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Human resource development policy in the context of software exports: case evidence from Costa Rica

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Abstract: Software industry development is acknowledged as an important engine of economic growth for many less developed countries. The role of national policy has been identified by various researchers as a catalyst to software industry and software exports development. Software development is a service that is both labour and knowledge-intensive, and thus an important aspect of related policy is concerned with the provision of appropriately educated and trained human resources in sufficient quantity. This paper provides an analysis of the human resources issues facing policy makers in less developed countries engaged in software exports policy formulation. The complexities are highlighted through the case study of Costa Rica, where there is an ongoing national strategic planning effort to increase software exports.

Key words: Costa Rica, software industry, policy, human resources.

I Introduction
Software industry development is acknowledged as an important engine of economic growth (Kambhampati, 2002). Recognizing this potential, stakeholders in many Developing and Transitional Economies (DTEs) have become actively interested in developing the software industry sector, particularly its exports potential (Carmel, 2003; Al-Jaghoub, 2004). High-profile success stories of India and Ireland have contributed to this growth in interest. The Indian IT industry has grown its revenue ten fold in the past decade, from US$ 4.8 billion in financial year 1997–98 to US$ 47.8 billion in financial year 2006–07. Its contribution to India’s Gross Domestic Product is estimated to have grown from 1.2 percent to 5.4 percent in the same period. (Nasscom 2007). Similarly, in Ireland there was more than a doubling of the number of
software firms (291 to 690) during the 1990s. The growth in both countries had significant implications for employment generation; for example, according to the Indian software and IT enabled services (ITES) industry Nasscom, in 2005–06 the combined software-ITES industry employed more than one million (NASSCOM, 2006). The growth in the software sector in India has contributed to productivity spillovers in other service companies and demonstration effects to other sectors, for example the local government (Arora et al., 2001).

The role of national policy has been identified as an important driver of the software industry and software exports development in both DTEs and developed country contexts. For example, Kambhampati (2002) describes the important role of policy measures in India. Watson and Myers (2001) discuss how policy has stimulated growth in Finland’s software industry. Policy formulation is concerned with the creation of an interconnected network of institutions, legislation, infrastructure, human resources, markets and finance. An important aim of policy, especially in DTEs, is to identify the export niche(s) in which the industry can operate and be cultivated. This must take into account domestic strengths and weaknesses, global competition, and the dynamic nature of global demand. Policy frameworks have contributed to shaping industry trajectories, for example the focus on products in Israel, foreign direct investments in Ireland, and on software services in India.

Prior research has pointed to the need to strengthen links between a country’s software exports and strengths in telecommunications and human resources (Ein Dor et al., 1997; Watson and Myers, 2001; Carmel, 2003; Heeks and Nicholson, 2004). Software development is both labour and knowledge-intensive; thus, an important aspect of policy concerns the creation of appropriately educated and trained human resources in sufficient numbers (Carmel, 2003; Heeks and Nicholson, 2004). For example, Ireland consciously took measures to increase their computer science graduates. India has historically capitalized on large numbers of qualified staff at relatively low cost to satisfy the skills shortages of clients primarily in the USA, and increasingly in Europe. In addition to increasing the numbers of computer science graduates, many training institutes (like NIIT and Aptech) have also developed their capacities to offer large-scale training programmes in an attempt to fill the demand-supply gaps. While there are important lessons for policy makers in aspirant new entrant software export countries, they need to recognize that the initial conditions that India and Ireland’s software industry development experienced in the early to mid-1980s were characterized by very different exogenous and endogenous features than the contemporary situation. During the 1990s, IT skills shortages meant that the strategy for human resources could be based on quantity at low cost. The 2008 scenario is characterized by a demand for greater levels of sophistication, requiring skills of product development, project management and cross-cultural sensitivity; and there is also a larger pool of countries and firms to choose from. Along with these challenges, there are also increased opportunities as global software outsourcing has become largely normalized as a business practice, as contrasted to the situation in the 1980s (Sahay et al., 2003). There are presently many more firms and countries looking for offshore suppliers and relatively fewer barriers to entry, for instance those related to visas and immigration laws, as seen in Germany’s Green Card scheme. Supporting the creation of an appropriate ‘educational capital’ is a challenge for policy makers to address, so as to enable software industry firms to exploit the emerging opportunities and attract foreign investment. However, many developing countries are constrained by lack of access to computers and the Internet, English literacy, and an educational curriculum that often tends to emphasize technical skills over critical thinking and management competencies (Kambhampati, 2002: 25).
The aim of this paper is to analyse some of the complexities DTEs face in software exports policy formulation with an explicit focus on human resources. These complexities are highlighted through the case study of Costa Rica, a nation where a national strategy process is underway to strengthen its software export sector. The authors were part of the strategy formulation process and report from that experience. The learning gained from this analysis can provide insights to other countries at a similar stage as Costa Rica in order to evaluate their strategic options with respect to human resource issues.

The rest of the paper is organized as follows: in the next section, we present an analytical framework related to software exports policy, with explicit focus on the role of human resources in strengthening this process. In section 3, the action research methodology adopted in constructing this case study is presented. This is followed by a description of the case study and its analysis (in section 4). Finally, in section 5, a summary and some implications are presented.

II Literature review and analytical framework

A starting point for our analysis is based on the Software Export Success Model (SESM) (Heeks and Nicholson, 2004). This exploratory framework was initially developed based on a review of the relevant literature from development theory (Porter, 1998), and a literature search of offshore software exports policy frameworks (see, for instance, Schwar, 1992; Correa, 1996; Ein Dor et al., 1997). An analytical framework seeks to identify, in a descriptive mode, conditions (such as industry best practices) that are crucial in defining software exports. This contrasts with the prominent aim of a theoretical framework to develop causal explanations and based on it statistical generalization. An analysis of the experiences of Ireland, India and Israel helped to identify important ‘success factors’, which were grouped into analytical categories considered central to software industry exports development. Using secondary data, this framework was subsequently applied to the analysis of three ‘second-tier’ nations: Russia, China and the Philippines. The framework was subsequently used empirically for the analysis of the software sector, and to develop recommendations for policy development in Iran (Nicholson and Sahay, 2003). In Costa Rica, this framework helped to identify the various elements that need to be considered in the development of a software exports policy.

The framework is comprised of five interrelated layers of analysis consisting of national software vision and strategy, national software demand, national software-related inputs, national software industry, and international demand. Each layer contains a set of factors or issues derived from a content analysis of selected secondary literature, including theoretical papers, empirical field studies and consultancy reports. This is combined with the authors’ own empirical experiences spanning the last 10 years of research in firm-level offshoring relationships to derive the central tenets of success in the development of software exports in successful nations.

In this framework, the national vision concerns the government’s policy-making organization or the industry association’s ‘vision of what software could achieve for the country, a vision shared by a relatively small but committed group of government officials and private entrepreneurs’ (Heeks and Nicholson, 2004: 274). Policy emphasis varies in different countries, and there are also differences in how closely the government tries to intervene. While China has developed formalized, targeted, industry-specific policies within the 10th five-year plan, Brazil has stimulated their industry through procurement and R&D incentives (Arora and Gambardella, 2005: 287). Both these countries present examples of more explicit policy intervention involving mechanisms such as protectionism, import substitution, export promotion; export
subsidies, preferential loans, management assistance, etc. (Carmel, 2003). In contrast, the Indian industry has developed with less explicit government intervention and the adoption of a more laissez faire attitude. However, Kambhampati (2002) points to some specific policies and areas of government intervention, such as the provision of tax breaks and the establishment of software technology parks.

Another aspect of the framework, national software demand, is described as a potential catalyst for export growth, which draws on competence gained through domestic projects. However, the lack of an adequate profitable domestic demand may cause entrepreneurs to consider export opportunities. The national software related inputs is the layer that illustrates the ‘tapestry of domestic infrastructure that supports and enables software exports’ (Heeks and Nicholson: 278). This is comprised of five areas of interest including people, technology, access to finance, research and development, and the transportation and legal infrastructure that enables reliable contracting. These factors are important inputs to the national software industry layer, which is concerned with the characteristics of the industry, concentration of large firms, competition between firms; clustering and collaboration. The foremost

Figure 1  The software export success model (Heeks and Nicholson, 2004)
layer of analysis is the nature of global demand, which should influence the national software-sector strategy. Effective expatriate and diplomatic linkages contribute to foreign clients and multinational firms, developing sufficient trust to establish relationships involving subsidiaries and outsourcing arrangements.

Given the aim of this paper, we focus on the particular issue of people, that is, human resources. The software industry in any country is human-resource intensive, and is shaped by various issues including scale, costs, skills (technical and managerial) and availability. Carmel (2003) points out that a nation’s software labour pool is not homogenous, and consists of a ‘spectrum of labour’, implying the varying skills and qualities of human resources. The high end of this spectrum consists of capable individuals, known in industry parlance as ‘talent’, with critical thinking and problem-solving abilities related to customization of IS development projects, analysis and design, project management activities, and the development of technical products. The lower end of the spectrum represents those with skills that can be learned in a relatively short period of time, such as rudimentary programming. Such skills can be effectively imparted through short-term diplomas offered through training institutes, rather than through longer-term university degree programmes.

Heeks and Nicholson (2004) emphasize the foundational role of skilled and talented staff in developing software exports. An implication of this is the need for policy makers to focus on establishing and strengthening the explicit interlinkages between projections of global demand and the curriculum changes required in university mandates. Furthermore, this also raises the need to develop tighter university-industry linkages. However, effectively establishing these linkages between global demand, university directions and local industry is subject to critique, as past projections of labour shortages have been erroneous (Barr and Tessler, 1998).

Successful software export nations tend to cater to a wider ‘spectrum’ of skills, and develop concomitant human resource development strategies. The cases of three successful nations in this regard, India, Israel and Ireland, are now briefly described.

1 India: focus on scale and skills
The majority of software development work up to the early 1990s was of the type derogatively termed ‘body-shopping’, whereby Indian developers would travel to the client site (mostly in the USA) for the length of the project. Work tended to be at the lower end of the skill spectrum, such as coding and maintenance. A key challenge here concerned scale, of providing large numbers of people to perform such lower-end tasks. With time, the international demand shifted to undertaking more complex and higher value-added work. There was an increased demand for higher spectrum skills, for example the knowledge of foreign languages and project management. Therefore, the Indian government and the national software association (NASSCOM), as a part of their national software vision and strategy, sought to develop policy measures to address these two facets of increased quantity, as well as the higher spectrum skills of human resources. Kambhampati (2002) describes how the 1997 IT Taskforce, ‘Operation Knowledge’, recommended improved IT education in schools, and the need for the Indian Institutes of Technology and Science to triple their output of students. The industry tried to meet this challenge by recruiting engineering (for example, mechanical, electrical and civil) rather than only computer graduates for software jobs. A number of universities also designed Masters, Diploma and subsequently Bachelor-level courses in computer applications (MCA, DCA and BCA respectively). Training institutes such as NIIT and Aptech played an important role in providing skill-based training (in Java, for example), which contributed to fill to some extent the gap caused by the
inertia of university bureaucracy to revise their curriculum in line with fast changing industry demands.

NASSCOM, through increased advocacy, sought to stimulate the development of higher education programmes. These were particularly geared to the ‘high spectrum’ needs of global software work including project management, marketing, finance and team-working in conditions of cultural, temporal and spatial diversity. However, such programmes remain in short supply in India, with few exceptions such as the Software Enterprise Management graduate course offered by the Indian Institute of Management, Bangalore. This programme was initiated in 2002 with endowments from ‘partner firms’, and is designed to meet the specific needs of working professionals from the Indian Software Industry. Senior officials from these partner firms served on the advisory board to enable better linkages between theory and practice. This weekend-based programme has been designed in a way such that a participant can graduate with the diploma at the end of three academic years, while continuing to work at his/her regular place of employment.

2 Israel: focus on software products and R&D networks

Israel’s national software industry specialization in products for Internet security and the telecommunication sector was fuelled by military-trained computing graduates who, after completing their service, entered a flourishing civilian computing sector. Military service helped to augment high-spectrum technical and business skills, while the military context also helped to develop leadership and communication qualities at a relatively young age, crucial for creating start-up firms (de Fontenay and Carmel, 2001). Jewish immigrants, who came from the Soviet Union between 1989 and 1991 with high-spectrum scientific expertise, provided another engine of human resource growth, supported by the government’s policy and priority on education with a focus on science and technology. The Israel Institute of Technology is one of the largest computer science departments in the world, and caters to the demands for ‘high spectrum’ computer science graduates in both numbers and quality. Research institutions were provided with significant incentives to form linkages with industry, and the curriculum content was redesigned keeping in mind the criteria of relevance to the private sector. This helped to create a vibrant structure to move from ‘invention to innovation’, as exemplified through the collaborative R&D networks developed through the Yozma program, and the Bi-national Industrial Research and Development Foundation (BIRD), established in 1977 in collaboration with the United States (DeFontenay and Carmel, 2001).

3 Ireland: focus on a multinational driven human resource strategy

O’Riain (1997) traces the Foreign Direct Investment (FDI)-driven growth of the Irish software industry after 1973, when major multinational corporations were attracted by the Irish Industrial Development Authority’s policies of financial incentives, and significant investment in education and telecommunications. Unlike India, Ireland avoided reliance on contract programming or body-shopping, and instead provided various incentives to large multinationals such as Anderson Consulting, Intel, Digital, SAP, Sun Microsystems, Ericsson and Prudential Insurance to locate in Ireland. This relocation was made possible by the ready availability of high-spectrum skilled staff. Heavin and Fitzgerald (2004) point out that certain commentators have described the software industry development in Ireland as largely a result of good fortune rather than that of a vision and predefined strategy. However, policy measures such as favourable tax rates demonstrate the recognition of Ireland’s emerging position within EU, politically as
well as geographically. The realization of the potential of the software industry was accompanied by an emergent software sector vision, which was supported by focused education policies. Trauth (1999) discusses the specifics of how the Irish educational system was aligned with the skills needed by the ‘handpicked’ multinational companies. A policy of equality of access to education was established in 1968, and two new universities were created in the 1970s and 1980s with a primarily technical and vocational curriculum. Traditional universities were also adapted to incorporate business and IT skills needs into the curricula, and further new technical colleges as well as adult evening classes were established around the country. The government also sponsored training programmes for those with a University degree, but without requisite skills for gaining work in the IT sector. These focused attempts by the Irish government to scale up the numbers and capacities of computer-science education was also accompanied by attempts to support diversity through the establishment of joint degrees, where computing was combined with foreign languages. Incentives were also provided to attract the Irish diaspora to return to their home country, especially from North America.

The three brief examples presented above emphasize the variations in human resources strategies with industry focus, national priorities, and geopolitical conditions. In Table 1, we categorize the kind of skills required at the low versus the high-spectrum end, and identify the specific policy initiatives taken by the three countries discussed above. While these linkages interpreted by us can be useful pointers for developing strategic directions, the different historical conditions within which these have been derived needs to be sensitively understood and accordingly adapted. We discuss this in relation to our empirical investigation in Costa Rica.

### III Methodology: an action research approach

Our involvement in this project was initiated in 2002, when we were invited to participate as consultants in the Costa Rican national initiative to develop a strategy for software exports. We participated in an ‘action research’ framework (Baskerville and Wood Harper, 1996), where we were expected to help in the formulation and evaluation of the national strategy. The starting point of our efforts (the problem definition phase) was the development of a plan for empirical work after conducting a literature search of the Costa Rican software industry to identify the current state, the key stakeholders, and the particular technological and geographical focus of the industry. The

<table>
<thead>
<tr>
<th>Skills typology</th>
<th>Role</th>
<th>Human Resource Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>High spectrum</td>
<td>Project manager</td>
<td>University–R&amp;D Linkages</td>
</tr>
<tr>
<td></td>
<td>Business analyst</td>
<td>University–private sector linkages</td>
</tr>
<tr>
<td></td>
<td>Systems analyst</td>
<td>Joint degrees</td>
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<td></td>
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<td>Focused incentives</td>
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<tr>
<td></td>
<td></td>
<td>Attracting diaspora</td>
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<tr>
<td></td>
<td></td>
<td>Enhancing numbers, quality and capacity of computer science programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foreign languages</td>
</tr>
<tr>
<td>Low spectrum</td>
<td>Coding</td>
<td>Computer language training</td>
</tr>
<tr>
<td></td>
<td>Testing</td>
<td>Role of private training institutions</td>
</tr>
<tr>
<td></td>
<td>Data processing</td>
<td>Increasing number of colleges and programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Attracting graduates from non-computer science backgrounds</td>
</tr>
</tbody>
</table>
authors visited San Jose for four weeks in August-September 2003. Semi-structured interviews were normally conducted in the workspace of the respondent, often involving Spanish-English translators when the need arose. In addition to the interviews, in line with our action research approach, two focus group sessions were also conducted, one with representatives from the private sector and the other with university staff. In these focus groups, discussions were held on issues involving multi-stakeholder relationships, such as university-private sector linkages, and problematic relations between small and medium firms with financial institutions. Another key intervention was in the form of a large national-level workshop conducted on the topic of global trends in the software sector, bringing together various stakeholders in order to provide a broader awareness of the multiple inter-institutional issues, gain their ‘buy in’ to the strategy formulation process, and elicit their suggestions on the specific initiatives to be taken. Furthermore, we conducted three smaller workshops on themes identified through our problem identification process, focusing particularly on policy formulation and implementation. To follow up on the impacts of our action interventions, in mid-2005, nearly two years after our initial actions, four interviews were conducted using audio conferencing, specifically to understand the challenges of implementing the specific policy directions that we had recommended in 2003.

One of the authors of this paper returned to Costa Rica in March 2006 to present at a software industry conference, part of which was dedicated to reflection on progress with the software export promotion strategy. During this time, six further interviews were undertaken with key stakeholders to bring us up-to-date with events and the effectiveness of the strategy so far, and identify further future measures. In Table 2, the various sources of data collection over time are summarized.

The meetings, workshops and interviews were mostly conducted in English, and when the respondents preferred to discuss the issues in Spanish, the services of a local translator were drawn upon. During the national-level workshop and one of the smaller workshops, professional simultaneous translation was provided.

In addition to these primary sources of data collection, various secondary data sources, such as industry reports, organization brochures and websites, industry statistics, etc., were analysed to gain an understanding of other related institutional aspects.

![Table 2 Summary of data collection sources](http://pdj.sagepub.com)

<table>
<thead>
<tr>
<th>Data collection mechanism</th>
<th>2003</th>
<th>2005</th>
<th>2006</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Interviews (co-present)</td>
<td>18</td>
<td>6</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Interviews (telephonic)</td>
<td>4</td>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Focus Groups</td>
<td>2</td>
<td>2</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Workshops</td>
<td>4</td>
<td></td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

The Software Exports Success Model (Heeks and Nicholson, 2004) guided the initial phase of data collection. Data analysis was further enriched through a process of extensive discussion between the authors and the various stakeholders, in which we shared with them our opinions and findings, and gained their feedback and further comments. A report was presented to the agency which had commissioned the study in 2003, which provided the bedrock for the articulation of the national strategy. Feedback received on it from various stakeholders provided further useful inputs to the analysis and framing of this paper.

In our work with the Costa Rican planners, we tried to facilitate the process by informing and setting up task force groups of stakeholders from the various organizations (private and public universities, trade facilitation organizations, banks and financiers,
telecommunications providers, software firms, the software association, and policy makers). These individuals have been tasked with systematically analysing the problems and making recommendations to policy makers for change.

IV Case study and analysis
The Costa Rican software industry is relatively recent, and in 2002 consisted of approximately 100 firms, 75 percent of which could be classified as small and micro-firms, implying that nearly two-thirds of the firms have less than 20 employees, and only 5 percent have more than 100 employees. The overall revenue of the industry was estimated in 2002 to be at about US$ 170 million, about 60 percent of which was exports primarily to Central America and Mexico. The software sector employed between 3,500–3,700 persons, the majority of whom are graduates from public universities. The software sector gained significant global publicity when the IT giant Intel established a development unit in San Jose, enabled through the direct involvement of the Costa Rican President (Ketelhoehn and Porter, 2002).

With respect to human resources, our analysis helped to identify a number of issues related to both quantity and quality, discussed below.

1 Quantity: the problem of scale
Micro-sized firms (10 to 20 persons) experience serious problems in scaling, especially as the owners need to adopt management roles in addition to the technical. This problem was described by a chief officer of a software firm who had grown over a decade from a ‘one-man in a garage’ start-up to about 100 people:

A challenge is when a company tries to move from micro (less than 10 people) to mini and small scale. The companies are not specialized to handle the management issues that arise and they don’t have the people to do that.

While growth in size often came with increased opportunities for exports, there was also the accompanying challenge of a lack of specialized human resources, for example related to financing and marketing. A manager of a small software company said:

We know it is easier to sell locally, because of geography. Only for large companies it is easier to sell overseas because they have the money. We have problems in marketing, as we do not have the resources to hire specialized managers. Maybe we can have system of mentoring.

IT parks or clusters which allow for an aggregation of geographically co-located software firms, as seen from the examples of the Silicon Valley in the US and Bangalore in India, enable the sharing of knowledge, experience and resources. Also, clustering IT firms alongside universities, such as in the high-tech city cluster of Hyderabad, or with priority sectors such as biotech or new materials, provide the potential for the development of cutting-edge applications and resultant patents at appropriate levels of scale. The increased scale that a cluster naturally provides allows firms to share resources for common activities like training or quality control, which in the longer run could potentially contribute to developing human resource capacities. In Costa Rica, such IT clusters did not exist, and this further magnified the problems of scale.

Being a small country, with a limited annual supply of graduates to the industry pool, Costa Rica suffers from inherent challenges – for instance, supporting the large-scale needs of people required for IT-enabled services such as call centres, and other back-office operations. Boeing considered San Jose for a call centre, but subsequently decided to locate to Colombia because of concerns over the difficulty in employing sufficient numbers (in excess of 500) of trained people in Costa Rica.

2 Quality of human resources
Quality is crucial, given the knowledge-intensive nature of software development activity. The potential to export is dependent
on the quality of the university graduates who enter the workforce. Three key quality-related issues identified through the task force on university-industry linkages identified in the task-force deliberations were:

- Weak university-private sector linkages;
- Poor English language capabilities; and
- Inadequate management capabilities of the technical staff.

Weak university-private sector linkages Contributing to the weak linkages were a number of factors, including poor intellectual property (IP) laws, the inertia of the university structure in responding to industry demands, a weak culture of applied research, and a lack of critical mass of researchers interested in studying software exports-related processes. A senior manager of a private-sector firm described how the links between his company and the university were steadily decreasing because of issues of weak laws (of IP protection), inadequate funding, and an absence of researchers to engage in applied studies:

> The intellectual property laws are poor and it is hard to keep secrets as there are no patents. Strange things can happen in the University. While we are interested in applied research, we do not have the funds to support long-term research. So, we are looking at applied student internships rather than PhD kind of research.

However, while student internships were relatively easy to establish, they were difficult to sustain because of their short-term nature. A manager of a small firm described this problem:

> Interns need a lot of supervision, and by the time they become able to contribute, they are ready to leave. It was different with some interns we had from Canada; they were ready to contribute right from the start.

While it appeared that interns from foreign universities like Canada were better equipped than the local students in terms of the skills needed to contribute to the work of the companies, there were limited formalized and institutionalized structures within the universities to sustain these linkages. Furthermore, university laws made it difficult for private-sector people to use public resources (such as computers and rooms) in public universities. Dealing with these irritants was very frustrating for private-sector industry people, who were used to ‘getting on with things’ efficiently. A private-sector manager described his frustration as follows:

> The linkage (university-private sector) does not exist. While the public universities are the best, they are very difficult to link up with. They set a lot of limits. They have created foundations to be like intermediaries, but they really don’t get on well with the companies. What we would really like to have is research on what the rules are in the university and to document them and give to the companies. If we ask CENAT (the University governing body) to do that, it will take years before anything is done.

Another manager echoed similar thoughts:

> I can think of many projects but what are the rules of engagement and also who would I pay and what will happen with the intellectual property.

The university policy of ‘theoretical work takes precedence over applied’ also contributed to widening the divide between the university and the private sector, and as a result no effective interface existed for firms on which to approach universities to deal with their research inquiries. A senior public university researcher told us:

> There is a lack of culture (in the universities) in research and development, because both the academic programmes and also the professors do not promote the culture. We cannot change anything until the culture is changed. We have to also make the research more applied and work more closely with the software firms.

Another senior university staff member echoed similar challenges:

> The factors which do not help to create a union between firms and universities are:
no culture or conscience to spend money on research, no incentive from government to industry to support research, the universities have limited budgets that limit research; our buildings, laboratories and equipment are all obsolete. There is a lack of maturity in professors to learn and do research. We do not have a critical mass of researchers.

The problem of a lack of critical mass of computer science researchers was also emphasized by another senior Professor, who contrasted the situation between Computer Science and his own field of Biological Sciences. In the latter, the existence of a critical mass of researchers in the department had been successful in furthering their research agenda. Since a similar culture was weak in the Computer Science department, there were no significant grant proposals being written by their faculty, which contributed to a ‘vicious circle’ of zero research funds, leading to additional teaching loads and, consequently, few opportunities to write grant proposals. As a consequence, there were no Computer Science research centres in any Costa Rican university, in direct contrast to the situation in the biotechnology area.

Public universities, as is the case in many developing countries, are poorly resourced and provide little incentive to do research. Poorly paid staff preferred consultancy projects to research. While efforts like internships, company sponsored research, etc., are useful in bringing about change, they are still not capable of changing institutional conditions such as the poor salary of staff, lack of time allocated to research, and the division between research and teaching work in the departments. A senior staff member in a public university lamented this problem:

The problem is that historically the public universities have very little resources, and because of that we cannot do research. We are doing our best, but that is not good enough to do quality research. So, what we need is more budgets to hire more people, and more incentives for doing research.

3 Poor English language capabilities

English language capabilities are a vital resource for software people working on global projects, the more so given that the primary market focus is the USA. This skill was currently seen to be deficient by many respondents, including this senior manager of a private-sector firm, who told us:

We must improve our English proficiency.
It is good now, but it should be better. We should speak like a US citizen.

While English capability was not considered a universal problem in Costa Rica, it tended to be pronounced amongst technical staff, including computer scientists. Most of the good English-speaking people were seen to be working in the tourism or hotel industry. A software industry manager said:

You find good people with technical skills, but if bilingual, that’s where we find bad people. The people that go for tourism study English, and so they don’t have technical skills. If we look for 10 English speaking software engineers, we cannot find them.

Another university staff member had similar thoughts:

In computer science, students can read English because they read a lot of technical things in English. But they are not able to speak or to even write.

While it is possible to have large-scale programmes to develop English language capabilities, a paradox exists in that a bilingual workforce would magnify the already relatively expensive labour costs in Costa Rica compared to India. A senior industry manager told us:

We also have a language barrier. It would be hard to translate some of the products into English. We would need to make a change in the composition of the labour force to make them more bilingual, but that would make them more expensive.

4 Inadequate management capabilities

Another challenge of the existing educational system in Costa Rica was that people with
technical skills often had limited management skills like those related to marketing, human resources, project and finance. There were no University programmes aimed at developing management capabilities of practising executives. The lack of these management skills was seen as a crucial constraint to marketing products, operating in the global marketplace, and making financial decisions. In short, the workforce had limited ‘middle management’ capabilities, a point emphasized in the following quotes from two industry staff:

We are very weak in marketing skills, we have good technical people but they have no idea about the kind of questions that are asked when we go to sell the product.

I realized that software companies have good technicians but they don’t know much about marketing, managing or about intellectual property. So, a lot of companies were suffocated because they began with someone paying for a program, but there was no one to manage and so they were stuck.

Some attempts were being made by the government and private sector to try and address this challenge to develop management capabilities. The national software export organization, PROCOMER (Promotora Comercio Exterior de Costa Rica), had put in place schemes designed to improve competencies in conducting software exports in small and medium companies. A private university, Universidad Latina de Costa Rica (ULA TINA), had designed curriculum improvement in collaboration with the Inter American Development Bank-funded ‘Prosoftware’ programme, and identified gaps in the existing university programmes, especially for the middle management level. Centro de Formación en Tecnología de Información (CENFOTEC), another private institution established through a private-sector venture capital, was trying to bridge the gap between industry needs and the (slow) pace of university change by designing management skills courses for practising software staff. Another initiative had been undertaken by a consulting firm under a project financed by ICCI-2 (Costa Rican Initiative for International Competitiveness) to develop specific courses to increase human resource capacities related to financial and innovation issues. This same agency had also developed a year-long programme called ‘The bullet proof manager’ to develop a set of 24 soft-skills such as those related to communication and project management. In addition, reduced fees for ISO9000 and Capability Maturity Model training and accreditation had been introduced by PROCOMER. However, government efforts to introduce schemes for developing human resource capacities suffered because of the poor dissemination of information amongst the industry regarding these schemes. For example, one manager in a small firm told us that he was unaware of the government’s schemes to financially support executives wanting to take up distance education courses. Many software firms did not see the benefit of formal accreditation such as the ISO.

V Discussion and conclusions

In summary, with respect to human resources capability in Costa Rica, the following key points can be made:

- Costa Rica in general has a small labour pool and, compared to the major competition, at relatively high costs.
- The educational focus in Costa Rica is primarily on Computer Science, and information systems related management skills are generally weak.
- English speaking skills of the technical people in Costa Rica are generally weak.
- There are no technical training institutions aimed at providing software developers with technical skills in specialized areas like biotechnology and biodiversity. Both of these are key economic clusters in Costa Rica where developing linkages would be beneficial.
- Costa Rica lacks any diaspora returnees in any great numbers.
The linkages between university and industry are fragile.

The task force entrusted with developing university-industry linkages made a series of recommendations, some of them less difficult to implement than others. For instance, formal and informally stated beliefs about applied research and rules on the use of resources in public universities are historically institutionalized, and derived from political action and other priorities. Altering these priorities and institutions may ultimately require changes in formal constitutions and job descriptions. Changing such institutionalized practices requires commitment and clear incentives from all concerned. On the other hand, forming new ventures aligned to the strategic direction involving joint courses such as CENFOTEC would be relatively easier to implement, although there are undoubtedly resource constraints to be addressed. Attracting training organizations such as India’s NIIT to support these processes may also be a shorter-term strategy.

The Costa Rica case provides insights into the particular problems faced by many DTEs in developing the software industry as a vehicle for economic growth. Specifically, the case illustrates the limits of analytical frameworks such as that of Heeks and Nicholson (2004), which systematically presents routes to development as exemplified by successful software nations like India and Israel. Costa Rica’s size, population and institutional setting does not provide the quantity and quality of human resources to follow the Indian industry’s early growth trajectory of low spectrum, low price and high quantity. Instead, the early Costa Rican strategy efforts, focused on developing the high spectrum, presented several paradoxes and dilemmas. The country lacks focused research and development, and has no military context to provide the mechanisms for technology that Israel possessed. Efforts to adopt Ireland’s multinational-led strategy is hampered by la Coalición Costarricense de Iniciativas de Desarrollo ‘CINDE’, a private organization responsible for promoting foreign direct investment in Costa Rica. CINDE’s approach to attracting foreign direct investment is undirected by the government or any sector policy. CINDE was widely regarded by many in the task forces as seriously undermining the growth of the indigenous software cluster by attracting large foreign multinational firms, which compete for the increasingly scarce Costa Rican human resources.

Policy makers in Costa Rica and other DTEs, who desire entry to the software exports area, are forced to consider the exogenous environment in terms of the market trends of buyers and suppliers in different countries. With regard to the endogenous setting, the analysis shows how some aspects of the formal and informal institutions (North, 1990) may enable and constrain the development of routes to growth. In democratic Costa Rica, the policy-making process in the task forces is attempting to take into account and coordinate the multiple institutions and organizations involved in software exports with varying degrees of success. Future work will need to focus on the continuing process of software industry development, which will provide further insights into software industry development in small DTEs.

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