The role and impact of MNCs in Costa Rica on skills development and training:

The case of Intel, Microsoft and Cisco[♣]

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Abstract

This paper presents a case study on "good practices" regarding how High-Tech Multinational (MNCs) have contributed to skills development in Costa Rica, according to paragraphs 29 through 32 of the Tripartite Declaration of Principles Concerning Multinational and Social Policy. While there was not enough data to conduct an analysis of impact on this regard, our case study is based on experiences of Intel Costa Rica, Microsoft Costa Rica and Cisco Costa Rica, and suggests a number of avenues for future enquiry into the spillover and spin-off effects generated by the operation of these firms. In addition, some of the main challenges that Costa Rica is facing on human resources availability, which constitute a significant caveat to a more active participation in the new knowledge-based economy are identified.

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Abbreviations

AEC	Alternative Education Center
ATHS	Agricultural Technical High School
CAMTIC	ICTs Costa Rican Chamber
CONARE	National Rectors Council
ICT	Information and Communications Technologies
ECP	Educational Computing Program
FDI	Foreign Direct Investment
FOD	Omar Dengo Foundation
GDP	Gross Domestic Product
INA	National Learning Institute
IP	Internet Protocol
ITCR	Costa Rican Technological Institute
KBE	Knowledge-Based Economy
LADS	Latin American Design Services
LASS	Latin American Software Services
LAES	Latin America Engineering Services Group
MICIT	Ministry of Science and Technology
MNE	Multinational Enterprise
NGO	Non-governmental organization
OPES	Office of Top Planning of CONARE
PEC	Professional Education Center
PIL	Partners in Learning
SINETEC	National System of Technical Education
TPHS	Technical Professional High School
UCR	University of Costa Rica

1. Introduction

Costa Rica is a small open economy, with a population of slightly over four million people and a US$9,481 (in PPP$) *per capita* income that positions the country among those with an average income. Its growth rate during the past fourteen years has been 4.4%, just over twice as much as its population growth. Due to sustained efforts in education and health for over 100 years, this country currently holds an outstanding position in human development (ranked 47th worldwide), characterized by a literacy rate of almost one hundred percent (95%) and life expectancy above 78 years, among other important social factors[1].

With the above indicators, it is not surprising that some experts claim that Costa Rica's success in attracting FDI inflows from High-Tech Multinational Enterprises (HT MNCs) during the last decade has been achieved because of the relatively abundant highly educated and healthy labor force (FIAS 1996, Miranda and Vargas, 2001, and Sanchez 2006). In fact, in the case of Intel, a relatively well-educated labor force, as well as stable and business-friendly economic and political conditions in Costa Rica were fundamental factors for the firm's decision to invest in this country in 1996 (Spar, 1998).

In addition to Intel's investment, other multinational corporations dedicated to the production of electronics, or firms that make intensive use of Information and Communication Technologies (ICTs) have established branches in this country during the last decade. Among these are Hospira Inc., Cisco, Microsoft, Baxter International Inc., Procter & Gamble and Motorola Inc. On the one hand, this development is due to important promotion efforts made by Costa Rican businessmen, and on the other hand, to a tradition that started with the Republic, of dedicating a great part of the national budget to education. Indeed, most multinational corporations have decided to establish branches in Costa Rica precisely due to the relatively high level of education of its citizens with respect to other developing countries (Larraín, López and Rodríguez, 2001). In short, according to Costa Rican authorities[2], there are 46 high-tech MNCs operating in this country, providing direct employment to over 14,000 people, and they exported more than US$3,000 million in 2005.

It is worth mentioning that some Costa Ricans who work for HT MNCs established in this country have been able to take part in sophisticated processes, such as production of the Intel Titanium server, and three other Xeon™ servers in 2007. In addition, the plant in Costa Rica participated in designing and developing testing equipment and programs, unit assembling processes, assembling technologies, and complex laboratories to detect flaws, more recently.

In spite of the above results, however, some researchers claim that there is currently a shortfall in the supply of a well trained workforce in Costa Rica, especially with respect to HT MNCs demands (Céspedes and González, 2002), which constitutes not only a

[1] As quoted in several documents of the World Bank and United Nations Development Program (UNDP)
[2] PROCOMER (the Promotor of Foreign Trade).

serious limitation for the development of such firms in the country, but also a major barrier for attracting more Foreign Direct Investment (FDI) inflows. Indeed, this paper shows clear indications that Costa Rica is facing an important challenge regarding skills development and training, especially if the country wants to make a successful transition towards the knowledge based-economy (KBE). It is therefore necessary to raise awareness among persons and organizations in different sectors (public, private and academic), especially in educational centers (high schools and technical-vocational institutions) with respect to training requirements in KBE-related areas. Besides, it is important to strengthen existing relationships between universities and businesses, in order to establish priorities regarding professional education, help define careers that more closely respond to the demand in the productive sector, create more dynamic curricula, develop and implement on-line education, and so for.

Another important challenge that Costa Rica is facing because of the insufficient amount of highly educated human resources is related to the limitations found by HT MNCs when they try to undertake Research and Development activities (R & D). In fact, having highly trained personnel at PhD level is critical to guarantee R & D development. As will be seen later on in this paper, there are not enough PhDs produced in Costa Rica. For instance, if Intel was interested in setting up a high-level R&D Lab; there may not be enough PhDs in Physics, Sciences of the Materials and Electronics in the country to make it possible.

Based on this information, the present paper addresses the important question – How could HT MNCs help a developing country such as Costa Rica to face the challenges regarding skills development which are already marked? This analysis is especially relevant for Multinationals from the ICT sector, which intensively use highly qualified labor, and are generally influenced by geographical contexts, as the country of origin and reception, and specific factors such as the nature of the companies and the dynamics dictated by the sector itself (Quintanilla 2002).

This paper presents a case study on "good practices" on how HT MNCs have contributed to skills development in Costa Rica, according to paragraphs 29 through 32 of the Tripartite Declaration of Principles Concerning Multinational and Social Policy, which state:

> "*29. Governments, in cooperation with all the parties concerned, should develop national policies for vocational training and guidance, closely linked to employment. This is the framework within which multinational enterprises should pursue their training policies.*
>
> *30. In their operations, multinational enterprises should ensure that relevant training is provided for all levels of their employees in the host country, as appropriate, to meet the needs of the corporation as well as the development policies of the country. Such training should, to the extent possible, develop generally useful skills and promote career opportunities. This responsibility should be carried out, where appropriate, in cooperation*

with the authorities of the country, employers´ and workers´ organizations and the competent local, national or international institutions.

31. Multinational enterprises operating in developing countries should participate, along with national enterprises, in programmes, including special funds, encouraged by host governments and supported by employers´ and workers´ organizations. These programmes should have the aim of encouraging skills development and training as well as providing vocational guidance, and should be jointly administered by the parties which support them. Wherever practicable, multinational enterprises should make the services of skilled personnel available to help in training programmes organized by governments as part of a contribution to national development.

32. Multinational enterprises, with the cooperation of governments and to the extent consistent with the efficient operation of the enterprise, should afford opportunities within the corporation as a whole to broaden the experience of local management in suitable fields such as industrial relations." (ILO 2006), p. 6).

Although there was not enough data to conduct an impact analysis on this regard, our case study, based on the experiences of Intel Costa Rica, Microsoft Costa Rica and Cisco, suggests a number of avenues for future enquiry regarding the spillover and spin-off effects of HT MNCs' operations. Indeed, we present a preliminary approach on this topic for the case of Intel.

To begin with, it is important to mention the relative importance of Intel, Microsoft and Cisco investments in Costa Rica. Intel Corporation started operations in Costa Rica under the name of "*Intel Costa Rica*" in 1998 as a microprocessor (i.e., Pentium II and Celeron) assembly and testing business, with an investment of more than US$500 million. In 2001 Intel expanded its operations in Costa Rica by establishing the Latin America Engineering Services Group (LAES) in the country, and hiring twenty-eight engineers, most of them (two-thirds) Costa Ricans, and the rest from other Latin American countries such as Colombia, El Salvador and Venezuela. The LAES offers research and development services in cutting-edge technologies, such as design of circuits and software. Approximately, the 3,600 Intel's employees in Costa Rica generate one quarter of this country's total exports (Delgado and Trejos, 2006).

Microsoft Inc. started operations in Costa Rica in June, 1995 as the first subsidiary located in Central America. At that moment the first employees were hired and they coordinated details for the local growth strategy. Before 1995, commercialization of its products was coordinated by other businesses in Latin America. At present, this company has a total of 43 employees in Costa Rica.

Cisco started operations in Costa Rica in 1996, with only two staff members under the name of Cisco Systems Costa Rica S.A.Cisco Systems Costa Rica S.A. Currently, this branch has around 20 workers, Cisco's office in Costa Rica operates as its headquarters for Central America. Its service areas are: sales, technical support and marketing.

This paper consists of five sections including the introduction, and it is organized as follows: Section 2 presents a literature review on Foreign Direct Investment (FDI) and training and skills development. Section 3 discusses the development of human resources in Costa Rica, based on information on the country and the profile of its labor force, national policies for training-related employment, financing of training, supply of technical training, and challenges faced by the country regarding skills development and training. Section 4 analyzes the impact of the three HT MNCs analyzed on public programs and special funds assigned to training, as well as policies and practices for skills development and training. In addition, the authors searched for evidence to determine direct and indirect impacts of skills development and training programs provided by these companies on the Costa Rican economy, specifically on employment generation and spillover and spin-off effects. Finally, Section 5 summarizes the research's main findings and presents some concluding remarks.

1. 2. Literature overview on FDI and skills development and training

Innovation and technological change processes that are currently taking place worldwide require that participants be highly competitive, at both the business and the governmental levels. Countries have to be more open to international information and knowledge flows, while promoting development of the necessary skills to absorb and use said information and knowledge, to create a favorable institutional atmosphere that will make it possible for countries to participate in the world growth process.

On the other hand, progress in information, communication and transportation systems facilitate transnationalization of many firms – a process that maximizes productivity by combining mobile advantages with region- or country-specific tangible and intangible resources.

Throughout this changing process, governments of many countries have acknowledged that MNCs can provide a package of external resources that may make an enormous contribution to a country's development (WIR, 1999). The process by which companies look for an appropriate production niche has an impact on the educational systems of the countries where they are established.

Human resources are a determining input in any business productive cycle, and they must have a certain amount of the basic knowledge necessary to fulfill their role satisfactorily. This is particularly relevant in the face of the new economy or the knowledge-based economy (Burton-Jones, 1999).

Several studies, among which the ones of Tuman and Emmert (2004); Axarloglou (2004); Noorbakhsh *et al (*2001); UNCTAD (2002) and Nunnenkamp and Spatz (2002), stand out, have mentioned the importance of having highly-qualified human resources to attract foreign direct investment inflows, where the main actors are the multinational enterprises and the host countries (mostly through educational public policy). Moreover, during the past decades, many countries have made efforts to improve the level of education of their human resources with support from international organizations and, in some cases, based on global initiatives. For their part, multinational corporations provide knowledge and training to their employees, thus promoting generation of new skills and access to information and technological improvements in the developing countries where they operate.

There are different teaching mechanisms, which may be developed through formal or informal channels. Formal education systems are normally governmental initiatives, whose purpose is to strengthen the quality of human resources to provide them with competitive advantages so that the country becomes strongly attractive to multinational companies. On the other hand, informal education takes place through

training given by MNCs to their staff, as well as through positive knowledge-related externalities.

Thus, the impact of multinational corporations on the education of a certain country may take place before the business is set up in the host country, as a way to attract them; and after they have been set up, because human resources need to adapt to continuous innovations and the process of seeking greater benefits generated by the establishment of a greater amount of multinational corporation (Tuman and Emmert, 2004; WIR, 2005). In fact, Tuman and Emmert (Op. cit), suggest that MNCs, in particular the ones from the United States, invest in those countries that have the highest enrollment rates in secondary education, and in those countries that have defined policies for expenditures in education.

There are three different mechanisms by which Multi National Corporations (MNCs) may have an impact on the educational system and human resources development of host countries: (i) changes made in the educational system to improve a country's capacity to attract MNCs ; (ii) changes in the educational system promoted by MNCs once they are established in the host country, to guarantee their development in said country; and (iii) generation of *knowledge spillover* and *spin-off effects* on the rest of the host country's economy.

(i) Changes in educational systems to attract MNCs

Without access to high-quality formal basic education, those countries that want to serve as operations bases for multinational corporations face difficulties to attract those businesses, especially those oriented to the production of high value-added goods and services; in addition, they loose opportunities to improve the benefits of this interaction by improving their workers' skills.

Some studies have quantified the impact of investment on education to attract multinational corporations. For instance, Axarloglou (2004) found that, in different states of the United States, a 1% increase in per capita expenditure in education increased direct foreign investment flows towards those states by 1.3% approximately.

Among the formal education initiatives that have been developed worldwide, the program "Education for All" stands out – an intergovernmental effort whose purpose is to increase the quality and quantity of basic education in developing countries (Miyamoto, 2004). This program was subscribed by most of the countries in the world, and it has six main goals aimed at achieving high-quality basic education for all the children without exclusion, and continuous education throughout their adult life, which will enable them to adequately perform their day-to-day activities.

This initiative has generated a strong impact on the amounts of official assistance aimed at strengthening basic education in various countries. Some examples are: Indonesia, with the Back to School Program; Singapore, where the so called Standardized Education System was established; El Salvador and Haiti, where various programs were

implemented, and Costa Rica, where the Educational Computing Programme and the Community Computing Programme have been developed. In addition, "Education for All" also motivated the countries themselves to make efforts in promoting improvements in their basic education systems, as is the case of Mexico and Brazil (Miyamoto, 2004).

Various policies have been implemented through the years by countries that are seeking to improve their educational level and attract multinational corporations, and, through them, promote the country's development and growth.

Efforts to promote secondary and tertiary education have been made through joint programs with varios industries, to be able to identify their needs, develop desirable and necessary human resources skills, and to emphasize education, so that it complements and more closely corresponds to businesses' requirements.

Singapore, Ireland and Africa, through their different investment promotion agencies, have aimed their efforts at developing programs such as the *World Class Universities, Experts Group on Future Skills Needs, Education Skills and Research* y *African Virtual University*. The European Union is also an example with its *Minimal Knowledge Platform.*

(ii) Changes promoted by MNCs in the educational system

Multinational corporations may play an important role in strengthening a country's human resources. This process may be carried out through training offered directly to workers in the business place, supporting formal education, or through direct collaboration with local universities.

These firms interact with knowledge- or education-oriented institutions, such as universities and public research institutes; they produce and develop research and development skills, and provide technical services to other businesses that may require them (WIR, 2005). They may also collaborate with educational institutions providing financial assistance or managing research projects. Some specific cases of research collaboration between multinational corporations and local universities are:

Microsoft Research Asia – along with the academia and governments in the Asia-Pacific region, this institution works to create innovative research and promote advanced education and science- and engineering-related careers in that region. It works in collaboration with local universities and pertinent organizations in four different ways: research collaboration, curricula innovation, talent or skills development, and science/knowledge exchange. Investigations have been established in collaboration with research laboratories of the Tsinghua University, Zhejiang University, Harbin Institute of Technology, Hong Kong University of Science and Technology, and the University of Science and Technology of China.

Intel – since the beginning of 2005 this corporation sponsors more than 250 research projects that are underway at several universities in various countries. Its

training program for teachers, launched in 2000, has trained over 2 million teachers in 30 countries, and the company also collaborates with the Ministries of Education and other governmental agencies to adapt the curricula in some countries. For instance, in Costa Rica, this business has created links with the Costa Rican Technological Institute (ITCR). This Institute has received financial support from Intel to develop new programs and increase enrollment of engineering students.

In Thailand, *Segate Technology* is collaborating with Khon Kaen University to open the Khon Kaen-Seagate Cooperation Research Laboratory to research and develop recording-head-based manufacturing technology. The laboratory uses systems technology and a research system to improve the students' knowledge, as well as their specialization. The laboratory also works as a resource shared between Seagate employees and the Khon Kaen University students, who work together in various projects. Collaboration between the industrial sector and universities offers opportunities to assist in the growth of industries which design hard disks and other related industries in Thailand.

In Brazil, the University of Campinas in Sao Paulo collaborates with several foreign firms in research and development. By 2005 more than 250 agreements had been made between the university and private companies, and 60 between the university and public companies. Some of the foreign firms with which the University works are: Ericsson, to develop fiberglass technology for optic amplifiers, and Motorola, to develop professional skills in electronics-related areas. Other agreements have been made with firms such as *Aventis, Bayer, Compaq, Hewlett-Packard, IBM, Monsanto, Novartis, Roche and Tetra Pak.*

In Rabat, Morocco, *STMicroelctronics*, has set up a training center to train teachers and students of Engineering schools, as well as to provide them with a curriculum that will allow them to contribute in innovative activities and in the semi-conductor industry.

In Mexico, *Delphi* – a firm that produces automobile parts – collaborates with the Monterrey Institute of Technology to ensure that students acquire the necessary skills for their jobs in the City of Juarez.

In India, *Motorola* is working with the Pune Institute of Engineering and Technology (PIET) to offer a postgraduate degree in Advanced Telecommunications Engineering with a focus on software (WIR, 2005).

The experience in Singapore shows that MNCs' contributions to the development of human resources in host countries may occur in many ways. Through the years, MNCs in Singapore have participated in different educational institutes and programs, such as the Tata-Government Training Centre (created in 1972), the Rollei-Government Training Centre (1973), and the Philips-Government Training Centre. The impact of multinational corporations in this country includes transfer of technology and skills through experts, training of instructors and technical staff, assistance in curricula development and development programs, donations, loans of equipment to firms, etc. (WIR, 2005)

It can be concluded from the previous discussion that the impact of multinational corporations on educational systems varies significantly depending on the context of the host countries and the type of business. However, many of the MNCs analyzed have defined policies in place to offer strong support to educational systems. The most common ways of support are: donations of didactic equipment and materials; infrastructure and technical support; technology supply; training to teachers; creation of education, research and development institutions; donations of equipment for educational centers, and prizes granted on research development, among others.

(iii) Generation of knowledge spillover y spin-off effects

Many developing countries may not only expect to receive potential benefits from FDI, such as employment generation, capital generation and export promotion, but most importantly, to acquire new technology which may spill over to the host country, allowing domestic firms to improve their own performance. This transfer of knowledge can be either voluntary through technology transfer arrangements, or involuntary through knowledge spillovers.[3]

FDI may constitute a valuable source of productive spillovers for developing countries through various mechanisms[4]. The best one known consists of knowledge spillovers from multinationals to domestic firms in host countries, which may be generated through different channels. For instance, there is worldwide evidence showing that MNCs make significant efforts to train their local workers (ILO 1981), (Lindsey 1986), and that multinationals offer more training to their technical and administrative staff than local firms (Chen 1983), (Gershenberg 1987), (Djankov and Hoekman 1999). In fact, (Sousa 2001) presents the most comprehensive analysis of multinationals' training activities. The relevance of these findings is that an important channel of knowledge spillovers may occur through labor mobility, whereby workers trained by or working in multinationals decide to leave and join existing domestic firms (*spillover*), or start new enterprises (*spin-offs*), taking with them some or all of the knowledge acquired from multinational corporations. This particular channel of knowledge spillover has been studied from a theoretical point of view, by (Fosfuri *et al*. 2001) and (Glass and Saggi 2002), and documented through empirical studies by (Görg and Strobl 2005).

Most training received by MNCs' workers is paid by the corporations and not by the workers, and the knowledge acquired is not only used within a specific firm, but it may also be used in other firms. Therefore, mobility of workers from MNCs to local firms is a positive externality that will lead to higher wages for these workers and/or greater productivity for other firms that employ them, once they leave their jobs in multinationals. (Fosfuri *et al*. 2001) created a model based on this idea. According to their model, a multinational corporation may use more advanced technology only after its local workforce has been trained. An initial FDI-induced technology spillover occurs

[3] For a review of extensive microeconomic literature developed to address this knowledge on productivity or spillovers see (Blomström and Kokko 1998) and (Görg and Greenaway 2003).

[4] Literature on foreign direct investment is extensive and has been summarized many times. For recent summaries, see (Markusen 1995), (Caves 1996), (Blömstrom and Kokko 1998).

when domestic firms give employment to these workers. Monetary spillovers take place when foreign subsidiary companies pay higher wages to their workers to keep them from leaving. Something very similar happens when the workers' knowledge increases, not through formal labor training, but through job training, i.e., learning by doing or learning by observing. It would be expected that knowledge related to production processes would spread from one firm to others simply through normal human interaction among employees doing similar work in different firms. A more sophisticated kind of explicit or tacit knowledge transfer may take place when there is an interaction between multinationals and local firms, for example between multinationals and their local suppliers. In some cases, multinationals cooperate with educational institutions in the host country to design special training programs (WB 1995), (Spar 1998), (Larraín *et al*. 2001).

Although the existing literature on economy has not been able to prove convincingly and for all cases studied that FDI produces positive spillovers in host countries, some studies have identified such potential benefits[5]. In one study carried out in Costa Rica, (Monge *et al.* 2005) found that 27.5% of local suppliers received training from MNCs, and that they were using new know-how acquired from MNCs to produce goods and services to sell to other Costa Rican firms. Moreover, the authors found that local firms have hired qualified personnel (managers, engineers and technicians) who have previously worked for MNCs in Costa Rica. Indeed, 36.2% of managers, 27.6% of engineers, and 31.0% of technicians working for local suppliers have previously worked in the country's MNCs . These figures are somewhat high for a small economy such as that of Costa Rica, and would seem to indicate that there is stiff competition for such trained personnel in the productive sector. With regard to how many local supplier firms were created by former employees of MNCs in Costa Rica, the authors found that in 27.6% of local supply companies, at least one of their owners had previously worked for MNCs in this country.

In light of the international experience, the last point is important: in Bangladesh, for instance, textile exports surged after Daewoo International Corporation (a multinational corporation) established a textile plant in 1979. Of the 130 Bangladeshi workers who were given familiarization training in Daewoo International Corporation technology in Korea, 115 subsequently left Daewoo International Corporation to set up their own textile processing plants for export.[6] Similarly, in his study carried out in Taiwan, (Pack 2001) found evidence to determine that managers trained by multinationals typically left those firms to create their own companies, and that this type of labor mobility from multinationals to local firms was important. More recently, (Smarzynska 2004) shows that domestic firms in Lithuania benefit from vertical (*inter-industry*) rather than horizontal (*intra-industry*) spillovers from multinationals, while (Görg and Strobl 2005) found that in Ghana, firms whose entrepreneurs worked in multinationals from the same sector are more productive than other domestic firms.

[5] A recent empirical work, (Hanson 2001) only finds weak evidence to determine that FDI generates positive spillovers for host countries. In a thorough review of existing literature, however, (Lipsey 2002) arrives at more favorable findings.

[6] To put this example in perspective, it is important to note that before Daewoo set up its Bangladesh subsidiary, there were only 40 people working in textile processing plants for export in that country (Rhee *et al*. 1984).

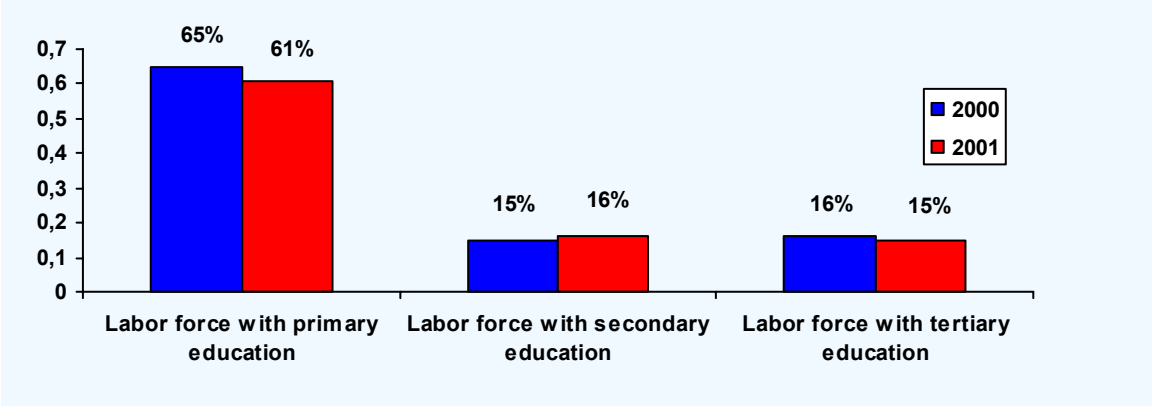
3. Development of human resources in Costa Rica

This section analyzes Costa Rica´s public policy on skills development and the related fiscal expenditure. The main features of training institutions in this country, considering the challenges currently imposed by the transition towards a knowledge-based economy are also discussed.

a. Public policy and related fiscal expenditure

In spite of having a healthy and relatively well-qualified workforce, Costa Rica faces important challenges in this field – specifically, low coverage in secondary and university education. In fact, while coverage of secondary education only reaches 50%, other countries with similar population and human development indices, have 100% coverage[7]. In addition, at university level, enrollment in Costa Rica is approximately half of what the country should have in order to maintain its human development level and achieve greater economic development[8]. Figure 3.1 shows the impact of these challenges in the Costa Rican workforce composition by academic level. Only 61% of the workforce has completed elementary education, 16% of the workforce has completed secondary education, and 15% of the workforce has a university degree.

Figure 3.1 Costa Rica: labor force and educational level



Source: World Development Indicators, World Bank

To face those challenges, Costa Rican authorities have launched a promotional campaign for all secondary school students, including financial incentives for their families, so that students will not drop out of school before they finish eleventh grade[9]. Likewise, there is a need to revise the existing scholarship system to finance university

[7] This is the case of Finland.

[8] In fact, according to a diagnosis of (CR-USA 2006), Costa Rica has 21% enrollment in tertiary education, while it needs twice as many students enrolled at this level.

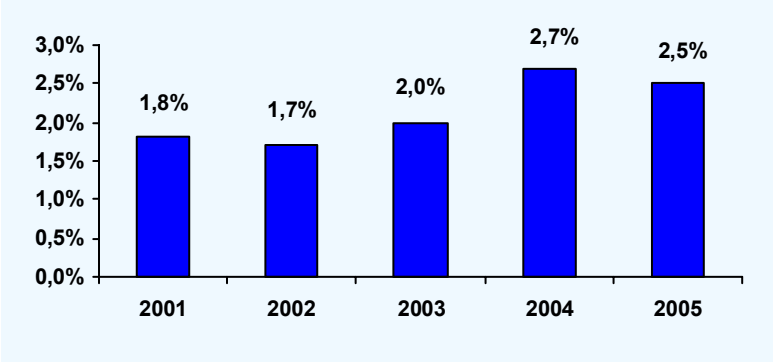
[9] See the National Plan for Development of the Arias-Sanchez Administration, 2006-2010 (http://www.democraciadigital.org/articulos/2007/2/1007-plan_nacional_de_desarrollo_2006_2010__jorge_manuel_dengo_obregon_.html)

education for students with scarce resources. The possibility to increase expenditures in education from 6% to 8% of the Gross Domestic Product (GDP)[10] is also being discussed.

For over 30 years Costa Rica has built a comprehensive educational system which emphasizes information and communications technologies (ICTs) presence in the curriculum. A tremendous effort has been made to ensure that educational facilities produce properly skilled knowledge workers and professionals, who can contribute to the country's development and its insertion into the *knowledge based-economy*. In fact, an Educational Computing Program (ECP) was designed and launched through an alliance between the Ministry of Public Education and the Omar Dengo Foundation. It started in 1988 in the country's elementary schools, covering a total of 57 educational centers and 61,570 students (Monge and Chacón 2002). This program is intended to develop certain abilities in children so they may take better advantage of ICTs, and succeed in the knowledge-based economy. By 2006, this program has reached 665 educational centers and 316,488 students, i.e., 53.4% of all children enrolled in elementary school. In 2002 the ECP started to be implemented in secondary schools as well, currently reaching 197 educational centers and 130,615 students in 2006[11], i.e., 69.9% of those enrolled in secondary education.

Aside from the resources that corporations directly invest in training their employees, education of the Costa Rican labor force is mainly financed by the government. As indicated in the previous point, Costa Rica invests approximately 6% of the GDP in its educational system. Moreover, during the last years an important effort has been made to increase the amount of resources assigned to tertiary education, and to the scholarship system for university students with scarce resources (Figures 3.2 and 3.3).

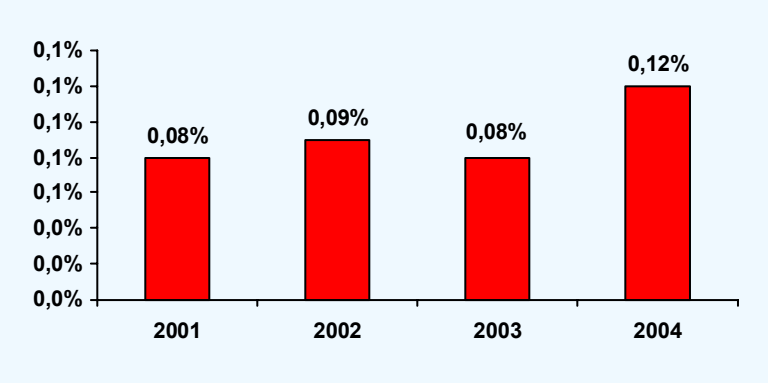
Figure 3.2 Budget for universities as a percentage of the National Budget



Source: Prepared by the authors based on figures from the National Comptroller's Office.

[10] According to Costa Rican legislation, the government must assign at least 6% of its GDP per year to education.
[11] According to figures provided by the Omar Dengo Foundation.

Figure 2.3 Budget for the National Scholarship Fund as a percentage of the National Budget



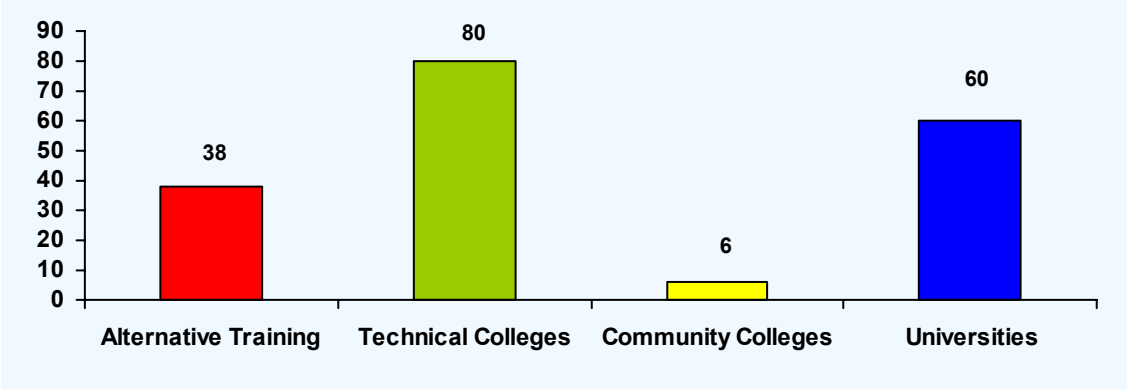
Source: Prepared by the authors based on figures from the National Comptroller's Office.

b. Training institutions

As a first step in this analysis, it is crucial to understand the course of education in Costa Rica during the last decade. That is, a discussion of current trends in Costa Rica's human resources education in the light of the country's transition to a knowledge-based economy. The following discussion is based both on a previous study by (Céspedes and González 2002) and more recent data from the Costa Rican authorities. All existing professional education centers in the country are described, from technical professional high-schools to institutions of higher education. The range of academic options available as well as the diplomas awarded between 1990 and 2004 is discussed. This information makes it possible to assess the country's development in the area of education, as well as to identify the main challenges that Costa Rica is facing on this matter.

Figure 3.4 shows the number of existing professional education centers in the country. As may be seen, Costa Rica has some institutions that cannot be included in the traditional classification, according to CONARE's (the National Rectors Council's) nomenclature for degrees and diplomas. This is the case for companies with training centers, such as New Horizons, Oracle de Centroamérica, Cisco, and Cenfotec, as well as private educational institutions classified as para-universities. The latter institutions are referred to as "alternative education centers" in this section.

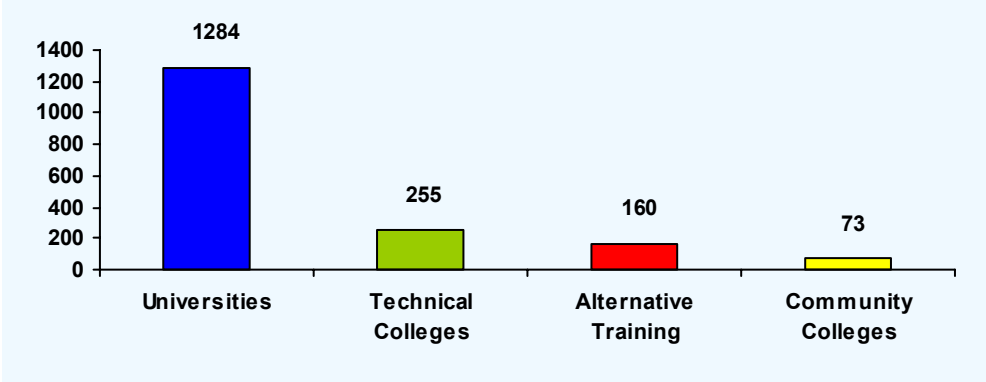
Figure 3.4 Costa Rica: Number and type of professional education centers



Source: (Céspedes and González 2002)

An analysis of the various existing academic options – technical professional high schools, university colleges, universities and alternative educational centers – shows that there are 1,535 options available in the country, considering all possible academic degrees (see Figure 3.5). However, the authors claim that some professional education centers may not be well-prepared to offer the appropriate training to meet the requirements of a knowledge-based economy. For this reason, a possible solution for quality control may be accreditation, which would force institutions to evaluate themselves in order to fulfill relevant standards.

Figure 3.5 Costa Rica: Professional training centers – academic options by type of center



Source: (Céspedes and González 2002)

Céspedes and González (Op.cit) estimate that out of all the options offered by these centers, 43% of the total number of diplomas was awarded to accounting and secretarial graduates, while careers in ICT – basically computer sciences and electronics – represent only 3% of the total amount of diplomas awarded.

On the other hand, the amount of students enrolled in secondary education (7th to 12th grades) during 1999-2006 is presented in Table 3.1, as well as the corresponding percentages of academic (from academic schools) and technical (from professional technical high-schools) options.

Table 3.1 Costa Rica: Students enrolled in diversified education: 1999-2006

	Technical		*Academic*		*Diversified*	
	Total	**%**	**Total**	**%**	**Total**	**%**
1999	**45,725**	**21.47**	**167,220**	**78.53**	**212,945**	**100.00**
2000	**48,360**	**21.07**	**181,089**	**78.93**	**229,449**	**100.00**
2001	**49,960**	**20.6**	**192,465**	**79.4**	**242,425**	**100.00**
2002	**52,943**	**20.5**	**204,250**	**79.5**	**257,193**	**100.00**
2003	**55.913**	**20.7**	**214,090**	**79.3**	**270,003**	**100.00**
2004	**57,414**	**20.36**	**224,522**	**79.64**	**281,936**	**100.00**
2005	**58,592**	**20.01**	**234,118**	**79.99**	**292,710**	**100.00**
2006	**60,386**	**20.2**	**238,434**	**79.8**	**298,820**	**100.00**

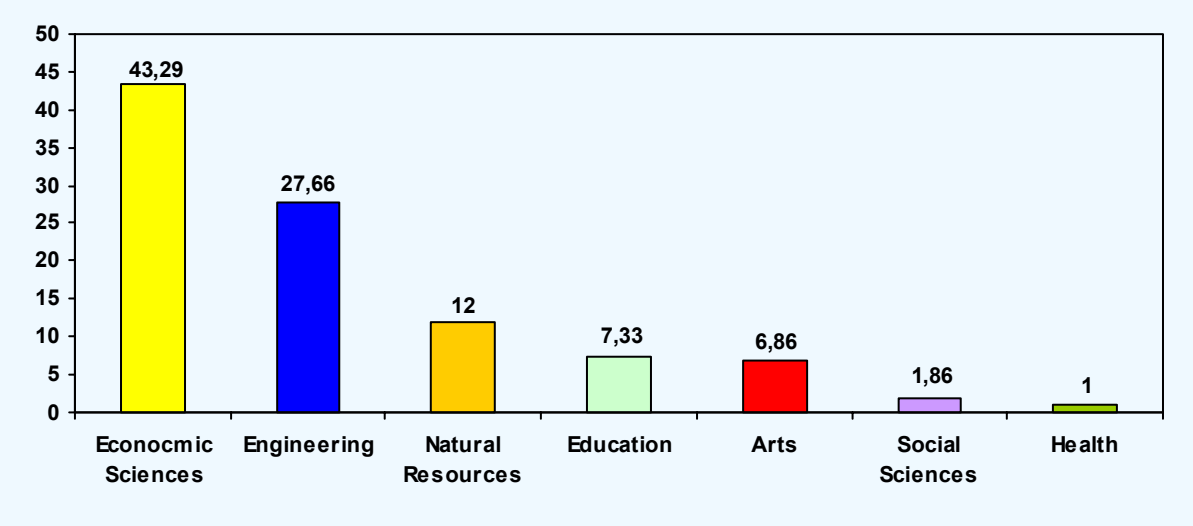
Source: Department of statistical of the Ministry of Education of Costa Rica

Some comments can be made based on the data presented in the Table 3.1. On the one hand, stagnation in the percentages of enrollment in technical education is greatly due to the lack of resources and infrastructure to receive a larger number of students, mainly, in areas such as computer science and electronics. On the other hand, in several Agricultural Technical High Schools student enrollment was reduced because there were not enough resources to open other options. However, this process has been reverted and more options are being opened every year in technical education in Costa Rica.

It is important to consider how Costa Rica compares to other countries with respect to the percentage of students enrolled in technical education as presented in Table 3.1 Although there is not enough information available on this regard, in Brazil, for instance, the percentage of students enrolled in technical education with respect to academic education represents only 9,2% (OREALC/UNESCO, 2005), less than half of that percentage in Costa Rica. Instead, in Chile this percentage represents 42,68%, twice as much as in Costa Rica.

The need to strengthen the national technical education system in Costa Rica through joint agreements among technical professional high schools, university colleges, and public universities is important, to make this type of professional education centers more attractive. Possible strategies might include allowing credit for courses taken in technical institutions when applying for direct admission to universities and university colleges. Only the Costa Rican Technological Institute (ITCR) has implemented this idea in recent years.

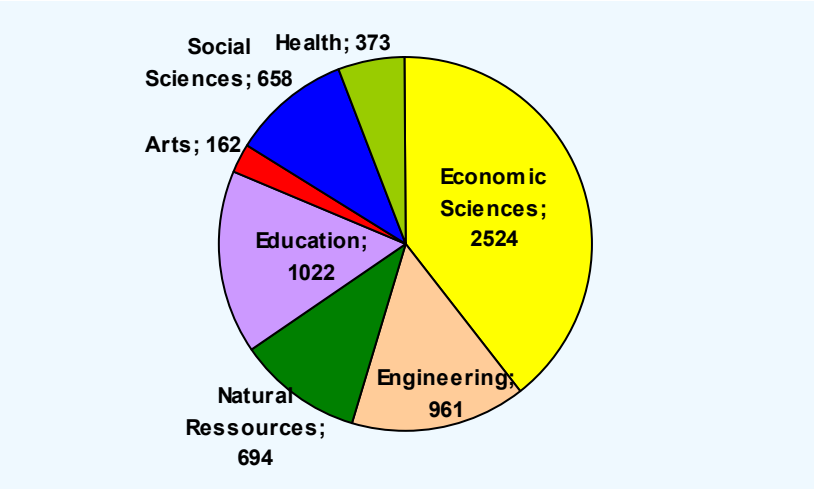
Figure 3.6 Costa Rica: PTCs – Percentage of degrees awarded by academic area, 1990-2000



Source: (Céspedes and González 2002)

Requirements for technically-trained human resources in different skills areas and different economic sectors must be defined, to respond to their needs Figure 3.6 shows the number of diplomas conferred in technical professional high schools by academic area. These schools have become a very important source of technical human resources, especially in the area of Engineering. However, the work of these centers should be better coordinated with businesses that might demand these types of professionals, since for example, about 75% of the people hired by MNCs have a Technician's degree, although, as will be seen later on in this section, in some areas MNCs would prefer to hire professionals with higher academic degrees, and not just technicians.

Figure 3.7 Costa Rica: Community colleges – degrees awarded by academic area, 1990-2000



Source: (Céspedes and González 2002)

In Costa Rica there are six Community Colleges, where the most popular specialization is *Economic Sciences* (Figure 3.7) in terms of the amount of diplomas awarded by these colleges. The second most popular career is Education, and Engineering is in third place. These results show that trends in degrees conferred at Community Colleges are similar to those conferred at universities, as will be discussed below.

Public and private universities awarded a total of 265,824 diplomas during the 1990-2004 period. This represents 6,2 degrees awarded per 100 people. Table 3.2 shows the distribution of these diplomas by academic area, as classified by the Higher Planning Office of CONARE (OPES). Looking at the amount of diplomas conferred during the same period, classified by public and private universities, it may be concluded that since 1997, private universities have conferred more diplomas than public universities. In fact, beginning in that year, the number of diplomas awarded by public universities has shown a tendency to remain stable. An important factor that might explain this situation is that budgets of public universities have not been increased in real terms during these years. As a result, in spite of a considerable increase in applicants for information and communications technologies-related careers, public universities can only accept, as a maximum, around 10% of them.[12] Another point to consider is the lack of qualified university professors, which makes it difficult to fulfill the demand for education in these areas: even if more students were to be admitted, in many cases it would be impossible to find professors (some times not even part-time professors) to handle this amount of students.

Table 3.2 Costa Rica: Universities – degrees awarded by academic area, 1999-2004

	Arts and Letters	Basic Sciences	Social Sciences	Economics	Education	Natural Resources	Engineering	Health
1990	332	333	1530	1513	2102	311	539	771
1991	422	389	1408	1873	2007	271	599	751
1992	399	390	1251	2516	2188	246	627	1514
1993	510	468	1414	3112	2719	203	657	1052
1994	508	497	1692	3803	3081	238	767	1510
1995	540	507	1684	4346	3724	208	728	1335
1996	558	655	1948	4898	4523	303	766	1400
1997	534	847	2455	5263	5440	318	923	1909
1998	635	989	2990	6185	7097	286	1040	2323
1999	727	116	3355	6528	9703	390	1229	2276
2000	623	119	3803	7104	9550	435	1522	2711
2001	657	1284	3294	5766	7827	423	1516	2532
2002	719	1402	4101	6221	9211	452	1437	2507
2003	686	1480	4430	6168	8400	427	1535	2620
2004	659	1816	3571	6131	8953	420	1817	2900

Source: (National Rectors Council 2006)[13]

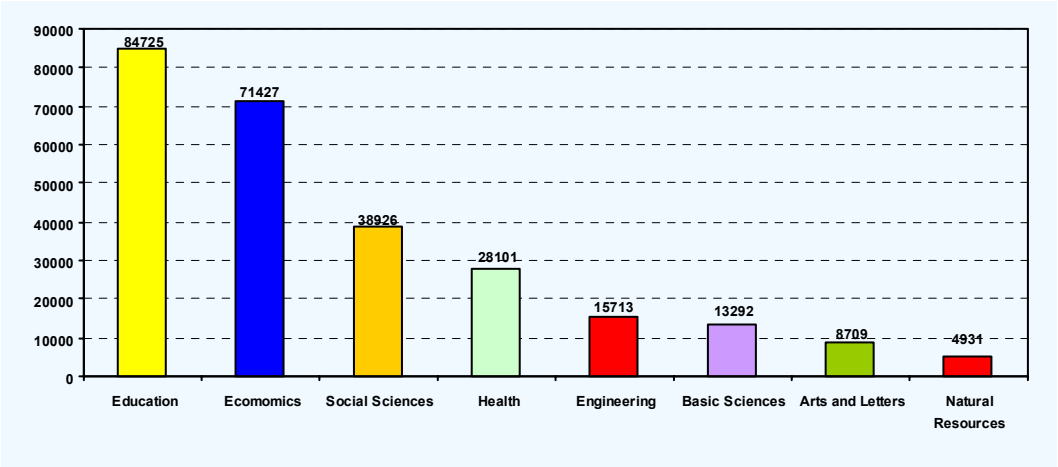
As in technical professional high-schools (TPHSs), Universities grant the greatest amount of diplomas in the areas of economic sciences (business administration), education (preschool and elementary), and social sciences (law and communication), as can be seen in Figure 3.8. It is also important to mention that the amount of diplomas

[12] For instance, in 2001 the Costa Rican Technological Institute received 2,400 applications for admission to the computer sciences program; however, only 170 students (7% of the applicants) were admitted.

[13] We would like to thank Alexander Cox for providing most of the data presented in this section

granted during the 1990-2004 period in Computer Sciences and Electrical and Electronic Engineering are respectively 10,645 and 2,578.

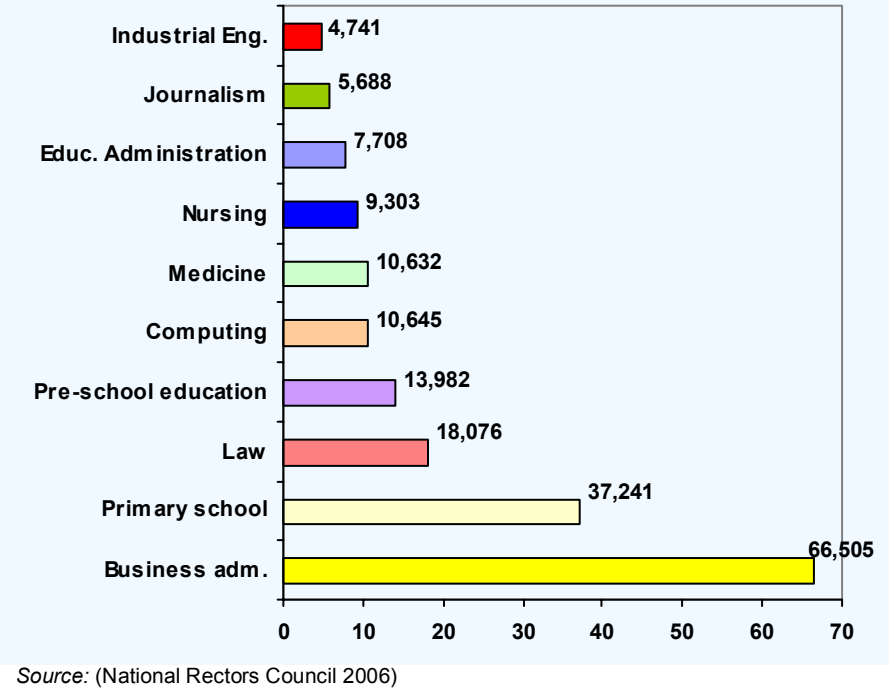
Figure 3.8 Costa Rica: Universities – degrees awarded by academic area, 1990-2004



Source: (National Rectors Council 2006)

Figure 3.9 shows the ten careers with the greatest amount of diplomas awarded: business administration, elementary education and law are the three degrees most sought after by students in Costa Rica. In the area of engineering, only computing and industrial engineering appear, in the 7th and 10th positions of this list respectively.

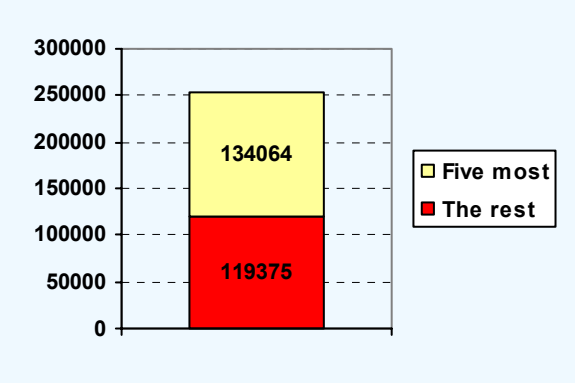
Figure 3.9 Costa Rica: ten careers with most diplomas awarded, 1990-2004 (1000s)



Source: (National Rectors Council 2006)

Careers such as electronics and electrical engineering do not even appear in this list, although they are considered vital to make the transition to a KBE, especially in high-technology sectors. Figure 3.10 shows that the five careers with the greatest amount of diplomas conferred between 2001 and 2004 (business administration, elementary education, law, preschool education and nursing) represent 55 % of the total amount of diplomas awarded, and none of them can be classified as related to or strategic for Costa Rican high-technology sectors.

Figure 3.10 Costa Rica: five careers with most diplomas awarded, 1990-2003

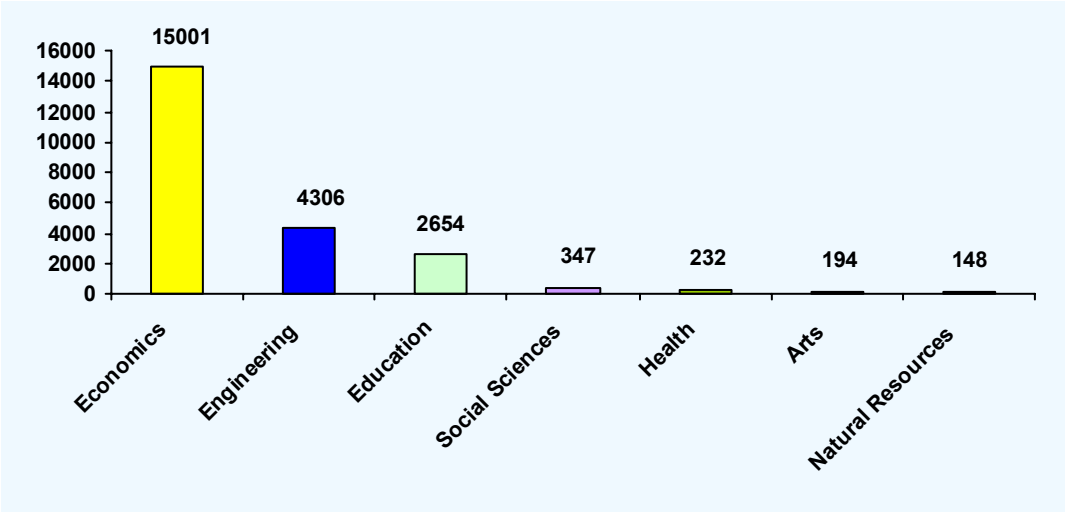


Source: (National Rectors Council 2006)

In summary, the above statistics indicate that there is a bias in Costa Rican public and private universities toward "traditional" careers, and substantial shortfalls are being experienced in the production of students in other careers that are crucial for the country's transition to a Knowledge-Based Economy.

There are several types of Alternative Education Centers (AECs) in Costa Rica that are worth analyzing. The first one is the National Learning Institute (INA), a public institution, followed by some private centers such as Cenfotec, CISCO, Fundatec, and para-universities.

Figure 3.11 Costa Rica: Alternative Education Centers–degrees awarded by academic area, 1990-2000



Source: Céspedes and González, 2002

As shown in Figure 3.11, the area of economic sciences continues to be the most important in terms of amount of diplomas awarded by AECs, while engineering is the second most popular area; this is different from what was found at the universities. According to these figures, AECs seem to be more flexible in adjusting to the needs of economic sectors reporting requirements for specialized human resources – engineering is the second most important area, and this seems to be more in agreement with human resources requirements for a KBE. However, the fact that the area of economic sciences continues to be the most popular in terms of number of diplomas awarded is still a concern.

In addition to the AECs, there are also some professional education centers (PECs) in Costa Rica, which awarded a total of 222,578 in the 1990-2000 period. Of this total, technical education in these institutions currently accounts for 8.3% of the total of diplomas issued, while in 1990 this figure was 21.4%. At a national level PECs have suffered losses in their attraction of Costa Rican students, and considerable efforts will have to be made in order to increase those percentages in the short term.

When analyzing these figures a question arises of whether technical graduates immediately integrate into the labor market or if they rather pursue a career in a university. Information shows that during 1990, universities conferred 68% of the total number of diplomas, while for the year 2000 that figure was 83.5%. These figures are disturbing from every point of view, because the percentage of technical human resources in areas considered strategic for the country's transition to a KBE is decreasing every year.

In short, the last analysis clearly indicates that centers for professional education (TPHSs, university colleges, universities and AECs) are producing more professionals in the areas of economic sciences, education and social sciences than graduates in areas that seem to be more relevant for a country in transition to a KBE, such as engineering.

Having discussed the training institutions of Costa Rica, in particular the type of professionals they are currently producing, it would now be convenient to consider to what extent such labor force is actually being required by MNCs . That is to say, it would be important to assess the difference between academic degrees *held* by current employees, and what MNCs indicate they *require* (the "optimum" degree distribution). Céspedes and González (2002) analyzed the supply/demand difference in human resources required by MNCs in the High-Technology sector in Costa Rica for the 2002-2006 period. The authors defined such differences as the average amount of human resources MNCs have in excess (+) or need (-) in a specific period of time, under current market price conditions, in order to achieve their optimal employment level. If the difference is positive (negative) for a given career and academic degree, MNCs have, on average, more (less) employees than they need in that specific career and academic degree.

The most important findings from this exercise, according to types of academic degrees, are:

- *Technician's degrees* – taking all careers into account, more employees must obtain academic degrees higher than their current technician's degree in order to meet MNCs requirements. Careers such as accounting, electronics and industrial engineering, and secretaries, administrative assistants, mechanics and laborers stand out in this area.

- *Diplomados* – careers with a shortage of professionals among MNCs employees with degrees at this level are accounting, electrical, mechanical and industrial engineering, nursing, secretaries, administrative assistants, mechanics and laborers.

- *Graduate degrees* – there are three careers (mathematics, physics, and law) in which MNCs wish to have less-qualified employees – that is, that instead of the current postgraduate degrees they hold, employees could simply have graduate degrees.

- *Post-Graduate degrees* – MNCs have problems finding employees at this level in the areas of business administration and human resources. There is also need for a more highly educated workforce in the areas of electrical and electronic engineering, computing and computer science, and industrial and mechanical engineering.

Another important aspect to analyze is the level of satisfaction MNCs have regarding the skills of their current employees. According to a survey carried out by the same authors, MNCs' employees in Costa Rica are relatively well qualified in terms of skills related to basic information systems. In fact, 98% of MNCs claimed to be satisfied regarding their employees' use of e-mail for work activities; 93% claimed to be satisfied regarding their employees' use of the internet, intranets or e-mail for teamwork; 91% were satisfied with their employees' capacity to search for relevant information over the Internet or in an intranet; 89% were satisfied with their employees' skills on the use of word processors, electronic spreadsheet and presentations; and 84% claimed they were satisfied with their employees' database management skills. However, with respect to general skills such as problem-solving; technical and vocational skills; human resources; skills in computer programming; training and teaching; scientific and mathematical skills; skills in financial administration; information management; foreign languages; and business administration, the authors found serious problems in employees' performance in the last four of these areas. That is,

- Problem-solving skills – only 58% of MNCs claimed to be satisfied

- Scientific and mathematics skills – only 48% claimed to be satisfied

- Business administration skills – only 36% claimed to be satisfied

- Foreign languages skills – only 9% claimed to be satisfied

In brief, it can be concluded that shortfalls exist in the supply of a trained workforce in Costa Rica, compared to current MNCs demands. This is something that Costa Rican authorities will have to deal with if they wish to continue attracting FDI inflows and promoting the development of more sophisticated activities by the MNCs already established in this country.

From the previous discussion it becomes clear that Costa Rica is facing an important challenge in skills development and training, especially if the country is trying to make a successful transition to the knowledge based-economy (KBE). In short, it is necessary to raise awareness among persons and organizations in different sectors (public, private and academic), especially in educational centers (high schools and technical-vocational institutions) with respect to training needs in KBE-related areas. It is important to strengthen existing relationships between universities and businesses in order to establish priorities regarding professional education, help define careers that more closely respond to the demand in the productive sector, create more dynamic curricula, develop and implement on-line education, and so forth. A related topic the extent to which MNCs have been involved in skills development and training in Costa Rica. This topic is discussed in the next section.

4. The role of MNCs

This section discusses the role of Intel Costa Rica, Microsoft Costa Rica, and Cisco[14] in skills development in Costa Rica. First, the strategic alliances of these companies with public institutions are analyzed, and later on, the corporate human resource policies.

a. Strategic alliances with public institutions

The relative involvement of the three mentioned MNCs in public education programs, special funds, and strategic alliances with training institutions in Costa Rica is discussed. The extent to which such MNCs have been involved both directly and indirectly in promoting changes in the public education system policies in Costa Rica are also explored.

a.1 Intel Costa Rica[15]

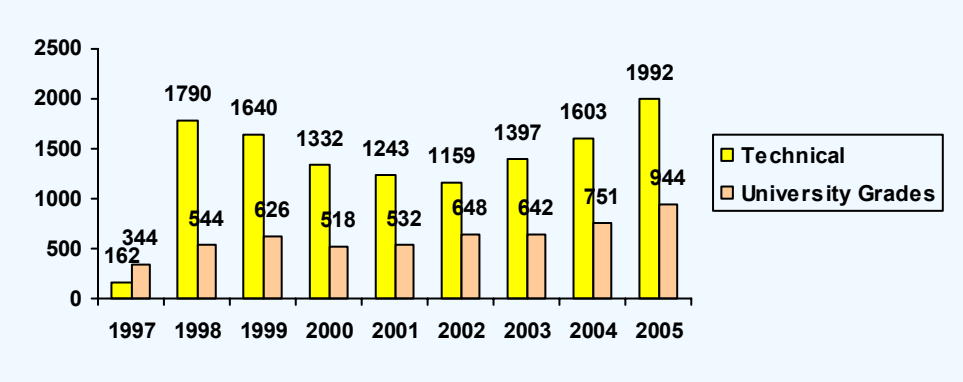
Intel Corporation started operations in Costa Rica under the name of "*Componentes Intel de Costa Rica*" in 1998 as a microprocessor (i.e., Pentium II and Celeron) assembly and testing business. This MNE has had a great impact on the country's economy. For instance, its foreign sales represent about one quarter (23.4%) of all Costa Rica´s total exports (Delgado and Trejos, 2006). At the present time, this plant in Costa Rica produces more than 90% of the chips for servers that Intel Corporation sells throughout the world. As will be discussed later on, operations of this firm in Costa Rica have had an enormous impact on the country's economy, because of the large amount of highly qualified personnel it has hired during the last 10 years (Figure 4.1), and the training it has provided to its employees. (Larraín, López y Rodriguez-Clare, 2001).

In 2001 Intel expanded its operations in Costa Rica by establishing the Latin America Engineering Services Group (LAES) in the country, and hiring twenty-eight engineers, most of them (two-thirds) Costa Ricans, and the rest from other Latin American countries such as Colombia, El Salvador and Venezuela. The LAES offers research and development services in cutting-edge technologies, such as design of circuits and software.

[14] It is important to mention that since labor unions do not exist in MNCs of the ICT sector in Costa Rica, it is not possible to study participation of the labor union sector in designing and implementing training and human development policies in this type of business.

[15] We would like to thank Gabriela Llobet (Public Affairs Manager) and Mary Helen Bialas (Academic Relations Manager) for their insights, and for providing most of the material presented in this section.

Figure 5.1 Costa Rica: Intel Employment by year (2006: ≈ 3600)



Source: Intel Costa Rica

Starting in 2004 the LAES was divided into two work groups, both of them located in Costa Rica: LADS (Latin American Design Services) and LASS (Latin American Software Services). The LADS absorbed most of the initial group of engineers with which the LAES was created, and it was basically focused on Intel Corporation's spearhead projects that are two or three years ahead of the current technology. The group has since doubled its size and diversified its staff, which currently consists of engineers and technicians in equal proportions. As of June 2006, 60 higher-level engineers and technicians work there.[16] The LADS has participated in developing five micro-processors, including the recently-launched "Core Duo™" and "Core Solo™".

The LASS, on the other hand, provides services to Intel Corporation, developing the software applications it requires. Its success is shown by the growth of its activities; its personnel went from the initial group of three employees to nearly 100. It works in the creation of computing tools for process automation, data base administration, global administration and client support services, Web applications services, and other different types of software projects.

An important contribution made by Intel Costa Rica has been its support to the national education system in elementary schools, secondary schools and universities. Annual investment reaches $700,000, not counting donations of laboratories to technical professional high schools and universities. In 2001 these contributions reached $2,500,000 in electronics and English language laboratories.

There are some programs developed by Intel Costa Rica since it started operations in Costa Rica that are worth mentioning in order to understand the ways in which this company supports skills development in the country.

[16] It is understood that higher-level technicians are those who graduated from community colleges.

Elementary and secondary education

For Intel, teachers' production and continued education to keep them up to date on educational subjects and teaching methodologies are key elements to provide students with higher-quality education, and a way to have an impact on the Costa Rican educational system. Intel invests around $300,000 per year in Costa Rica to support and improve teachers' preparation in the areas of sciences, mathematics, technical education and computing, providing the students with the skills they will need to confront the demands of modern times

Intel ® Educar is the star program to train elementary and secondary school teachers in the use of technology. Through this program, the teaching and learning processes become more dynamic and interactive in the classroom. In Costa Rica, this educator training program is carried out together with the Ministry of Public Education and the Omar Dengo Foundation. More than 9,500 teachers have been certified in *Intel ® Educar* training since the program was launched in 2000.

Program to improve teaching of sciences and mathematics

Every year, Intel promotes improvements in the quality of science and mathematics teaching as the sponsor of several activities carried out by the CIENTEC Foundation. These activities include support for the Foundation's Web page, the Biannual Mathematics Congress and the Annual Science Congress. About 500 Costa Rican teachers participate in each congress, and Intel gives scholarships to 25 teachers with lower incomes to participate.

Self-instruction manual to train students to develop scientific projects (MEP/MICIT)

Intel is sponsoring the creation of a "self-instruction" Training Manual for rural teachers, which they may use to improve their own skills to motivate and guide students in developing scientific projects. A pilot plan was implemented with 60 teachers in 2003, coordinated by the Ministry of Public Education, and this 40-hour training program – formally accredited by the Civil Service – was launched in 2004. More than one thousand elementary-school teachers have completed this training to this date.

"Students as Scientists" professional development program

To improve the quality of science teaching and increase student participation in scientific fairs, Intel Costa Rica invested $50,000 to establish a training program for science teachers. The program, mainly aimed at elementary school and secondary-school teachers, shows how to design a scientific research project and include scientific projects in the curriculum. This training was launched in June 2004, after a preliminary adjustment process, in collaboration with the Ministry of Public Education and the Ministry of Science and Technology (MICIT). To date, 800 science educators have been trained in different regions of the country. The 40-hour training is formally accredited by the Civil Service and the University of Costa Rica's School of Education, which awards continuing education credits for the course. By the end of 2005, more than 1,200 teachers

had been trained in the *Students as Scientists* program, whose goal for 2007 is to reach 5,000 teachers.

High school mathematics teaching

In 2004, Intel launched a new pilot project to strengthen high school mathematics teaching in seven secondary schools in Costa Rica. The goal is to improve teaching in the classrooms, through a training process and monthly follow-up with 14 mathematics teachers. It donated 5 portable computers to each institution, introducing a learn-by-doing project methodology and other practices focused on students' needs. In July 2005, six teachers were sponsored by Intel to receive a special 2-week training in Boston, USA, and then share the course with other 240 mathematics teachers.

A new initiative called "Intel Mathematics Day", was launched in May 2004, by which 70 mathematics teachers were invited to learn about direct mathematics applications in the workplace. This enabled educators to bring real-world experiences to their students and create more interesting mathematics classes. Teachers observed examples of mathematics applications and then worked on a one-to-one basis with Intel's employees to acquire first-hand knowledge about the use of mathematics in different situations.

Technical education

During 2004-2005, Intel donated industrial equipment to the Ministry of Public Education's Technical Education Department whose cost is estimated at over $20 million, to be distributed among various Costa Rican technical schools.

Teachers and students can develop very innovative projects with this equipment, and in 2004 an inter-institutional fair with 20 technical schools was carried out, in which 120 students from different regions participated, presenting innovative products they created using the equipment donated by Intel. Along with the donation of robots to technical schools, they included a course on robotics as part of the curriculum for those educational centers[17].

It is important to mention that when Intel Componentes of Costa Rica started operations in Costa Rica, there were not enough technicians available in the country, therefore, it hired 400 technicians who already had two-and a half years of experience in average, working for other national firms. With the new graduates, this shortfall was quickly filled (Céspedes and González 2002).

Training policies in technical education have also undergone some changes through the synergy created between the Ministry of Education and the MNCs operating in the country[18]. One of those changes consisted in the creation of a program in electronics with a focus on robotics, thanks to the donation of robots by Intel – this was confirmed by Ms. Mary Helen Bialas, K-12 Manager, Intel Costa Rica.

[17] Interview with Mary Helen Bialas, K-12 Manager of Intel.
[18] Interview with Mr. Fernando Bogantes, General Director of the SINETEC (National System of Technical Education)

Finally, it is worth mentioning that Intel (and other MNCs) has indirectly promoted the transformation of several academic high-schools into Technical Professional High-Schools (TPHSs) in Costa Rica, because of the higher demand for this type of labor force. Indeed, while in 2004 there were 80 THPSs operating in Costa Rica, at the present (2006) there are 85 THPSs in the country, and it is expected that by 2007 there will be 90.

Higher education

Through different "active" programs in higher education, Intel Components maintains a strategic academic relationship with the University of Costa Rica (UCR) and the Costa Rican Technological Institute (ITCR). It works jointly with both institutions to modernize and update the curricula for electric engineering, electronics, and materials science engineering, physics and mathematics, providing advice, support and training for teachers. For instance, the ITCR opened a degree in Electronics to prepare the higher-level technicians required by Intel Costa Rica since it started operations in this country.

Intel Costa Rica has had an important impact on the enrollment of students in careers such as Computer Sciences and Electronics. At the ITCR and the UCR, the two most prestigious universities in the country in these areas, the number of students enrolled in those careers has shown a considerable increase since 1997. This was also observed in other engineering-related careers such as industrial maintenance, industrial engineering and electric engineering. In fact, Larrain *et al*. (2001) found that the number of students taking engineering at the ITCR went from 577 in 1997 to 874 in 2000, showing an increase in the relative importance of these careers in total enrollment for the school (from 9.5% to 12.5%, respectively). On the other hand, according to figures provided by Intel, while in 1998 the ITCR and UCR graduated a total of 60 electrical engineers, by 2005 that figure went up to more than 200 graduate students in the same career. Considering that Intel in the past years has been absorbing approximately 10% of these new graduate students, this means that an increase in the supply of this type of professionals makes it possible to establish and develop new MNCs in Costa Rica, in addition to other local firms in the electronics sector. This is a positive externality of Intel's support for skills development and training programs in Costa Rica.

a.2 Microsoft Costa Rica[19]

Microsoft Inc. is the world leader in software. The firm was founded in Seattle, Washington in 1975 and currently has more than 60,000 employees around the world.

Microsoft Costa Rica started operation in June, 1995 as the first subsidiary located in Central America. At that moment it hired its first employees and the details for the local growth strategy were coordinated. Before 1995, negotiations with market representatives were coordinated through other Latin American firms. At present, this company has a total of 43 employees in Costa Rica.

[19] The authors want to thank Claudia Toledo, Academic Programs Manager, for her valuable insights and most of the material presented in this section.

Currently, Microsoft offers several education programs in various countries; the most successful one has been *Partners in Learning* (PIL) – a global education initiative created by Microsoft, implemented in partnership with local governments, Ministries of Education, and key stakeholders to propose tools, programs and practices to allow students and teachers realize their full potential. PIL includes three programs: *Partners in Learning Grants Program*, *Fresh Start for Donated Computers* and *School Agreement Subscription Licensing Program.*

Partners in Learning Grants Program

With this program, Microsoft assigns resources to enable school teachers to improve students' learning process through ICTs use. The resources provided by Microsoft are: training for teachers and students, support from technicians, evaluation and certification of students' skills.

According to the information available in (PIL 2006), overall, the various Microsoft training programs have reached 10,659 teachers, 1,241 educational leaders and 764,000 students. The investment made during the past three years amounts $2, 281,100.

Fresh Start for Donated Computers

Through this program, licensing documentation for the Windows Operating System and CDs for installation is donated. The Windows 98 and Windows 2000 editions for Pentium II computers or older are also offered so that schools can choose the suitable version according to the technical characteristics of the computers they have.

Two hundred and thirty-nine educational institutions that might take part in this plan were identified, covering a total of 3,940 computers, for a total amount of $276,571.

Agreement to the Subscription Licensing Program

This is an annual subscription by which Microsoft will offer preferential prices to elementary public schools. These institutions are the only ones eligible to acquire the upgrades of the Windows and Office Operating System at special prices. Out of 85 professional technical high schools (PTHS), 43 PTHSs are already participating and 60 % of the computers were covered by this program.

In Costa Rica, 48% of secondary-school students currently drop out of school[20], this is a challenge that the country must overcome. Possible solutions include the improvement of the quality of teachers, and the quality of evaluation instruments. To do this effectively a diagnosis in all regions of the country must be carried out which should cover the 239 educational institutions that have been identified which may take part in this program.

Near 1,200 teachers and 75,000 students will be trained in Excel XP and 60 additional teachers completed a 40-hour training that included an international certification in Microsoft Excel XP. The objective was to prepare teachers for a

[20] Ministry of Education's Department of Statistics 2006

replication model in which each teacher will train 20 colleagues, reaching a total of 1,200 teachers. In turn, they will reach approximately 75,000 students by replicating the course and taking advantage of the School Agreement signed with the Ministry of Education. This strategy aligns with the country's master strategy to continue attracting investment for the development of young talent.

The Microsoft Office Specialist (MOS) program has graduated 188 teachers, as well as 32 students and 24 members of the Omar Dengo Foundation. Also, 40 employees from the Ministry of Education received training under the Microsoft Project to implement all the academic projects for the Ministry. In addition, 12 teachers were trained and are responsible for training and certification in IC3 (Internet and Computing Core Certification) of 240 new students from 37 different schools[21].

Peer Coaching

This program has been implemented by the Omar Dengo Foundation and the Ministry of Public Education. Instructors received training in different countries. This program offers programs and resources to promote different ways to use technology according to educators' requirements.

Currently, 18 schools are participating jointly with the Omar Dengo Foundation.

Imagine Cup

This program is aimed at university students in different areas, to allow them to acquire and develop their best software development skills, making them able to generate solutions in specific areas. This program organizes worldwide competitions, such as those in Japan and India. Recently, a team of students from the Costa Rican Technological Institute won the fourth place in Japan. In 2005 an innovation center was established at the Costa Rican Technological Institute with an investment of $500,000. This laboratory provides services to nearly 1,000 students and 50 professors. In addition, in 2005 the ParqueTEC was inaugurated, which has allowed incubation of 15 technology-based micro-businesses. The main objective of this program is to donate computing laboratories to teams in marginal zones. So far, 12 laboratories of this type have been installed, at a cost of $760,000. They are located in different parts of the country and they have benefited more than 10,000 people. Six hundred thousand dollars worth of software have also been awarded to different NGOs and communities under this program.

Digital narrative

Advisors of the "digital narrative" program of the Omar Dengo Foundation were trained through this program which uses an innovative methodology that enables students to use video-editing software to carry out research and prepare scripts or reports.

M Zone

[21] Internal Information of Microsoft Costa Rica

This program provides the skills necessary to create train and publish a digital newspaper for adolescents. Four hundred and fifty students, 15 tutors, 15 teachers and 6 trainers have benefited. There are other programs of public interest that have had a social impact.

In this way, 15 IT Academies have been opened whose goals are to provide low-cost licensing options, on-line courses, and discounts for international certifications, as well as the possibility of participating in world-class virtual conferences. There is another very interesting program that has been sponsored by Microsoft to strengthen the software industry in Costa Rica. For each income dollar generated by Microsoft, there are $7.70 dollars ARE generated in the country, which stay in the country and are distributed through the Partners Ecosystem.

There are currently 6,179 partner businesses such as training centers, development businesses, service businesses, etc. that reach approximately 30,000 people, out of whom 10,700 are IT professionals and around 21,000, are software developers.

Likewise, through its Latin American Division, Microsoft provides important contributions for the adoption of Information and Communications Technologies. It creates content and educational material on ICTs in books, CDs, etc., to distribute among elementary and secondary education centers in different countries including Costa Rica.

Microsoft has also launched an on-line safety program which has made it possible to train more than 140 policemen from the Ministry of Public Safety about the safe handling of information through the Internet. Teachers and school children have also been trained in the adequate handling of their information, and on how to avoid safety risks.

As a whole, only during the year 2006 765,000 students, 10,500 teachers and 1,200 school directors have benefited from these programs

a.3 Cisco[22]

Cisco, Inc. is the world leader in Internet network devices. Currently, networks play an essential role in communications for businesses, education, governments and homes, and Cisco's Internet Protocol (IP)-based solutions for communications are often the basis of these networks. Cisco's hardware, software and services can be used to create Internet solutions that enable people, businesses and countries to increase their productivity, improve their clients' satisfaction, and strengthen their competitive advantages. The Cisco brand has become a synonym for the Internet, and its Internet-based business solutions provide major improvements in productivity. Cisco' vision is to change the way people work, live, play and learn.

[22] The authors want to thank Marco Cobb, Jorge Rodriguez and Rebeca Ramírez, for their valuable insights and most of the material presented in this section.

The firm was founded by a group of scientists from Stanford University in 1984. Since its creation, Cisco engineers have been leaders in developing Internet Protocol (IP)-based network technology. This IP innovation tradition continues, with leading products in the industry, in core areas of routing and switching, and in advanced technologies in areas such as Networks for Homes, IP Telephony, Optical, Security, Storage and Wireless LANs.

Currently, with more than 37,050 employees around the world and thanks to the intelligent network services incorporated in its products, Cisco continues to create faster, smarter, and longer-lasting networks, with a generational focus regarding an increasingly evolving infrastructure.

Aside from hardware and software products, Cisco offers its clients a wide range of services, including technical support and state-of-the-art services. Cisco sells its products and services both directly – through its own sales force – and indirectly – through its channel partners, to large companies, small and medium-sized businesses, service providers and final clients (consumption). Cisco emphasizes on three major areas: core technologies (routing and switching), service providers market, and cutting-edge technologies markets.

Cisco has been recognized as a pioneer in using the Internet for its own business practices, providing consultancy services to other organizations around the world through its Internet Business Solutions Group. During 2003, Cisco saved more than US$2.1 billion dollars by using Internet-based solutions to provide support and training to its clients, and carry out finances and manufacturing processes administration.

Cisco started operations in Costa Rica in 1996, with only two staff members, under the name of Cisco Systems Costa Rica S.A.. One of the staff members was an Electrical Engineer and the other one was a Systems Engineer. Currently, this office has arround 20 workers.Cisco's office in Costa Rica operates as the headquarters for Central America. Its service areas are: sales, technical support and marketing. The first *Enterprise* laboratory of the region of this type is in Costa Rica, and it provides fast access to the newest technologies available in Internet networks. The investment in this laboratory is up to a couple of million dollars and it is aimed at clients, channel partners, and students throughout Central America.

Cisco Networking Academy Program is an educational program created by Cisco to help provide skills in Information and Communications Technologies (ICTs), thus showing its commitment to the countries' development and corporate social responsibility. The program is carried out jointly with government, public and private education institutions, non-governmental (NGO) and international organizations, and leading enterprises in the industry.

Cisco Networking Academy trains its students on skills to design, create and maintain computer networks, so that they acquire the necessary skills needed for IT related jobs and to pursue recognized certifications in the ICTs industry, in response to the market's requirements, which gives them a clear competitive advantage.

After they take the program, young people can perform their duties in network-, Internet- and computer-related jobs, and they can also pursue higher education careers in engineering, computer sciences, and related fields.

The Cisco Networking Academy was created in 1997 after some engineers of the firm – who were working to connect a group of USA colleges into a network – realized that it was necessary to train students and professors so they could give maintenance to the solution after it was implemented. The formalization of a complete curriculum on data networks and its education model via e-learning, adding in-person and practical laboratory sessions, gave way to the program which to date has trained more than two million students around the world.

Since it was established in Costa Rica in 1999, the Cisco Networking Academy has become one of the main points of entry to education in information technologies in the country, introducing students to the human resource platform that the country requires to be more competitive.

In Costa Rica Cisco has provided the program to 15 public and private educational institutions, including the Costa Rican Technological Institute, the University of Costa Rica, the Omar Dengo Foundation, the Latin American University on Science and Technology, the National University, and the InterAmerican University. In conversations, not confirmed yet, the INA (National Learning Institute) will be included in the program, and it will be receiving the same support.

Since implementation began, 6,834[23] Costa Rican students have participated in the program. Currently, 1,656[24] are taking courses such as Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional (CCNP), the Elementary course on Information Technology, and Security and Wireless Networks.

As Faustino Montes de Oca[25], Coordinator of the Regional Cisco Networking Academy at the Costa Rican Technological Institute said: "*The Cisco Networking Academy is a tool that gives many people an opportunity they did not have before to participate in the ICT sector, and to improve their employability, producing a positive impact on family finances, and, in turn, on the local economy. The digital divide has become a problem that not only affects our generation, but also represents a difficulty for the country's and the world's future. For this reason, this initiative constitutes, without a doubt, a great contribution to bridging the divide, while at the same time assisting Costa Rica to become more competitive, from a training perspective, in attracting foreign investment."*

Cisco' participation in improving certain public education programs, as well as in training its own employees, has brought about positive impacts for the Costa Rican economy, such as an increase in availability of qualified human resources. For example, it is worth noting that many other Costa Rican workers have benefited from the Cisco

[23] Data as of July 6, 2006.
[24] Data as of July 1, 2006.
[25] Interviewed as part of this research

Networking Academy Program, because the country has become relatively successful in attracting new MNCs that require the type of professionals trained through this program[26].

The previous discussion makes it clear that the three MNCs studied are interested in helping Costa Rica to face some of the main challenges discussed in Section 3, regarding the shortfall of some skills in this country's labor force. These MNCs have chosen a direct approach to support skills development and training by the Costa Rican educational system. They have sponsored training of teachers to improve their skills in the areas of sciences and technology. Additionally, they have implemented some special programs in both elementary and secondary schools, in order to enable young generations of Costa Ricans to adopt ICTs. They have also supported improvements in the infrastructure of the educational system granting computers and other ICT equipment to elementary and secondary-schools as well as to universities. Finally, due to their increasing demand for more qualified labor force, the MNCs have promoted changes in both the number of technical education institutions and the number of students enrolled in engineering-related careers. It may be concluded that the three MNCs analyzed have been directly and indirectly involved in promoting changes in the Costa Rica educational system, thus contributing to the country's successful transition into the knowledge-based economy.

b. Human resource policies

Aside from promoting changes in the Costa Rican educational system discussed in the previous section, Intel, Microsoft and Cisco, have always been involved in the development of their workers' skills, through training programs both inside and outside the firms.

Intel Costa Rica

The most outstanding feature of the skills development and training program of Intel Costa Rica is its vision of a *lifelong learning process*. This process involves three clearly defined types of training, with some overlaps between them, during the time a worker is employed by Intel. The first one consists of 40 hours of training on Intel's values, and it must be taken by all employees when they start working for the firm, plus a *job training plan* that new employees draw up together with their bosses, including the training they will need in order to acquire the required skills to perform their duties in the position for which they were hired. This training may include courses, tasks and even temporary relocation of employees to other Intel plants outside the country (for up to two years).

The second type of training consists of *specific training* when employees' positions within the firm change, or as part of the continued training they require as a result of the rapid technological changes that take place in the electronics sector at a global level – as a rule every 18 months. Just as for the job training plan, temporary tasks and relocations

[26] An example is Sykes Company, a human resources services provider that operates in the country.

may be involved.[27] The third and last type of training is the i*ndividual development plan* – an instrument to help employees design and execute a training plan that will allow them reach their goals, according to where they see themselves within the firm's organization in the medium term.

As indicated previously, for employees to reach their proposed goals in the various categories of the training and skills development programs, the firm uses two training methods: (i) on-the-job training and (ii) off-the-job training. For off-the-job training Intel has a policy to subsidize university studies of its employees, as long as they are related to the firm's productive activity. For instance, Intel covers up to 50% of the enrollment cost and materials (books) for employees who want to pursue their careers at the University of Costa Rica and the Costa Rican Technological Institute. Regarding language training, specifically English and Portuguese, Intel Costa Rica covers the total cost of its employees' courses, and even allows them to use part of their work time to attend classes.

With respect to wages, it is important to point out that as of December 2005, the average monthly wage for Intel employees was US$836, while the average wage for employees in the manufacturing sector was US$491. As pointed out by Monge *et al.* (2005), this is due to the fact that Components Intel of Costa Rica hires professionals with higher education levels (out of the 3,400 workers the firm had at that time, more than 1,530 were professional employees – most of them engineers), and also because of the sharp competition in the productive sector for human resources of this kind. Indeed, the authors found that 36.2% of managers, 27.6% of engineers, and 31.0% of technicians working for Costa Rican local suppliers had previously worked in MNCs in this country.

Microsoft Costa Rica

In Microsoft Costa Rica, it is a policy of the company to provide permanent training to its employees, allowing them to adapt to the constant technological changes.

Microsoft Costa Rica has a MCS (Microsoft Consulting Services) program, especially designed for employees and personnel of Microsoft-certified companies. MCS offers highly qualified staff with technical skills and knowledge of the industry to help the companies take advantage of their ICT investments, such as e-commerce, planning of business applications, architecture of distributed computing, etc.

It is important to mention that Microsoft Corp. chose Costa Rica as beneficiary of its community assistance program for the third time during the last two years, because of the quality of the projects. The process of choosing a country to receive help is not simple, because many Latin American countries compete for this assistance, and a software company chooses those that offer more guarantees for a return on the investment.

[27] For instance, in 2005, more than 270 Costa Rican engineers were sent to other Intel plants around the World to receive training and then return to Costa Rica. This figure represents more than one-quarter of the total number of engineers hired by Intel Costa Rica.

Cisco

Cisco training policies for its employees in Costa Rica are not very different from those used by Intel Costa Rica and Microsoft Costa Rica, previously described. Two procedures are used in this training: E-learning training and New Hiring training. In the engineering and commercial areas training consists of Lifelong learning, which is necessary because of the constant changes in the ICT sector.

Its training plans are on-the-job and off-the-job, and depend on guidelines from Cisco headquarters. In fact, there are guidelines in place, and training plans must be part of every employee's development plans. Moreover, Cisco has a very strong philosophy which requires that each employee must seek his/her own development, for which Cisco will provide the tools they need. It is considered a responsibility of each employee to take advantage of the training options available in each area.

It is worth mentioning efforts made by MNCs efforts to improve the skills of their labor force in Costa Rica have generated important results, not only for themselves, but also for Costa Rica. In the first case, it was possible for Intel´s plant in Costa Rica to make the Titanium server and three other Xeon™ servers during the first six months of 2007. This plant has also participated in the design and development of testing equipment and programs, unit assembling processes, assembly technologies and complex laboratories to detect flaws[28]. These examples show that Components Intel of Costa Rica has reached a high level of productivity characterized by the capability of its employees to assemble and test complex products.

On the other hand, the Costa Rican economy could be benefiting by the transfer of knowledge from MNCs. Although training received by MNCs´ employees is to a certain degree specific to the firm, at least part of that training may become a positive externality for the rest of the country's economy, when some employees leave the firm to work in other MNCs or local businesses in the country (spillover effect), or when they leave to establish their own business in an area related to their former work (spin-off effect).

Although there is not enough data to conduct an analysis of the impact generated by the operation of MNCs in the country, 13 interviews carried out with former Intel employees in Costa Rica make it clear. For instance, all of them stated that training received at Intel allowed them to improve their performance in their new jobs, and also to improve their wages. Two of these former employees indicated that they started their own business after they left Intel, one of them immediately after leaving, while the other one did it several years later. On the other hand, only a small amount of Microsoft or Cisco employees have left the firm during the last ten years, and it was not possible to find evidence to determine whether former Microsoft Costa Rica or Cisco employees have moved to other MNCs or local companies to work there, bringing with them the knowledge acquired during their employment in these MNCs (spillover effect), or have

[28] See the weekly publication El Financiero, 591, November 13-19, 2006

set up their own companies to sell services to Microsoft Costa Rica, Cisco or to other firms (spin-off). It is clear that a rigorous research must be undertaken in order to determine whether MNCs´ efforts to improve the skills of their employees in Costa Rica are indeed producing spillover and spin-off effects for the rest of the economy.

In spite of the efforts made by MNCs to promote positive changes in the Costa Rican educational system and in the skills of their own labor force, it is important to recognize that a shortage of highly educated labor force prevent MNCs established in Costa Rica to engage in research and development activities (R&D). That is, the insufficiency of highly trained staff, with doctoral degrees is a shortfall that Costa Rica has to deal with in order to participate in more value-added activities of MNCs . Indeed, during interviews carried out with MNCs' representatives they indicated that there are not enough PhDs in Costa Rica.

The shortage of highly educated personnel with PhDs is making it difficult for other MNCs to carry out R&D activities in Costa Rica. In fact, in Cisco, Federico Zuccarino[29] declared that a lot of the R&D of the company is carried out in India, and that for the time being, the firm does not have any interest in establishing a R&D group in Costa Rica. Something similar is happening with Microsoft, where according to Claudia Toledo[30], although there is a plan to install research centers in Latin America, Costa Rica is not necessarily one of the options.

5. Conclusion

Although Costa Rica has been successful in attracting FDI, as has been well documented elsewhere, there are still important challenges to overcome in the area of skills development and training, if this country is to continue being an attractive location for MNCs, and to support the development of more value-added activities by the MNCs already operating in the country. Moreover, for this country to make a successful transition towards a knowledge based-economy (KBE), it is important to raise awareness among people and organizations in different sectors (public, private and academic) – especially in education centers (high schools and technical-vocational institutions) – regarding training needs in KBE-related areas.

It is also important to strengthen relationships between universities and businesses in order to establish priorities regarding professional education, to help define careers that more closely respond to the demand of the productive sector, create more dynamic curricula, develop and implement on-line education, and so forth. Regarding researchers' production, especially at PhD level, universities must make a great effort to implement doctoral programs in computer sciences, electronics, physics, etc. Fortunately, some efforts are already being made in the country. For instance, the Universidad Latina de Costa Rica[31] is offering a doctoral program in computer sciences, while the Costa Rican

[29] He is the Systems Engineering Manger of Cisco for Central America.
[30] She is the Microsoft Academic Program Manager.
[31] This program is being taught in collaboration with the University of Alicante, Spain. It started in 2005 in Costa Rica and it currently has 18 students.

Technological Institute is analyzing the possibility of offering a PhD in Electronics soon[32].

Regarding efforts by MNCs in the ICT sector to support public training programs, as well as their own internal training, evidence has been presented to show that Intel Costa Rica, Microsoft Costa Rica and Cisco have made important contributions in this area; this is consistent with the international evidence discussed in Section 2. While there was not enough data to conduct an impact analysis of these contributions, the case study suggests a number of avenues for future enquiry in terms of the spillover and spin off-effects. For this reason, the authors recommend a more in-depth analysis in order to assess the extent to which Costa Rica can be presented as a successful case in getting knowledge spillovers from the operation of MNCs in the sector of electronics.

Based on the evidence presented here, it would seem that the three MNCs studied in this paper are operating in conformity with the ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy, especially because these MNCs have supported the development of a highly educated and vigorous labor force which has played a key role for the country to be successful in moving towards more sophisticated value-added activities, at least in the case of Intel, as well as in attracting new FDI inflows.

[32] The possibility to open a doctoral degree in electronics at the ITCR's Department of Electronics is being considered.

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