the supply of information.

4. Study Development

Starting from the 1970's, the researches addressed to technology in developing countries took a more dynamic direction, focusing the changes happened along the time and the way companies had executed them, challenging, therefore, the perspective of the "technological dependence" that dominated the study field on management of technological innovation in that context (Bell, 2006).

The studies related to the development of own technological competences demonstrated the existent relevance in the involvement of companies in the generation of technical knowledge for the creation of those competences (Katz, 1987; Dahlman, Ross-Larson & Westphal, 1987). According to Bell (1984), above all in long-term, the accumulation of those competences is a necessary condition to technical evolution. Those studies aimed the underlying learning mechanisms, focusing, however, the acquisition of knowledge, and not the processes of conversion of individual learning in the organizations.

In the beginning of 1990's the studies on the development of innovative technological capabilities in companies of emerging countries have taken a broader perspective than the one followed so far. Such studies started to address the focus to the organizational and managerial dimensions of the accumulation process of technological capabilities, to the learning mechanisms and construction of the knowledge, to the specificities of the company and of the consequences of these in the managerial performance (Leonard-Barton, 1990; Lall, 1987; Kim, 1997; Dutrénit, 2000; Figueiredo, 2003).

In 1987, Lall approached the discussion on the paths of accumulation of technological competences, tends as study object a group of Indian industries (cements, steel and textile). The results demonstrated a transition sequence from basic levels to higher levels of acquisition of technological competences, having been also verified the influence of the government politics in the studied industries.

Studies performed by Leonard-Barton (1990, 1992) evidenced that the increments accomplished in equipments, products and processes of the studied companies were associated to the invigoration and the renewal of the basic competences of those companies. Those competences were classified by this author in four dimensions: technical systems; employees' training; managerial systems; values and norms. Those studies, however, don't make an evaluation of the evolution of those competences in long period, nor do they weave comparisons among the studied companies.

Kim (1995, 1997), in case studies accomplished in Hyundai Motors and in Samsung Electronics, demonstrated the importance of the processes of learning conversion from individual to organizational. In the second study (1997), the author reinforces the importance of the external atmosphere in the adaptation of the companies to the commercial and technological context. On the other hand, the study accomplished by Dutrénit (2000) in a Mexican glass company demonstrated the importance of the intra-managerial learning processes in the accumulation of technological competences in the studied reality.

The studies that analyzed companies of border technology dedicated attention to the processes that are underlying to the generation path of technological competences in those companies. The studies developed by Cohen and Levinthal (1990), Leonard-Barton (1990) and by Garvin (1993) demonstrated the importance of the incorporation of external knowledge for the development of competences or innovative capacities. The studies in companies of border technology still approach the processes of learning conversion from individual to organizational, according to Nonaka and Takeuchi (1997) meetings, training at work and sharing of experiences are examples of mechanisms that can take to the socialization of knowledge.

It is noticed, by the analysis of the existent studies in the literature related to companies of emerging countries, that great part of those is directed to the description of the paths of accumulation of technological capabilities of the companies, not creating, however, a relationship between its path and the underlying learning processes. Great part of the studies

accomplished in companies of border technology is directed to the understanding in the way as those organizations maintain and renew the already existent technological capabilities and the accumulated ones, not being the focus of those studies the way as they reached those competences along the time, what is of primordial importance for the companies of emerging countries (Figueiredo, 2003).

In that sense, recent studies (Figueiredo, 2003; Bell, 2006) looked for to rescue, in the context of the latecomers, the dynamic perspective of the first studies of the 1970's. The understanding of the dynamics in process of technological accumulation is fundamental in the context of emerging economies, because, for those companies to reach the technological border it is necessary that they accelerate the process of technological accumulation to a rate proportionally faster than the one observed in companies of industrialized economies (Miranda & Figueiredo, 2010).

Concerning technological learning, according to Bell (1984), it is constituted by processes through the ones which people and, through them, organizations acquire aptitudes and technical knowledge. Figueiredo (2004), however, considers it as a process that allows to a company to accumulate technological capacity along the time. According to Bell (1984) the learning is divided in two processes – one of acquisition, which is of individual ambit; and the one of conversion, which is of organizational ambit. This way, an organization directed to learning is the one capable to generate, acquire and transmit knowledge, allowing the production of continuous improvements (Figueiredo, 2003).

Several models and metric of learning analysis are available in the literature (Nevis, Dibella & Gould, 1995; Kim, 1995, 1997; Nonaka & Takeuchi, 1997). This study will use as reference the analytic base developed by Figueiredo (2003, 2009) that characterizes the processes of technological learning in: a) internal acquisition of knowledge - they are the learning mechanisms by which individuals acquire tacit knowledge through different activities accomplished inside of the company; b) external acquisition of knowledge - they are those mechanisms by which individuals acquire tacit and/or codified knowledge out of the company; c) socialization knowledge - they are the mechanisms by which individuals share the tacit knowledge (mental models and technical aptitudes); d) knowledge code - that are the learning mechanisms by which individual tacit knowledge, or part of it, becomes explicit.

Concerning the existent definitions in the literature to characterize technological capacity, particularly in the context of companies of industrialized economies, Katz (1976) approaches it as an inventive activity or systematic creative effort to obtain new knowledge. According to Lall's definition (1987), however, it is an internal technological effort to acquire the domain of new technologies, to adapt them and to improve them.

In this study, it will be used as base the definition proposed by Bell and Pavitt (1995) that extols that the technological capacity is of diffuse nature and it incorporates the necessary resources (or knowledge stocks) to generate and to manage technological changes. Such resources accumulate and incorporate to the individuals (as aptitudes, knowledge and experience) and, mainly, to the organizational systems, routines and procedures of the company (Bell & Pavitt, 1995; Figueiredo, 2003).

It is through the technological capacity that companies accomplish production and innovation activities. The perspective about innovation adopted in this study is in consonance with that described in the Manual of Oslo (OECD, 2002) that defines the innovation as a continuous process with growing degrees and/or complexity apprenticeships, involving the resolution of problems around different activities, demanding for that capacity stocks and specific learning processes to the companies and other organization types, being this process influenced by the nature of the institutional context in which these are inserted (Figueiredo, 2009; Dosi, 1988).

It is understood that the technological capacity or the internal knowledge base of a company, or even of a department, is accumulated in four components: a) physical system – equipments, software, machinery; b) people – tacit knowledge, abilities and acquired experiences along the time by people, known as the human capital of the organization; c) organizational system – the knowledge that is accumulated in the organizational and managerial routines of the organization; d) products and services – this component refers to

the part of the technological capacity that can be seen and that is resulted of the acquired tacit knowledge by the organization and its members (Lall, 1992; Bell & Pavitt, 1995; Figueiredo, 2003, 2005).

With the purpose of analyzing the levels of technological capabilities in the empiric field approached in this study, it was made an adaptation of the metric used by Figueiredo (2003), which was built based in studies developed by Bell and Pavitt (1995) tends as base the original model elaborated by Lall (1992).

The metric developed by Figueiredo (2003, 2009) classifies the technological capabilities in routine and innovative activities, being these divided in different types, levels and according to the complexity degree. That author defines the routine technological capabilities (or production capacities) as the necessary aptitudes to use a technology, knowledge or organizational mechanisms. On the other hand, the innovative technological capabilities (innovation capabilities) are those that allow creating, modifying or improving products or processes, modifying the technologies, the knowledge and the organizational mechanisms (Figueiredo, 2003, 2009).

The adaptation of the metric to the reality in study was made through secondary data, documents compiled in the specialized literature and through primary data obtained by the composition of a panel of specialists of the sector and of the accomplishment of interviews with those specialists. As well as in the original metric, the columns represent the technological competences by function, and the lines represent them by complexity level (Figueiredo, 2009).

Given the specificities of the area in study and in agreement with the data obtained in this part of the research, the adapted metric is constituted by four levels of competences for four technological functions. Picture 1, bellow, represents the adapted metric: the columns present four technological processes/functions for the studied sector, having the following descriptions: a) Management of the Productive Unit – this function includes the activities referred to the facilities, bookkeeping and cataloguing of data of the flock and the established articulations in the economical context; b) Nutrition – this function embraces the activities referred to the nutritious handling of the animals; c) Health – this function regards the activities directed to care with hygiene and endemic controls of the flock; d) Reproduction – It describes the activities directed to the accomplishment of the reproductive handling of the animals in the properties.

LEVELS OF TECHNOLOGICAL COMPETENCE	TECHNOLOGICAL FUNCTIONS AND RELATED ACTIVITIES			
	Management of the Productive Unit	Nutrition	Health	Reproduction
1. Routine	Basic notes about the flock as administration mechanisms; Change of information with the suppliers; Technical attendance in incipient level.	Feeding of the animals only with what is available in the property.	Use of sanitary control actions in basic level (e.g.: isolation of sick animals). Sporadic use of control actions of endo and ecto-parasites, usually answering to an endemic situation.	Use of natural mating, without control or management of data.
2. Basic innovative	Individual accompaniment of the animals through the use of records (weight control, accomplished procedures, among other); Accomplishment of medium prediction of inputs consumption; Articulation with class entities.	Feeding with roughage and concentrate, and mineral supplement suitable for feeding the animal.	Use of quarantine system for recently acquired animals. It is accomplished prophylaxis of the main ecto and endo-parasites .	Use of mating stations, with natural and controlled mating to avoid exhaustion of the reproducers; Accomplishment of data control.

<p>3. Intermediate innovative</p>	<p>Accomplishment of control of animals, resources and inputs of the property through software; Cataloguing of the genealogical information of animals; Accompaniment of productive-reproductive performance; Articulation with organs with research institutes.</p>	<p>Planning of the animals' diet in agreement with age, aptitude and productive and reproductive state; Preparation of the feeding of the animals in the own company, with the use of specific equipments (e.g.: grinders, mixers); Use of a system for water supply for the animals.</p>	<p>Use of sanitary control (e.g.: cleaning and disinfection of the facilities) for specific and frequent periods along the year; Use of kits for diagnosis of diseases; Use of the SAMACHA method (card with indicative colorations for comparison with the mucous membrane of the animal with purpose of identification of the worming need).</p>	<p>Use of reproductive biotechniques, like artificial insemination and transfer of embryos to increase the productivity of the flock; Use of reproducers and elite sires.</p>
<p>4. Advanced innovative</p>	<p>Use of implants of subcutaneous chips in the animals for individual identification and data control; Development of researches related to the engineering of the facilities, looking for the well-being of the animals; Actions of technology transfer in international levels (e.g.: with suppliers, commercial partners).</p>	<p>Development, in R&D labs, of researches directed to the production of victuals or appropriate alimentary supplement to the specific needs of the animals.</p>	<p>Development of partnerships with R&D labs for accomplishment of researches of prevention of diseases diagnoses; Development of researches with molecular markers for identification of diseases; Accomplishment of researches for the development of vaccines.</p>	<p>Use of females multiple ovulation routine for transfer to receiving sires of embryos; Development of researches directed to the genetic improvement of the animals; Accomplishment of researches directed to the development of new reproductive biotechniques.</p>

Picture 1. Metric of evaluation of the technological capabilities for the caprineculture

Source: Adapted from Lall (1992); Bell and Pavitt (1995) and Figueiredo (2003) based in the field research.

These levels represent complexity degrees reached for the execution of specific activities, and they can be described like this: a) level 1 – Routine – It characterizes those properties where the developed activities are not related to the changes in the existent processes. In this level the property has capacity to execute a task, not having, however, abilities to modify it; b) level 2 – Basic Innovative – It characterizes those properties where, besides the routine activities, they also make small adaptations in equipments being also evidenced a larger control of the activities of animal production; c) level 3 – Intermediate Innovative – It characterizes the properties where there are larger levels of production control, as for instance, the use of reproductive biotechniques; d) level 4 – Advanced Innovative – It characterizes the activities developed in R&D centers through accomplished researches in united and/or transferred way, aiming at the development of innovations and impelling the movement in the sense of catching-up and/or overtaking the border of the production and/or of existent innovation.

5. Results

Starting from the data collected with the managers of the companies in study, an analysis was made in order to detect the mechanisms and present learning processes, inherent to the external acquisition, internal acquisition, socialization and knowledge code, as well as the relationship of these with the technological functions of each company, as displayed in Picture 2 below.

LEARNING MECHANISMS AND PROCESSES		COMPANIES AND TECHNOLOGICAL FUNCTIONS			
		Company A	Company B	Company C	Company D
External Acquisition	Professional consultants			Health	Health
	Experiences in other states				Unity Management
	Interaction with suppliers	Nutrition		Unity Management, Nutrition, Health and Reproduction	Nutrition and Health
	Interaction with customer	Unity Management		Unity Management, Nutrition, Health and Reproduction	Nutrition and Health
	Interaction with other breeders	Unity Management, Nutrition, Health and Reproduction	Nutrition	Unity Management, Nutrition, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction
	Interaction with other organs	Unity Management		Reproduction	Unity Management, Nutrition, Health and Reproduction
	Interaction with associations	Unity Management		Nutrition and Reproduction	
	Participation in events	Unity Management, Nutrition, Health and Reproduction		Health	
	Use of technical assistance	Unity Management	Unity Management, Health and Reproduction	Health and Reproduction	Nutrition and Health
	Search for information	Unity Management, Nutrition, Health and Reproduction			Unity Management
Internal Acquisition	Involvement in the installation of breeding facilities	Unity Management			Unity Management
	Routine operations of breeding facilities	Unity Management, Nutrition, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction
	Improvements through projects of experimentation	Nutrition and Reproduction		Nutrition and Reproduction	Nutrition and Reproduction
	Manipulation of creation processes	Reproduction		Reproduction	Reproduction
Socialization	Course-based Training				Reproduction
	Learning by doing	Unity Management, Nutrition, Health and Reproduction		Unity Management, Nutrition, Health and Reproduction	Unity Management and Health
	Sharing of Knowledge	Unity Management, Nutrition, Health and Reproduction		Health and Reproduction	
Code	Manual notes	Unity Management, Health and Reproduction		Unity Management, Nutrition, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction
	Use of Office	Unity Management, Health and Reproduction	Unity Management, Nutrition, Health and Reproduction		
	Use of specialized software	Unity Management, Nutrition, Health and Reproduction			Unity Management, Nutrition, Health and Reproduction

Picture 2. Technological functions for learning mechanisms and processes

Source: elaborated by the authors.

5.1 External knowledge acquisition

Concerning external knowledge acquisition mechanisms, there were noticed flaws in the use of professional consultants. Only in company D the contribution of this learning process could be observed in the functions of unit management, nutrition and health of the animals. In the other companies, the use of veterinarians, zootechnicians or consultants of the area, who are not of the own company, is inexistent or is pointed as generating of costs and insufficient for the resolution of problems.

I had two veterinarians and they gave me a loss, both of them. [...] I had a goat that lowered and rose, lowered and rose. Then I took it to the veterinarian, he examined, then he indicated medicine and such. Then the goat did nothing, and nothing, and nothing. [...] it is my champion's sister. I lost the goat because of him (Fragment of the interview with the manager of company B).

The search for the experience of breeders of other states is made only by company D, whose manager constantly researches innovations in the structural aspect in breeders from São Paulo, as well as information related to the breeding practices in the states of Rio Grande do Norte and Paraíba.

About relationship networks, it is noticed that there is a deficiency in company-universities interactions. Even facing the recognition, on the part of the managers, of the importance of this interaction, the physical distance or even the indifference on the part of the academics hinders that such relationship could be built and bring benefits for both parts.

The great problem for us, as individual producers, is the difficulty, the kilometeric distance that exists between the producer and the **means**. [...] The university has to call the producers, to invite the producers, breeders (Fragment of the interview with the manager of company C).

Besides, the interaction with government organs, like EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária / Brazilian Agricultural Research Corporation) and EMATERCE (Empresa de Assistência Técnica e Extensão Rural do Ceará / Company of Technical Attendance and Rural Extension of Ceará), it is presented as incipient in the production of good results. The main causes of these flaws in the interaction with these and other organs would be related to a deficiency in the professionals' formation and consultants and, mainly, in the costs related to the consulting of these organs.

What EMBRAPA wanted, made a calculation and such, how many animals could be raised and if it had conditions to set up a technical assistance and to develop experience. That I had a reserved area to a laboratory, for insemination, for transfer and Embrapa only agreed if I had to pay for everything. I had to pay for everything. This way it was difficult. [...] And if it wouldn't work, who should be **damaged**? It couldn't work for me (Fragment of the interview with the manager of company D).

On the other hand, the relationship between the own breeders and associations is seen highly as something necessary and important, being present and being valued by all the managers. This relationship would be, therefore, responsible for improvements in the practices of administration of the business and animals breeding. Besides, the evolution of this relationship is observed by the appearance and the invigoration of concrete partnerships in all the levels of the business, not just in what concerns the sharing of information, but in the development of projects and acquisition of equipments together.

As individual producers, we don't have space anywhere. We, as association, have a different treatment. [...] Association brings opportunities, you know, because they understand that the association has power (Fragment of the interview with the manager of company C).

I want to buy an ultrasound. [...] because of this group, of those three or four friends that are in the goat business, I believe that we should acquire together. We have plans of doing a partnership with personnel from Minas. We already talked about it for embryo transfer (Fragment of the interview with the manager of company D).

The participation in events is valued and practiced by all the managers of the companies, as much exhibition events as of competition, as well as the participation of the same ones in congresses or lectures of the sector. Such participation is pointed as source of information for new practices in the breeding facilities, especially, related with the health of the animals. The manager of company C, for instance, started to use quarantine norms in new animals:

At first, I didn't have orientation. But then, when we started to frequent exhibitions and had contact with breeders, then we had that idea. Then I started to adopt those norms (Fragment of the interview with the manager of company C).

Regarding the search of information in magazines or specialized sites in the area, the manager of company D just pointed out the importance of this kind of reading in the development of new processes and practices when affirming that "knowledge is a matter of feeling, it is through reading and animal breeding".

5.2 Internal knowledge acquisition

As acquisition mechanisms intern of knowledge, the involvement in the facilities of new nurseries and in the operations of routine of the same ones it was pointed by the managers as essential in the growth of the business. Such mechanisms, especially the operations of routine of the nurseries, are responsible for the development of new knowledge in what he/she concerns the functions of administration of the unit, health, nutrition and reproduction.

Improvements are also used by experimentation processes. Such processes are related with the reproduction functions and nutrition of the animals.

I changed the system over there. Before, they were all together, all in the same stall, collective. Now, for some time, about three months, I separated each animal. When they are fed with ration I try to lock the animals, in other words, they eat separate, individually. Then I can measure how much they are eating (Fragment of the interview with the manager of company C).

5.3 Socialization and Knowledge Code

Concerning the socialization of knowledge, the manager of company D highlights the importance of employee's attention on the work of the veterinarian and of the own manager, being able to him to develop autonomy to accomplish the procedure by himself, besides the importance of team work.

First he learns. [...] Whenever I make something I have somebody close to me and there is something that I already know and he learns. [...] Who works in the team is versatile. [...] Then, later we make another thing; the cattle holed the fence over there. Then inside the property he has to be versatile. If you leave a specific employee specifically in some job, he usually learns only that. When he doesn't come to work, you lose. So there must be team work (Fragment of the interview with the manager of company D).

About investment in training, the manager of company C is willing to invest in training, but he didn't still find the right employee, because he complains of the lack of interest and motivation on the part of the employees that already worked with him:

It is lack of interest of them. See, I have been talking to some friends and we say this: I think I didn't still get to "hit the target", I didn't still get to "hit the target" of the business, I didn't get, but I am sure that that guy will become a good professional, because I didn't still get a guy who likes that, I mean, who wanted to be there in the job because he likes. Then my bigger difficulty is that, perhaps, because I didn't find a guy who had a right aptitude. They go because they need the job, some job, you know. Then I didn't get a guy who likes to breed, of living there, [...] certainly I have interest of professionalizing that guy, his technical formation and everything (Fragment of the interview with the manager of company C).

The manager of company C that already invests in an employee's professional formation, through courses addressed to the agriculture areas and livestock:

I support [...] education not so much, but it is more in the matter of professional formation for agriculture and livestock [...] I always look for that they have technical knowledge, especially because it's a form of valuing them. [...] for instance, he has a course, specialized in an animal, about insemination, animal castration, on handling, I try to make him to acquire the knowledge, preferably to apply it here (Fragment of the interview with the manager of company D).

About the process of code of the information, the manager of company C uses *Office* software to classify the data of the flock. The managers of companies A and D, however, affirm they have recently acquired specialized software for animal control.

I write down everything by name, everything in the computer [...] vaccine day, mating day, birth day, vitamin day, everything about it (Fragment of the interview with the manager of company B).

I don't know. I know that it was bought, my son discovered, he bought it and installed the software with the help of a man from Juazeiro; it seems that he had that software (Fragment of the interview with the manager of company D).

6. Conclusions

The analyses accomplished with the information supplied by the managers of the companies in study evidenced the importance of learning mechanisms in the innovation process and development of the technological capabilities. Picture 3, bellow, presents the levels of each one of these technological functions observed in the four companies of the caprineculture sector.

CAPRINECULTURE COMPANIES	ATIVIDADES E FUNÇÕES TECNOLÓGICAS			
	Productive Unit Management	Nutrition	Health	Reproduction
Company A	Intermediate innovative	Basic innovative	Intermediate innovative	Basic innovative
Company B	Routine	Basic innovative	Routine	Routine
Company C	Routine	Intermediate innovative	Basic innovative	Routine
Company D	Intermediate innovative	Intermediate innovative	Basic innovative	Basic innovative

Picture 3. Levels of technological capabilities in the studied companies

Source: Elaborated by the authors.

Since the objective of this study consisted of analyzing the implications of learning processes underlying in the dynamics of the accumulation of technological capabilities in companies participant of the caprineculture productive chain, it is believed that the same was reached. This way, it was possible to observe the implications of the underlying learning processes in the accumulation of technological capabilities related to the produced unit management, nutrition, health and reproduction.

It is noticed, however, about the learning mechanisms, that there is a distance between universities and breeders of caprineculture sector. So, it is suggested for future studies, a focus on this observed problem, observing that the narrowing of such relationships, as it happens in the relationship among the own creators, would be salutary for both parts, making possible an increase in the levels of technological capabilities.

Still in this sense, it is observed in the activities and technological functions of the companies analyzed, which are the activities related to the nutrition that possess a more developed level of technological capacity, compared to the other functions, being this the more beneficiary with the current learning mechanisms used. On the other hand, the activities related to the reproduction still lack better improvement front to the other learning mechanisms observed, these last ones must be worked from way to generate and to develop more advanced technological processes in this aspect.

Finally, due to the inherent limitations to the own research method used, it is suggested to approach in subsequent studies this same relationship in other empiric fields, especially areas in that such activity sector is more developed, in order to notice as the learning processes analyzed would interfere there in the levels of the present technological functions. In that way, it would be possible to base such understanding about these relationships and to reach new practices that make possible the development of the productive segment in comment, aiding the formulations of public politics addressed to the needs of the sector.

7. Bibliography

Banco do Nordeste do Brasil – BNB (2009). *Agenda do produtor rural*.

Bell, M. (1984). Learning and the accumulation of industrial technology capacity in developing countries. In: Fransman, M., & King, K. (Ed.) *Technological capability in the Third World*. New York: Macmillan.

_____. (2006) Time and technological learning in industrializing countries: how long does it take? How fast is it moving (if at all)? *International Journal of Technology Management*, 36 (1-3), 25-42.

Bell, M., & Pavitt, K. (1995). The development of technological capabilities. In: Haque, I. U. (Ed.). *Trade, technology and international competitiveness*. Washington: The World Bank.

Büttenbender, P. L. (2001). *Acumulação de competências tecnológicas e os processos subjacentes de aprendizagem na indústria metal-mecânica: o caso da AGCO comercio e indústria Ltda, Santa Rosa -RS*. Dissertação de Mestrado – FGV/EBAPE, Rio de Janeiro, RJ, Brasil.

Campos, K. C. (2004). *Arranjos produtivos locais: o caso da caprino-ovinocultura nos municípios de Quixadá e Quixeramobim*. Dissertação de Mestrado (Economia Rural) – Universidade Federal do Ceará, Departamento de Economia Agrícola. Fortaleza, CE, Brasil.

Campos, R. T. (2003, janeiro/março) Tipologia dos produtores de ovinos e caprinos no estado do Ceará. Documentos Técnico-Científicos. *Revista Econômica do Nordeste*, Fortaleza, 34 (1), 85-112.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35 (1), 128-152.

Costa, A. D. (2007). *Nível tecnológico, rentabilidade e cadeia produtiva da ovinocaprinocultura de corte no estado do Ceará*. Dissertação de Mestrado (Economia Rural). Departamento de Economia Agrícola. Centro de Ciências Agrárias, Universidade Federal do Ceará, Fortaleza, CE, Brasil.

Dahlman, C., Ross-Larson, B., & Westphal, L. (1987). Managing Technological development: lessons from the newly industrializing countries. *World Development*, 15 (6), 759-775.

Denzin, N. K., & Lincoln, Y. S. (2006) *O planejamento da pesquisa qualitativa: teorias e abordagens*. 2. ed. Porto Alegre: Artmed.

Dosi, G. (1988) The nature of the innovative process. In: Dosi, G. et al. *Technical Change and Economic Theory*. London: Pinter Publishers.

Dutrénit, G. (2000) *Learning and knowledge management in the firm: from knowledge accumulation to strategic capability* Northhampton, MA, USA, Edward Elgar.

Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA (1989). *Recomendações tecnológicas para a produção de caprinos e ovinos no estado do Ceará*. Sobral: EMBRAPA, 58 p. Circular Técnica, 9.

Figueiredo, P. N. (2003) *Aprendizagem tecnológica e performance competitiva*. Rio de Janeiro: Fundação Getulio Vargas.

_____. (2004, julho/dezembro) Aprendizagem tecnológica e inovação industrial em economias emergentes: uma breve contribuição para o desenho e implementação de estudos empíricos e estratégias no Brasil. *Revista Brasileira de Inovação*, 3 (2), 323-361.

_____. (2005, janeiro/março) Acumulação tecnológica e inovação industrial: conceitos, mensuração e evidência no Brasil. *São Paulo em Perspectiva*, 19 (1), 54-69.

_____. (2009) *Gestão da inovação Tecnológica*. Conceitos, métricas e experiências de empresas no Brasil. Rio de Janeiro: LTC.

Flick, U. (2004) *Uma introdução à pesquisa qualitativa*. 2. ed. Porto Alegre: Bookman.

Food and Agriculture Organization of the United Nations – FAO (2009). *Faostat*. Retrieved November, 15, 2009, from <http://faostat.fao.org>

Garvin, D. A. (1993, July/August) Building a learning organization. *Harvard Business Review*, 71 (4), 78-91.

Godoy, A. S. (1995, março/abril) Introdução à pesquisa qualitativa e suas possibilidades. *Revista de Administração de Empresas*, 35 (2), 57-63.

Instituto Brasileiro de Geografia e Estatística- IBGE (2009). *Pesquisa pecuária municipal*. Recuperado em 10 dezembro, 2009, de <http://www.sidra.ibge.gov.br>

Katz, J. M. (1976) *Importación de tecnología, aprendizaje y industrialización dependiente*. México, Fondo de Cultura Económica.

_____. (1987) Domestic technology generation in LCDs: a review of research finding, In: KATZ, J. M. (Ed.), *Technology generation in Latin American manufacturing industries*, New York: St. Martin's Press.

Khan, A. S, Costa, A. D., Lima, P. V. P. S., Silva, L. M. R., & Ximenes, L. J. F. (2009). Avaliação do Nível Tecnológico da Ovinocaprinocultura de Corte no Estado do Ceará. In: Ximenes, L. J. F., Martins, G. A., Sobrinho, J. N., & Carvalho, J. M. M. (Org.). *As ações do Banco do Nordeste do Brasil em P&D na arte da pecuária de caprinos e ovinos no Nordeste brasileiro*. Fortaleza: Banco do Nordeste do Brasil. 436 p. Serie BNB Ciência e Tecnologia, 3.

Kim, L. (1995). *Crisis construction and organizational learning: capability building in catching-up at Hyundai Motor*. Paper presented at the Hiotsubashi - Organization Science Conference, Tokyo.

_____. (1997) The dynamics of Samsung's technological learning in semiconductors. *California Management Review*, 39 (3), 86-100.

Lall, S. (1987). *Learning to industrialize: The Acquisition of Technological Capability by India*. London: Macmillan.

_____. (1992) Technological capabilities and industrialization. *World Development*, 20 (2), 165-186.

Leonard-Barton, D. Implementing new production technologies: exercises in corporate learning. In: Glinow, M. A., & Mohrman, S. A. (Ed.), (1990). *Managing complexity in high technology organizations*. New York: Oxford University Press.

_____. (1992). Core capabilities, core rigidities: paradox in managing new product development. *Strategic Management Journal*, 13, 111-125.

Marins, L. M. (2005) *Globalização de competências tecnológicas inovadoras no contexto de industrialização recente: evidências de uma amostra de institutos de pesquisa e desenvolvimento (P&D) em tecnologias de informação e comunicação (TIC) no Brasil*. Dissertação de Mestrado – FGV/EBAPE, Rio de Janeiro, RJ, Brasil.

Mirandal, E. C., & Figueiredo, P, N.(2010, janeiro/março). Dinâmica da acumulação de capacidades inovadoras: evidências de empresas de software no Rio de Janeiro e em São Paulo. *RAE Revista de Administração de Empresas*, 50 (1).

Nevis, E., Dibella, A., & Gould, J. (1995). Understanding organizations as learning systems. *Sloan Management Review*, winter, pp. 73-85.

Nogueira Filho, A., & Alves, M. A. (2002). *Potencialidades da caprino-ovinocultura na região Nordeste do Brasil*. Fortaleza: Banco do Nordeste/Etene.

Nonaka, I., & Takeuchi, H. (1997). *Criação de Conhecimento na Empresa: Como as Empresas Japonesas Geram a Dinâmica da Inovação*. Rio de Janeiro: Campus.

Organization for Economic Co-operation and Development– OECD (2002). *Information technology outlook-highlights*. Paris.

Yin, R. K. (2004). *Estudo de caso: planejamento e métodos*. 2ª ed. Porto Alegre: Bookman.