

TECHNOLOGICAL CAPABILITIES AND LEARNING IN SMALL COUNTRIES: THE CASE OF CAPE VERDE ISLANDS

Alexandre O. Vera-Cruz, Gabriela Dutrénit, Arturo Torres

Economics and Management of Innovation, Universidad Autónoma Metropolitana-Xochimilco, Mexico City

Emails: veracruz@correo.xoc.uam.mx; gdutrenit@laneta.apc.org; atorresv@correo.xoc.uam.mx

Abstract

The aim of this paper is to discuss the problems that Cape Verde Islands' firms have been confronting in the process of building up technological capabilities. Based on the concept of National Innovation System as an analytical tool, this work investigates the opportunities and constraints Capeverdean firms face in their efforts to improve and upgrade their technological capability. Particular attention is paid to the analysis of the linkages between the private sector and the State. The cases analyzed are two Capeverdean firms located in the Software and Food processing (fish) sectors. The evidence suggests that the State has a very important role to play as a facilitator of technology-based, private-sector development. The creation of policies that foster and consolidate the building of linkages between private firms and public actors of the economy appears to be of crucial importance to improve the successful acquisition and use of new knowledge and technology by the Capeverdean firms.

Keywords: Technological capabilities, learning, national system of innovation, islands, Cape Verde

Introduction

In the last decade, the concept of National Innovation System (NIS) has been used as an analytical tool to understand development processes. According to this approach, the most important input is knowledge and its successful translation into improved and profitable goods and services through a continuous process of learning. Freeman (1987), defines a NIS as a network of institutions (in the public and private sectors) whose activities and interactions initiate, import, modify and diffuse new technologies. According to Lundvall (1992), a NIS comprises all parts and aspects of the economic structure and institutional set-up affecting learning as well as searching and exploring the different subsystems (production, marketing, finance) in which learning takes

place. The NIS approach allows the inclusion not only of economic factors influencing innovation, but also looks at institutional, organizational, social, and political aspects. Despite their different interpretations, all versions of the NIS approach place firms at the very centre of focus with learning as a key issue within it (Nelson, 1993; Niosi et al, 1993; Patel and Pavitt, 1994; Edquist, 1997, 2000).

Based on the findings of studies conducted over the past three decades, a theoretical framework has been designed to better understand how firms develop their technological capabilities (Katz, 1987; Lall, 1992; Bell and Pavitt, 1993 and 1995). However, most works have focused on the experience of Latin American and East Asian countries, and limited attempts have been made to assess these issues in Africa (Biggs, Shah and Srivastava, 1995; Mengistae and Teal, 1998; Tyler, 1995; Lall and Pietrobelli, 2002; Muchie, Gammeltoft and Lundvall, 2003; Oyelaran-Oyeyinka, 2006). Moreover, these studies tended to look at large firms in large countries, and largely ignored the characteristics that determine these processes in small and medium-size enterprises (SME). This paper addresses this omission by focusing on small firms located in a small African country such as the Cape Verde islands.

Based on the NIS approach, the aim of this paper is to explore the problems that Capeverdean firms confront in the building up of technological capabilities. Particular attention is paid to the links between the private sector and the State, and its impact on the capability building process. An additional objective of this paper is to generate some insights for the design of a more effective policy to accelerate this capability building processes in Cape Verde.

A case study methodology is used for the analysis of the two firms located in the Software and Food processing sectors respectively. This selection will allow analytical comparisons between the capability building processes of firms pertaining to sectors with different technological

complexities and market orientations. The main sources of information are in-depth interviews.

The content of this work is as follows: Section 2 discusses the literature on learning and technological capability building in the context of the NIS approach; Section 3 describes a set of key features of the country; Section 4 explains the research design and methods; Section 5 contains an analytical description of the empirical evidence of the two sectoral innovations systems examined: software and canned fish; Section 6 compares and discusses the results; finally, Section 7 contains some final reflections.

Learning and technological capability accumulation and the role of the State

Literature overview

There is a growing consensus about the centrality of scientific and technological advance in driving economic progress, and that increasing national investments on innovation are essential to ensure a country's economic growth (Schumpeter, 1942; Solow, 1956; Abramovitz, 1956 and 1986). In fact, technological and institutional change, and national technological capabilities are seen as major determinants of economic growth and economic development. (Freeman, 1987; Fagerberg, 1988).

However, it is not clear enough how science and technology, which appear to be key factors for industrial development in advanced economies, can be effectively used for economic and social development in today's developing countries. The ongoing discussion on this issue has drawn attention on the role of knowledge as a basis for economic transformation (Nankani, 2005; Juma, 2005), emphasizing the role of policies stimulating business development, the renewing of infrastructure and the building of human capital. To a large extent, an effective use of science and technology for development depends on the ability of developing countries to build up a trajectory of learning and innovation. In particular, the process of learning generates the conditions for a knowledge creation process, thus becoming a key issue to endogenous development in less developed countries. However, where should a country set its priorities in the construction of a trajectory of learning? Each country has to identify the sectors that are worth investing and assist them correspondingly. Besides the specificities, the overall support for industrial develop-

ment and particularly the acquisition of industrial skills in economic development are necessary to strengthen this fragile trajectory of learning (Lall and Pietrobelli, 2002; Oyelaran-Oyeyinka, 2006)

The identification of structural linkages at local, regional, national and international levels and the design of National System of Innovation (NIS) further contribute to successful choices of public investment (Freeman, 1987; Lundvall, 1992; Nelson, 1993; Edquist, 1997; Kim, 1997; Niosi, 2000; Cassiolato and Lastres, 2003). The choice of the right sector matters because the knowledge base and overall technological level can differ largely and affect the effectiveness of the learning processes as well as the knowledge generation and transmission. The Sectoral System of Innovation (SSI) is therefore a relevant concept (Breschi and Malerba, 1997).

Referring to the technological capability building process at the firm level in developing countries, existing literature highlighted how technologically immature firms learn through time and accumulate knowledge. This enables them to progressively carry out new activities and acquire new technological capabilities (Bell and Pavitt, 1995; Lall, 1987 and 1992; Kim, 1997). In this context, learning is defined as a process that involves repetition and experimentation to do things better and faster, and to identify new production opportunities. Learning processes have a gradual, accumulative, systemic and idiosyncratic character. These processes are influenced by the features of the NIS and by the type of linkages created between the agents in specific contexts and sectors.

Although the referred literature has focused mainly on the processes of technological capability building, some works have shown that managerial capabilities, particularly the profile and leadership of the firms' founders, are crucial to understand how firms deploy strategies of learning and technological capability building (Vera-Cruz, 2004; Vera-Cruz and Dutrénit, 2005).

Supporting SMEs in Developing Countries

However, not much is known about the characteristics of technological capability building process in SMEs, and limited attempts have been made to assess these issues in Africa (see Biggs, Shah and Srivastava, 1995; Mengistae and Teal, 1998; Tyler, 1995; Lall and Pietrobelli, 2002; Muchie, Gammeltoft and Lundvall, 2003; Marcelle, 2004; Oyelaran-Oyeyinka, 2006), particularly in the small countries context.

The analysis of the technological capability process, particularly in the context of small countries and particularly in the case of small island economies, cannot be dissociated from the discussion about the role of the State in economic activities, which is a recurring feature in the debate on the Washington Consensus (WC) and its implications for economic development. Although one could be tempted to consider the WC as an outdated issue, it should not be forgotten that it inspired a wave of reforms that fundamentally transformed the landscape of developing areas. In the case of Africa, the premise for the WC was that State-led development strategies were the cause of failure for the small economies of the region. Following the policy advice based on this premise, during the 1980s and 1990s developing countries introduced structural adjustment programmes. However, the failure of the WC has been commonly recognized, particularly in the case of the small economies (Habasonda, 2003). Referring to the neo-liberal model, basis of the WC, Stiglitz (1998) points out that it gives a minimal role to the government, essentially one of ensuring macroeconomic stability, with an emphasis on price stability, while getting it out of the way to allow trade liberalization, privatization, and getting the prices right. He argues that while many of these policies are necessary for economic success, they are far from being sufficient.

Today, in the so-called post-WC, the focus on a functioning market economy continues to be recommended and an active participation of the state in the economy continues to be discouraged. The role of the state is basically to create the necessary conditions for the markets to flourish. However, in the reformulated concept of the World Bank, there is a rehabilitation of the state's role. According to Habasonda (2003), "The question is no longer whether the state should be involved, but how it is involved. Societies are seeking to strike a new balance between public and private enterprises and are struggling to reassert the common good as a benchmark of governance. However, the extent or the limits of the state activities remains disputed, especially in the field of macroeconomic policy and public goods."

The role of the State in economic development is therefore still under discussion. In the case of Cape Verde, a small country that became independent just 33 years ago, the State has been a key actor in the evolution of the economy as a whole. According to the NIS approach adopted here, the State is called to play a fundamental

role in the innovation process. Adopting that approach, this paper discusses the problems that Capeverdean firms confront in the process of building up technological capabilities. Special attention is paid to the links with other agents of the innovation system, particularly with the government, who continues to play a key role in the economic development.

The country specificity

Cape Verde is a very small country integrated by 10 islands, covering a total of 4,030 km². It was a Portuguese colony until 1975, when it obtained its independence. 55.9% of a total of 403,000 inhabitants live in urban areas.

Until its independence in 1975, Cape Verde was essentially an agricultural country, based on subsistence production. The industrial activities were basically the extraction of salt, the production of rum, the desalinization of water, the cooling industry for fish conservation, a firm of canned fish that was created in 1930, and a few other facilities. Commerce was the most important activity, and it was based mostly on imported products. The country independence brought new activities, and a strong concern for the development of the industrial sector.

During the first years of independence, the nationalist government built up a planned state-led economy funded by external aid. Several public firms were created in the key sectors. A strong effort was made to create the modern institutions and dependable infrastructure.

In 1990, the nationalist party lost power and the new government implemented a liberal model. Economic reforms were introduced, which meant a change in the development model from a planned to a more market-oriented economy. The three characteristics of the new development model were: (i) a tight control over the public expenditure to ensure a limited budget deficit; (ii) an economic management approach with a market orientation instead of a central planning approach, along with trade liberalization; (iii) a reduction of the participation of the State in the direct economic operations and privatization of public assets.

The privatization of public assets, such as those in energy generation and telecom services, brought different kinds of problems, such as high prices and irregularities in the provision of services. It is not clear to what extent these problems are associated with the privatization of public

assets or the way this process was carried out in the country, but the result was that the population and the firms' performance were affected.

Since economic reforms were introduced, the private sector is recognized as the engine for national development. However, the State continued to participate in direct economic operations. For instance, in 1993 it created the interinstitutional Commission for Innovation and the Information Society (CIISI), whose mission it was to implement a strategy to move toward electronic government and an information society. CIISI promotes the use and development of the Information and Telecommunication Technologies (ICT) in Cape Verde. In the case of the fishing sector, the State possesses and has increased its participation in the fishing infrastructure (modern fishing boats, a pier with a cooling system, and freezing facilities).

At present, Cape Verde is implementing a development strategy based on growth, reduction of poverty and good governance. The private sector in Cape Verde is however weak and still lacking an incentives structure that would reward it for more innovation and competitiveness, which would enable it to play the role of an engine of economic growth as assigned by national development plans.

The country is characterized by a small industrial sector; the industry and energy sectors together only contribute with 7.7% of the GDP. In fact, their contribution to the economy decreased from the level they had six years in 1999, as listed in Table 1. In turn, commerce (wholesale and retail trade), transport and communications sectors have a share of 20% each. Agriculture is also a small sector, taking a share of only 8.0% of the GDP. Its share of GDP shrunk over the past 8 years while construction and other services have gained importance.

Table 2 contains some indicators that reveal the effort carried out by Cape Verde to develop human capital, reduce poverty, and improve the living conditions in the last decade. Some of these figures reveal a better performance than the average in Sub-Saharan Africa (SSA), as recognized by the IMF (2005c). The Cape Verde GDP per capita (US\$1915) represented almost three times that of the SSA (US\$632) in 2004. Regarding development of human capital, Cape Verde's net enrolment ratios in primary and secondary school (90.1% and 57.5% respectively) are above those of the SSA (averaging 69.2% and 25.5% respectively) for the same year.

Table 3 describes the profile of Cape Verde in terms of its resources, industrial organization, institutional set-up and incentives structure for learning and technological capability building. There is a limited endowment of natural resource and a very small local market. Micro and

Table 1. Cape Verde: Gross Domestic Product by Sector 1999-2005 (% of the total GDP)

Sector	1999	2003	2005
Agriculture, forestry and livestock	11.3	9.4	8.0
Fishing	2.3	1.5	1.1
Industry and energy	8.7	6.6	7.7
Construction	7.8	8.4	9.3
Commerce	17.7	19.6	18.5
Hotels	2	2.6	2.1
Transports and communications	19	18.6	19.0
Banks and insurance	4.9	4.3	3.8
House renting	5.3	5.3	5.1
Public service	13.4	12.9	12.0
Other services *	7.6	10.7	13.3
GDP/ total	100	100	100.0

Source: IMF (2005a, 2006)

* Includes "Intermediary banking services" and "Taxes and duties on imports"

A set of open-ended interviews with policy makers allowed us to identify five cases in different sectors having exemplary outcomes, amongst which we selected two for this research regarding accessibility, importance of locality and main sector of activity. Based on that, this research focused on how and why these outcomes were achieved, in other words how the accumulation process was carried out, and what are the determinants and constraints to the accumulation process. Firms constituted the unit of analysis of this work.

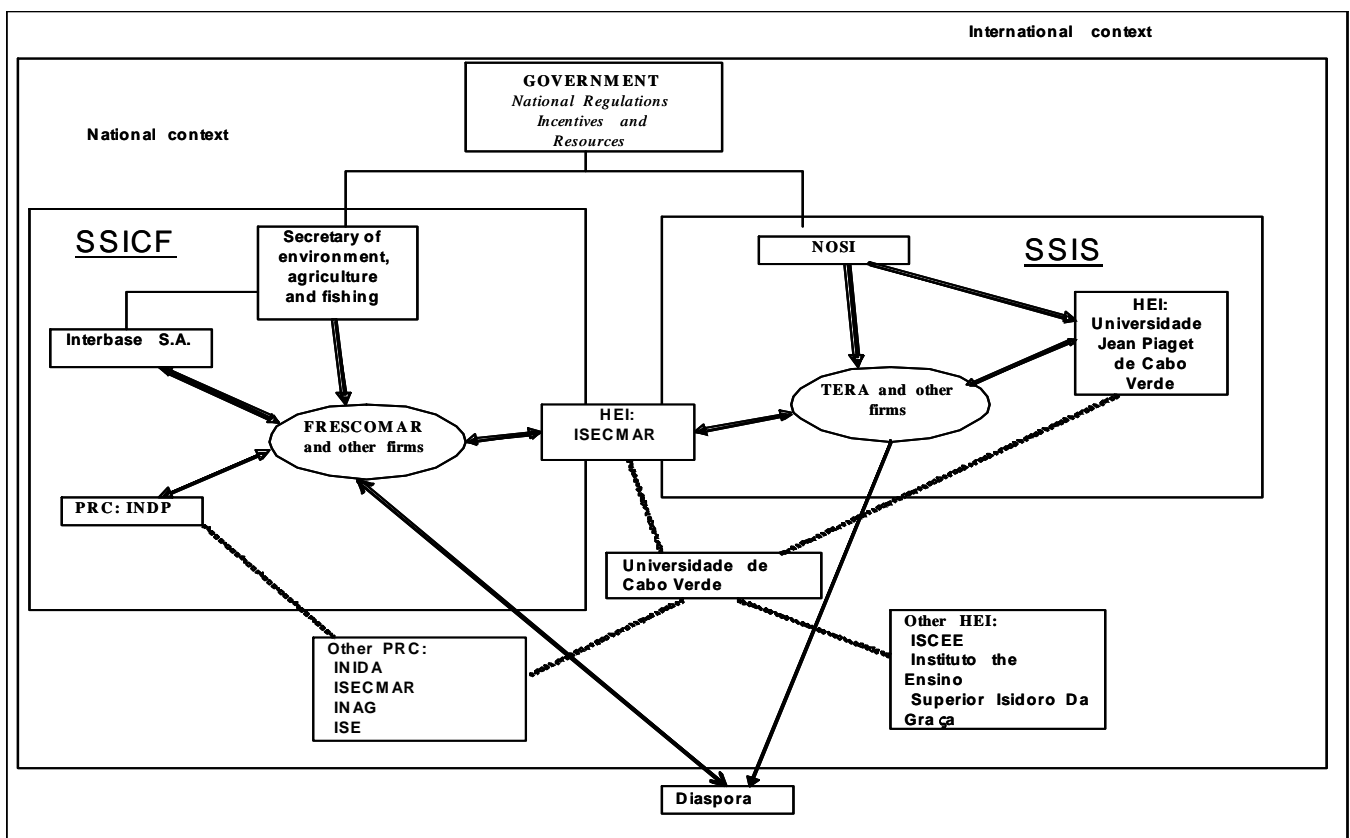
A pilot case study of TERA (the software firm included as a case study) was carried out to gain empirical evidence and insights about the challenges and opportunities of an SME in Cape Verde. Based on that, the initial research design was improved and data collection plans were refined. Afterwards, the two case studies were conducted successively. A report was written for each case and finally a cross-case report was elaborated. Three sources of evidence were used: (1) interviews with managers, owners and personnel of the

firms, policy makers and researchers, (2) casual meetings and informal conversations and (3) printed materials internal and external to the firms. Interviews were the main source of information, 12 interviews were carried out. Their main topics covered were: evolution of the product lines, type of clients, type of links with suppliers, evolution of the technological activities carried out locally, links with educational institutes and research centres, and links with the government. Effects of the local environment in general on the technological activities of the firms were a focal issue at the interviews.

The empirical evidence

Each system of innovation investigated in this study, the Sectoral System of Innovation in Software (SSIS) and the Sectoral System of Innovation in Canned Fish (SSICF), aims at identifying the main agents, their links and the characteristics of the accumulation of technological capabilities of a representative firm. Figure 1 illustrates the

Figure 1. Capeverdean NIS and two Sectoral Innovation Systems



Note: HEI: Higher Education Institutions, PRC: Public Research Centres, SSIF: SSI in canned food, SSIS: SSI in software.

Source: Own elaboration, the institutions are described in table 3 and below.

main agents and their links in the context of the Capeverdean NIS, which are described below. Particular attention is given to the role played by the State, through government agencies within the system functioning.

THE SOFTWARE INDUSTRY

The SSIS is incipient and it is integrated by 3 key agents: NOSI (a government agency), higher education institutions and firms.

The characteristic of the system of innovation

The agents

1. NOSI: a government agency

After the government carried out the economic reforms in the early 1990s, it decided that the Cape Verde economy was to be better integrated into the information society. It was within this context that in 1993, the Interinstitutional Commission for Innovation and the Information Society (CIISI) was created. CIISI's target was to implement electronic government and to make the people of Cape Verde part of the information society. CIISI created NOSI (Núcleo Operacional de la Sociedad de la Información - Operational nucleus of the information society), an operational group for promoting both the use and development of ICT in Cape Verde. NOSI proposes policies and, if approved by the cabinet, diffuses them within civil society and participates in their implementation.

NOSI has two main donors to fund its projects: the World Bank and the European Union. It has a flexible organization structure with a projects focus. It employs 50 technicians, 40 of which have a university degree in Telecommunications, Electronics, or Informatics; most of them have been certified by Microsoft or Oracle.

NOSI has a decent share of technicians of the SSIS in Cape Verde, and contributes to the human resources training in this area by different ways: it offers training courses for its personnel, invites personnel from other agencies to their courses, and has students from educational institutions who carry out short stays at NOSI.

NOSI runs 3 large projects: (i) the system for the financial management of the government; (ii) the electoral management; and (iii) the house of the citizen. NOSI is in charge of the conception and development of information systems. It basically has to generate integral solutions for

the problems, which is largely adaptive R&D.

2. Higher education Institutions

Instituto Superior de Engenharia e Ciências do Mar (ISECMAR)

The ISECMAR was created in 1996, after the reorganization of the Centro de Formação Náutica. It is a polytechnic institute that initially offered careers in the areas of Engineering and Ocean Sciences. Later on, it diversified its offer, including Informatics and Automation Engineering, Electric and Electronic Engineering, and Telecommunications Engineering.

Universidade Jean Piaget de Cabo Verde

Instituto Piaget is a Portuguese higher education institute. It has 3 campuses in Africa: Angola, Mozambique and Cape Verde. The Universidade Jean Piaget de Cabo Verde was created in 2001. Two careers related to software are offered: Engineering Systems and Informatics, and Communication Sciences, both at technical and university degree levels. At the end of their studies, the students carry out a practice at NOSI and firms of the sector.

3. The firms and the market

Even though there are several firms selling computers, there are only 10 firms that are, at different levels, oriented to software development. They are SMEs with shortage of capital.

Four types of agents compete in the market: freelancers, the 10 local firms, foreign firms and NOSI. Demand is quite high but supply is reduced; in addition, the market is not structured. Local firms are largely oriented to carry out services in informatics and do not have qualified personnel. For this reason they have lost market share, and at present there is a strong dependence on foreign firms and technicians for the most basic activities of software development. Even though there are trained human resources in Cape Verde with university degrees, they are isolated and there are difficulties to incorporate them into an entrepreneurial project. They prefer to work for the Government.

Nature of the links in the SSIS

NOSI-firms. This is an unequal link in terms of the technological capabilities of both agents. NOSI considers

that the existent firms are insufficient and do not have enough maturity of their technological capabilities; that is why it believes it has to attend the market demand to ensure the accomplishment of its mission. NOSI is working with some firms largely for the installation of local networks and not for web design. It transfer the firms those activities that it considers they are capable of carrying out. Even though the strategic plan includes activities oriented to foster the creation of new firms, these activities are neglected or at least not prioritized.

NOSI-Higher Education Institutions. NOSI has signed a protocol with the Instituto Piaget for the creation of a SISCO academy. It also signed a protocol with Microsoft for the certification of human resources in this platform, and is looking to transfer this project to an education institution for the organization of the courses and the follow up of this project. These two cases illustrate that NOSI is opening spaces to develop the SSIS in Cape Verde, and is looking to transfer some of the new activities to other institutions. To accomplish its mission, NOSI needs to develop the market, and it is only interested in maintaining the activities related to the design of the informatics policy.

The case of a firm: TERA

Profile of the firm

The firm was created in February 2002. The owners are two young people with university degrees from Brazil, one in business administration, and the other in Communication Sciences. This latter has previous experience in another firm of the same sector in Cape Verde.

TERA is a micro-firm; it only has 3 people involved, the 2 owners and 1 employee, who is a technician in informatics. The firm has the flexibility to hire more personnel for specific projects. During 2004 the average number of people hired was 6. TERA has four areas of specialty:

- ⇒ Informatics consultancy (e.g., maintenance of computer equipment, management of informatics parks in desk environment, Cyber coffee, etc., this is a continuous service)
- ⇒ Managerial consultancy (e.g. business plans, market research, data analysis and processing)
- ⇒ Web development (e.g. development of a virtual work environment and web pages)

Development of software solutions

The firm uses open technology (open software like Linux, php, apache, mysql), which it considers to reduce uncertainty in the long-term by avoiding technological dependency. It uses open tools and multiplatform. TERA is in a process of migration towards a better technology (not completely open). It has not certified its processes, but the firm is aware of the certification needs, thus it carries out a set of activities to ensure the quality of its processes and services.

Its clients are largely other SMEs. It has had 25 clients, 5 of which are regular. TERA has experience in the international market and its long-term market strategy includes obtaining a position in the Portuguese speaking countries (PALOPs).

Characteristics of the learning processes and the accumulation of technological capabilities

The first activities carried out by the firm were web development, design, montage and maintenance of the site; after that, they added the informatics consultancy to their portfolio of business activities. Gradually the firm developed an integrated solutions approach with 4 major areas of specialty.

The innovation activities are focused on the development of new products. The firm has acquired experience in developing tailor-made local solutions. The most important development project was designed for a firm, which was initially an FM radio and became an internet radio stream site. The site has a dynamic nature as it is based on very simple routines that enable the client to continuously update it. This is a new concept for Cape Verde. The project presented a technological challenge for TERA, and a marketing challenge for its client as it allowed it to open new options, such e-Commerce.

The main motivations for developing new products were a combination of the firm's initiative and the clients' suggestions. Innovation activities increased the scope of products, their product quality and market share, opening new markets and reducing costs.

TERA acquires knowledge from internal (through project development) and external sources (through clients and specialized publications). Networks and informal contacts with technicians from NOSI and local and foreign firms are also important. In terms of learning mechanisms, TERA learns from its own business activities, the interaction with students of higher education institutions who spend internships in the firm, and interaction with customers. In the

case of the Global FM radio project, they have been interacting regularly with customers over the past 3 years. The proximity has allowed TERA to react quickly to client needs, and it has also facilitated feedback from clients. TERA maintains cooperation links with NOSI, and they are partners in one project. In contrast, the links with other firms in the sector are limited.

Even though the firm is aware of most incentives schemes offered by the government, it was difficult to apply because the call for fulfillments was not regularly opened. Once the firm was willing to apply to a fiscal exemption scheme, however that year the program was suspended.

The firm's strategy is to develop a set of modules that can be easily articulated to offer solutions to clients along their value chains. The still limited experience in development projects did not allow TERA to generate the minimum knowledge base that would enable it to create a set of standard products (like in the case of the radio). A wider range of products/solutions, and the provision of quicker answers to the queries would definitely attract more clients and increase its future growth potential.

Some of the important advantages of the firm are: availability, quality and low cost of human resources; proximity to clients; infrastructure of services; and limited rivalry with local competitors with a similar profile (in fact there are no other firms with the same 4 areas of specialty).

However, the firm also considers its growth to be hampered by a set of problems:

Market characteristics. There has been a high demand for routine services, and a shortage of demand for qualified work. This has pushed the firm to dedicate most of the employees' time to elementary services, leaving limited space for developing new ideas, learning and innovating, which in turn requires dedicating time to adaptive R&D activities. Currently the demand is growing, above all in web pages; the former constitutes the main competence in this area. Capeverdean firms have limited visibility in the market, therefore clients tend to rely more on foreign firms. Additionally, the firm's clients, competitors and technicians have developed a short-term mind-set, in the sense that they want to reach their objectives immediately. This puts a lot of pressure on the firms and makes it difficult for them to plan their actions and to get involved in a learning de-

velopment process.

The price policy of CVTelecom. CVTelecom is a telecommunications firm. Originally it was a public firm; it was subsequently privatized and sold to Portuguese firm in the 1990s. This firm maintains a monopolistic position in a key sector for development. Its prices for Internet access (ADSL) are too high, and this increases TERA's costs to get access to the web and reduces its potential client base. In short, this price policy limits the development of ICTs.

The functions assumed by NOSI in the SSIS. NOSI was created to sort out the government's informatics needs and promote the introduction of ICTs. It has played a key role in the creation of the SSIS, but it has not created conditions for the development of the private sector. Government's purchases are important because the market is small, but they are not supportive of local private sector development. NOSI carries out 4 activities: specify, buy, implement and control. If the SSIS would be mature, it could concentrate on the control activity and leave the rest to the private sector. But the government's needs for modernization push NOSI to become engaged in a trajectory of development more consistent with a private firm. NOSI has difficulties in transferring these activities to the private sector, as it has not yet reached the capabilities to assume them. In fact, NOSI competes with the firms, even though that is not its purpose. It is indirectly crowding out private sector activities. At present, it is reducing its participation in system administration and informatics consultancy, but it is keeping its presence within the applications area.

Lack of an adequate incentives structure for local firms. Even though there are some fiscal incentives for private firms, they are more oriented to attract foreign firms than to stimulate the emergence and technological development of local ones. Access to credit is difficult and the procedures very bureaucratic, thus the firm uses mostly its own resources for investment. There are some financial schemes for punctual projects, which are used largely by commercial firms. However, they were not sought to promote technological development.

THE CANNED FISH INDUSTRY

The characteristic of the system of Innovation

The Sectoral System of Innovation in Canned Fish (SSICF) is incipient and consists of 5 key agents: a minis-

Table 2. Some indicators of Cape Verde

	1999	2004
A. Economic performance		
GDP per capita in current U.S. dollars	1379.3	1914.7
Real GDP growth (%)	8.8	4.4
B. Population		
Population (000)	423	495
Urban population (%)	52.4	56.7
C. Human capital		
Youth literacy rate	85 (1995)	89.1 (2003)
School net enrolment, primary (rate)	93.8 (2000)	90.1 (2005)
Secondary net enrolment (rate)	54.1 (2000)	57.5 (2005)
Tertiary Level (rate)	3.6 (2000)	6.9 (2005)
D. Effort in Human capital Development		
Public expenditure on education as % of GDP	3.6 (1990)	6.6 (2005)
Public expenditure on education as % of total government expenditure	NA	17.0 (2003)
E. Poverty		
Incidence of absolute poverty 1/	49 (1990)	37 (2003)
Under-five mortality rate (per 1,000)	60 (1990)	35

Sources: IMF (2005a), IMF (2005b), World Bank (2006), UNESCO (2005).

small sized firms, some of them with State participation, characterize the industrial organization. The private sector is reduced in size and, in spite of the economic reforms of the 1990s; the State continues to play an important role in economic development.

Cape Verde is at an early stage of the institutional building, with a limited incentives structure to foster private investment. Firms also confront a poorly developed industrial and technological infrastructure, as highlighted by Muchie, Gammeltoft and Lundvall (2003) and Oyelaran-Oyeyinka (2006) for other African countries. Although it has got higher rates of school enrolment than those of the SSA and a number of technically well-trained human resources, the amount of people with skills and abilities required to foster the development process is still scarce. Cape Verde is dislocated from the main international sources of technology and R&D, and at the same time, there is still a very limited capability of the country's universities and research institutes to generate new knowledge and technologies. This constitutes a mayor limitation for local firms to access modern technologies and competitive advantages.

Research designs and methods

The problems that Cape Verde Islands' firms (illustrated by two cases) have been confronting in the process of building up technological capabilities are investigated by means of case studies. The cases are two Capeverdean firms that are part of a Sectoral System of Innovation (SSI) that operates under a NIS. An SSI contains the agents and institutions (related to a specific sector) that interact to improve the performance of firms and promote innovation. The firms in the two case studies are part of the software and food processing (fish) SSIs.

A multiple-case research design was applied, thus following a replication logic. Each individual case study consisted of a specific set of evidence and respective conclusions. At the end, a cross-case analysis was conducted and general conclusions were drawn. Following Yin (2003), the cases were selected to predict similar results and make the findings more robust (literal replication). The selection included a set of two cases with exemplary outcomes regarding the accumulation of technological capabilities.

Table 3. Cape Verde Profile in terms of resources, industrial organization, institutional set-up and incentives structure for learning

Topic	Characteristics
Physical Resources	Limited endowment of natural resources. A poor and expensive transport infrastructure (cooling tracks, fishing boats with cooling systems, etc.)
Human Resources	Well-trained human resources, as compared with SSA, and a young population (e.g. high rates of School enrolment at secondary and tertiary levels as compared to SSA. Even though Cape Verde has a number of technically well-trained human resources, capable of running the existing institutions, their capabilities and skills for creating and consolidating the new institutions that Cape Verde needs for the development process are still feeble.
Market Size	A reduced local market. It is one of the smallest countries of SSA, with about 0.06% of the total population of this region.
Industrial Sector and entrepreneurship	There are only 483 industrial firms, most of them micro and small firms, having 10 employees in average. The entrepreneurial culture is more oriented towards commerce than industry, which limits the long-term investments, risk taking, etc.
Technology and Higher Education Institutions	There are five research institutes: the Higher Institute of Engineering and Sciences of the Sea -Instituto Superior de Engenharia e Ciências do Mar (ISECMAR), the National Institute of Management -Instituto Nacional de Administração e Gestão (INAG), the Higher Institute of Education -Instituto Superior de Educação (ISE), the National Institute for the Development of Fishing -Instituto Nacional para o Desenvolvimento Das Pescas (INDP), and the National Institute of Research and Development of the Agriculture -Instituto Nacional da Investigação e Desenvolvimento da Agricultura (INIDA). The national university (Universidade de Cabo Verde) is still in the early days, it was founded in 2006; there are three private schools of higher education: the Universidad Jean Piaget de Cabo Verde (a campus of the Portuguese Instituto Jean Piaget), the The Higher Institute of Economics and Entrepreneurial Sciences -Instituto Superior de Ciências Económicas e Empresariais (ISCEE), and the Instituto the Ensino Superior Isidoro Da GraVa., (a higher education private school owned by Capeverdean capital) The young national university is promoting the integration of the existent research and teaching institutes. A poorly developed industrial and technological infrastructure, poor suppliers of engineering skills and technological services. In general, the country is dislocated from the main international sources of technology and R&D.
Institutional setting and incentives structure	It is in an early stage of institution-building. With the independence process, many of the old institutions were dismantled and new institutions were created. A limited incentives structure to strengthen the private sector: It has been established some economic incentives for promoting employment, stimulating investment in some new economic sectors, and in the creation of new firms, such as: (i). Incentives for the generation of employment for young people, (ii) Incentives for telecommunications and Internet, and pharmaceutical firms, (iii) Fiscal incentives for new firms. However no incentives are been designed for promoting the raise of the general investment in existing industry and export activities Strong dependence on international aid under project finance, which contributed to the macroeconomic stability and to infrastructure development, but limited the national capacity to design a development strategy.

Source: Own elaboration based on information from interviews with Cape Verde policy makers and researchers, and various printed materials from diverse sources such as EFA, IMF, World Bank and UNESCO.

try (the secretary of environment, agriculture and fishing); a public firm with colonial roots (Interbase); a research centre (INDP); a higher education institute (ISECMAR); and firms.

The agents

1. Secretary of environment, agriculture and fishing

The Secretary is directly involved in the economic activity of this sector in four ways: (1) through a promotion function, that consists of negotiating and channelling external aid for the fishing sector, (ii) acting as an intermediary between different agents, (iii) regulating the market and signing international agreements, and (iv) regulating the access and exploitation of national resources.

The State has invested resources foreign donor money in a set of facilities related to the fishing industry. In 2001, the State acquired 8 new and modern large tuna fishing boats, and built a pier for small fishing boats that includes a freezing tunnel for fish conservation and an ice machine to support the small boats that generally lack a freezing system.

2. Interbase S.A.

This is a public firm that provides freezing service and commercializes frozen fish and other products from the sea. This firm is rooted in the colonial period; it was founded in the 1960s. Interbase provides the freezing service for the traditional fishing business and the industrial firms of canned fish.

3. Research centre: Instituto Nacional de Desenvolvimento das Pescas (INDP)

The INDP is the national institute for the development of fishing; it was established in 1992 is active in two main areas: scientific research and the diffusion of new fishing technology.

Regarding fishing technology, the main tasks are: to experiment and diffuse technology among the operators of the sector, to improve and adapt techniques of capture according to the conditions of Cape Verde; to carry out experimental fishing of non-exploited species. Regarding fish technology, the main tasks are: to experiment and diffuse new conservation and processing techniques; to explore new fish-based products; to support the national operators in the market forecast for their products.

It is also concerned with the advice on how to improve the economic and social impact of fishing in Cape Verde, and promote actions for the development of fishing technology. The INDP consists of 60 researchers and technicians.

4. Higher education institute: Instituto Superior de Engenharia e Ciências do Mar (ISECMAR)

The Centro de Formação Náutica (CFN) was established in 1984 to offer careers in the areas of Engineering and Ocean Sciences. These areas were strategic because Cape Verde was planning to acquire a new merchant and fishing fleet. Even though the ships were bought, the project did not evolve largely because of the country's low volume of international trade. In 1996, the CFN became ISECMAR, a polytechnic institute, which covers a broad range of knowledge fields including Informatics and Automation Engineering, Electric and Electronic Engineering, and Telecommunications Engineering, as mentioned in the case of the SSIS before.

5. The firms and the market

The production of canned tuna fish has some tradition in Cape Verde. The first firm was set up in 1930 on the island of Sal. A few years later another firm was established in the island of San Nicolau; both were founded by Portuguese entrepreneurs and were equipped with old machinery from Portuguese plants. In spite of using out of date equipment and technology, it seemed that the quality of the products was good because they were well accepted by the market.

The producers of Capeverdean canned fish produce mainly for the domestic market. There is a high domestic demand absorbing more than 80% of the total production. Exports are low basically because of a chronic shortage in shipping supply.

At present, there are three firms of canned fish: Frescomar S.A.; J.A. Nascimento & Filho, Lda; and the Sociedade Ultramarina de Conservas, Lda. They are located in different islands within the country.

The nature of the links in the SSICF

INDP-firms linkages: Weak links; the INDP and most firms rarely interact. Actually, firms perceive the INDP as a research centre linked to fishing but not involved in the fish processing technology.

Firm-firm linkages: Firms participate in the same domestic market, but the rivalry seems to be low. This is partially due to the fact that the firms are located in different islands and their fish suppliers are local. Additionally, the market is big enough to absorb their still small production. The firm has not joined ventures nor do they cooperate. Links with the government also appear to be weak. It seems that the firms are not able to send the government clear messages regarding their needs.

Interbase-firms linkages. These are commercial linkages between clients and suppliers, as Interbase provides freezing service and commercializes frozen fish. Neither flows of information nor knowledge were identified in these links.

In general, the SSICF is not well integrated; links between the agents are very weak.

The case of a firm: Frescomar S.A.

Profile of the firm

Frescomar SA was legally founded in 1997 and started operations in 2000. It is located in the island of São Vicente. Initially, the firm was based on private equity; however, due to financial difficulties, the State acquired a part of the capital to ensure its survival. The State's participation also provided better access to the conservation infrastructure and to raw materials through international fishing agreements.

The firm employs directly 100 workers. It has 10 employees with a bachelor's degree and one with a master's degree. Frescomar SA manufactures 4 types of fish: tuna, melba, mackerel and sardine, and has 6 products (fillets and slices). Fish is the main input, but it also uses malagueta Chilli, oil and cans. The firm is largely equipped with second hand non-automated equipment; it integrates different vintages of equipment technology. Since 2001, Frescomar is certified by the U.S. Food and Drug Administration (FDA). Frescomar produces for the domestic market, but also exports to the US and the European Union, especially Italy, Holland and Portugal, with exile Capeverdian communities as its main consumers.

Characteristics of the learning processes and the accumulation of technological capabilities

Frescomar was created to produce canned tuna fish for the European market. According to the original business

plan, the firm was only supposed to produce tuna fish in small cans. To penetrate the European market, the firm underwent the required certification processes. An important supplier was Interbase, who provided the tuna. It supplied the required infrastructure to freeze the fish according to the quality norms of the European Union in 2001.

Shortly after operations were initiated, Interbase had a problem of ammonia leaking, so the European Union imposed an embargo on Cape Verde for the fish related products. Consequently, Frescomar could not export to its original target-market and had to redefine its market strategy towards the domestic market, US, Brazil and Central Africa.

In the case of the US, there is a market niche consisting of the Capeverdian and Portuguese communities. Even though Frescomar could rely on the Agora agreement to penetrate the American market, a new problem emerged. It required a direct connection between the export country and the United States. As Cape Verde does not export an important volume of products, there are no regular maritime liaisons with the US, in fact, there is only one ship that makes the liaison between Cape Verde and the United states, making the frequency limited and non-regular. In other words, problems related to the marine infrastructure of the country limit the export capacity of the firm. As a result, in spite of the focus on exports since the early days, 90% of its production is designed for the domestic market.

Not being able to rely on Interbase, it looked for other local suppliers of tuna fish. However, Cape Verde does not have an industrial fleet dedicated to the fishing of tuna; there are only small boats that fish for the local market (each island), and they do not have the capacity to supply for the industry. There are problems regarding volume and quality, since they do not have sufficient equipment for industrial fishing and conservation. This is another problem related to the maritime infrastructure. As a result, the firm had to frequently stop production, and had on average only a utilization rate of 30% of its production capacity.

To sort out this problem, the firm had to undergo a process that started by the diversification of its product mix, first by incorporating new varieties of fish (melba, mackerel and sardines), and then by introducing larger sizes of cans. This diversification process reveals that the firm not only acquired production capabilities to stay in the market, but it also acquired some innovative technologi-

cal capabilities. Meanwhile, the European Union ended the embargo against Cape Verde and the firm diversified even its product mix both in raw materials and packaging, by introducing shellfish and glass containers.

The firm has used different learning mechanisms to acquire its technological capabilities. Learning from experience has been very important, particularly in the area of maintenance and plant operation. Training has been another important learning mechanism. The firm uses in-house training and also sends its personnel to be trained in their foreign firms, particularly in fish processing. For instance, before introducing the shellfish production line, the firm sent some technicians to be trained in large shellfish processing facilities in Europe.

Even though Frescomar seems to gradually be acquiring more capabilities, as revealed by the diversification activities and the penetration of new markets, it faces existential risks due to problems that are beyond its decision-making capacity. The problems are related to the supply of input (fish) and the transport system.

The supply of fish. The supply of fish is associated with the fishing infrastructure, the freezing infrastructure and the fishing agreements with countries that fish in the Cape Verde economic area. The fishing and freezing infrastructure was designed to improve private sector activity; however it seems was not sufficiently dependable to attract the sector. Thus, the government had to further get involved again. The case of the acquisition of 8 new and modern large tuna fishing boats, and the building of the pier with an associated freezing facility illustrates this involvement. The government has signed an agreement with the European Union, which makes available for the local market a mere 5% of the fish captured in the Capeverdean economic zone. According to the firm, the government should sort out two issues in order to solve the problems of lack of fish by means of the agreements: (i) signing good agreements with other countries for fishing activities, and (ii) regulating the access and exploitation of the national resources according to the agreements. At present, the government does not control the volume of fish caught and the problem of lack of supply still persists. The difficulties associated with the lack of fishing and freezing infrastructure and control over the international agreements make it difficult for the firm to engage in a continuous process of learning from either the foreign or the domestic market, and steady growth.

The transport system. The lack of regular maritime liaisons with the United States limits export activities.

The determinants and restrictions of the accumulation

Both SSI cases are characterized by incipient and limited links between the agents; in fact they are in the first stage of the building process. The difficulty of the learning and technological capability accumulation processes observed by a firm of each SSI was discussed. Both firms are small and find themselves building and consolidating the routine production and basic innovative technological capabilities. This stage is particularly critical in the case of the small firms.

A set of factors that stimulate the accumulation in both firms were identified:

- ⇒ Well-trained human resources. This is associated with an important effort made by the country in higher education.
- ⇒ Incipient but growing market (increasing returns). The market is very small but expanding and there is a substantial amount of uncovered needs.
- ⇒ Market niche both in Cape Verde and in the emigrant community where local products are well accepted.

In addition, in the case of TERA, the software firm, proximity with the client and a quick response to client requirements are also factors that stimulate accumulation.

The two cases also suggest the existence of a set of factors that constrain the accumulation process:

- ⇒ High costs due to the lack of local input suppliers.
- ⇒ Weak and expensive infrastructure, as illustrated by the costs of the CVTelecom services in the case of TERA and lack of a merchant marine and fishing fleet in the case of Frescomar.
- ⇒ Limited links with other agents of the SSI were observed, as revealed by the limited links of TERA with NOSI, and Frescomar with INDP and ISECMAR.
- ⇒ Lack of entrepreneurship and/or a first generation of entrepreneurs.
- ⇒ Lack of an industrial fabric and industrial culture, in contrast to the existence of a trade tradition and culture that leads to focus more on buying than on

doing, thus hampering innovation activities. The Capeverdean Commerce and Industrial Association is integrated largely by commercial firms dedicated to export and import activities. In the case of software, most of the firms are focused on selling computers instead of being focused on software development.

Unclear boundaries between the functions of -local private sector).

The authors

Alexandre O. Vera-Cruz is a Professor at the Master/Doctorate in Economics and Technology Management, UAM-X. Dr. Vera-Cruz is also a member of the National System of Researchers in Mexico, regular member of the Mexican Academy of Science, and referee of the National Prize of Technology.

Gabriela Dutrénit holds a PhD in Science and Technology Research Studies, SPRU, from University of Sussex. She is member of the National System of Researchers in Mexico; regular member of the Mexican Academy of Science; member of the Social Science Committee of the Science and Technology Consultant Forum of Mexico.

Arturo Torres Vargas holds a PhD in Science and Technology Research Studies from SPRU, University of Sussex. Dr Torres is currently a professor-researcher at the Master/Doctorate in Economics and Management of Innovation Program at UAM-X.

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