Information Technology Training in Developing Countries

A Case Study in Jamaica

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Abstract It is well known and well documented that there is a severe shortage of information technology professionals around the world. In an approach to address this shortage, Furman University in Greenville, South Carolina and the University of the West Indies in Kingston, Jamaica have developed a training program to help produce and sustain an information technology workforce in Jamaica. This paper describes the Caribbean Institute of Technology (CIT), a software training institute that was started in Jamaica in 1999. The institute consists of a main centre in Montego Bay and several satellite centres distributed across the island of Jamaica. These centres provide an intense ten-month training program for up to 100 Jamaicans at each site every year. The paper describes the organisation of the centres, the curriculum of the program, the co-operative efforts between Furman University and the University of the West Indies, and the future direction of CIT. Although this paper describes a case study within Jamaica, such an institute might well be duplicated in other developing countries.

1. BACKGROUND

An acute shortage of information technology (IT) workers is hampering the ability of companies to reach their potential in an information-based economy. For example, a recent survey indicates that almost 20 percent of

top U.S. executives cite the lack of skilled IT personnel as *the* most serious constraint on the growth of their business. In a 1997 report (U.S. Commerce 1997), the U.S. Department of Commerce projected that more than one million new information technology workers will be needed in the U.S. by the year 2005. A 1998 survey (ITAA 1998) by the Information Technology Association of America and Virginia Polytechnic University concluded that there were at that time more than 300,000 unfilled information technology jobs in large and mid-sized corporations in the U.S. today. Similar shortages in information technology workers have also been reported internationally (OECD 2000).

Further, the demand for IT workers appears to be mushrooming. In a more recent report released June 30, 1999 (U.S. Commerce 1999) on the challenges to expanding the IT work force, it is projected that 1.4 million more computer programmers, computer scientists, and engineers will be needed in the U.S. by 2003. In the same report, it is estimated that information technology accounted for 35 percent of U.S. economic growth in 1998.

The studies cited narrowly define the term information worker to include only programmers, systems analysts, and software engineers. When Web page designers, electronic commerce developers, database administrators, computer support specialists, and others are added to the list, the shortages are considerably higher.

There are at least three major factors contributing to the global shortage of IT workers:

- the rapid rate at which information technology changes and is integrated within business processes;
- the inability of colleges and universities to produce adequate numbers of educated IT workers; and
- the exclusion of a large segment of the global population from opportunities to fully participate in an information society.

Clearly the first factor is something over which we have little or no control. With regard to the second of these factors, all U.S. colleges and universities are producing only 25,000 computer science and information science baccalaureate graduates a year. Universities and colleges are simply not able to re-engineer themselves at the pace needed by corporations hiring new college graduates, meaning that this factor will not be an easy one to overcome. Indeed, we argue that addressing the information technology worker shortage will require fundamental changes in our approach to information technology education. The case study presented here describes one experiment of how this could be done. The focus of the approach described addresses the third of the above factors.

It seems natural that the identification and cultivation of new sources of human capital will assume an important role as we attempt to address the information worker shortage. Indeed, the combination of the importance of information technology to corporations competing in a knowledge-based economy and the severity of the shortage of information technology workers injects a crucial new parameter for economic development. In particular, those geographic regions that can produce and retain a supply of well-trained information technology workers will gain a competitive advantage over those that come up short in this important area.

Given the shortages described above, many major U.S. corporations have already looked offshore to India, the Philippines, and other locations to find scarce software development resources. Indeed, many have argued that the new information and communication technologies provide important opportunities for the developing world (e.g. Talero and Gaudette 1996). We agree that the magnitude of the global shortage of IT workers presents opportunities for other developing countries to establish IT industries, *provided* they can train an adequate number of high-quality IT workers. The case study we present focuses on a training program to produce such workers in Jamaica, but we believe the concept we have implemented will find usefulness in a number of additional locations.

2. A SOFTWARE TRAINING CENTER IN JAMAICA

Jamaica boasts a literate and conscientious workforce and the country has demonstrated its ability to adapt readily to modern industrial technologies. The Jamaica Digiport International (JDI), a joint venture between AT&T, Cable and Wireless, and Telecommunications of Jamaica, established Jamaica as the most sophisticated telecommunications market in the Caribbean, boasting a 100% digital network. With 2.5 million citizens, Jamaica is the largest English-speaking country in the Caribbean. When an excellent telecommunications infrastructure and a literate and large English-speaking population are combined with its proximity to the U.S. and a shared time zone with the U.S. East Coast, Jamaica offers a promising location for the development of an offshore software industry to serve U.S. markets.

However, there is one crucial factor missing. Jamaica does not have an adequate supply of trained software developers, nor a system for producing such a supply. A robust software industry requires a reasonably large number of well-trained IT workers (Reichgelt 2000). The traditional route to producing such a workforce is through tertiary education. We have already remarked on the difficulty of producing the required numbers of these

workers through the traditional tertiary educational system in the U.S. This approach will be markedly more difficult in developing countries where resources for tertiary education are more limited and access to tertiary education is far less widespread.

In Jamaica, for example, the graduation rate for tertiary education is 5% of the eligible population. This can be compared with 43% in the U.S. and 35% in Canada and the United Kingdom (World Bank 2000). Even if developing countries could mount efforts to increase the overall tertiary graduation rates, increasing the number of students graduating with credentials in software development is yet another challenge.

In this paper we describe a non-traditional program to complement the traditional tertiary educational system. This program is the outcome of a unique international university partnership between Furman University (Greenville, SC, USA) and the University of the West Indies (Kingston, Jamaica) to help establish and nurture an IT training center, called the Caribbean Institute of Technology (CIT), in Jamaica (Abernethy and Reichgelt 2000a). The primary rationale for such a center is to create a critical mass of trained software developers and put in place a system for producing larger numbers of such workers to fuel the growth of a software industry in Jamaica.

As mentioned earlier, a commonly held view has been that at least a bachelor's degree in computing is a necessary prerequisite for a career in software development. The concept of CIT is based on a different assumption. CIT enrolls talented secondary graduates into an intensive full-time (40+ hours per week) software development training program. The training offered is focused entirely on software development concepts, methods, and skills. There is no pretense to offer a broad or liberal educational experience (Abernethy and Reichgelt 2000b). Admittedly, this approach has drawbacks, but it may be the only way developing countries can attain the numbers of trained IT workers to enable a chance of success in the evolving global IT market.

2.1 The CIT curriculum

The planning and development of the CIT curriculum was coordinated by Furman University and the University of the West Indies. The two universities also took the lead in the interviewing and testing process for selecting students for CIT acceptance. Finally, the universities also helped in recruiting instructors for CIT and developed and delivered training sessions for these new instructors.

As noted in the previous section, the program of instruction at CIT is non-traditional. Of course, this calls for a new curricular approach. The curriculum designed and implemented by Furman University and the University of the West Indies focuses on client/server computing. It consists of a 15-week Core Curriculum, followed by two 8-week modules chosen from several different focus areas. The Core Curriculum emphasizes pseudocode and algorithm design, object-oriented principles, programming in C and C++, database concepts and SQL, and Web authoring with HTML and DHTML. Focus areas are chosen from (currently) one of four areas: Advanced C++ Programming, Visual Basic Programming, Database Design and Advanced SQL, and Java Programming. The entire CIT curriculum will be online by the spring of 2001 to facilitate its use in additional training centers in Jamaica (see the section *Future Development of CIT* below).

The curriculum is delivered with an emphasis on hands-on laboratory experiences. A typical 8-hour instructional day would be broken into 3 hours of lectures and 5 hours of laboratory work and programming projects. In addition to the formal instructional component, students are expected to complete a significant 'real-world' project near the end of the rigorous ten-month program. After graduation, the students are prepared for entry-level programming positions.

2.2 Increasing university co-operation

Starting in January 2001, co-operation between University of the West Indies and Furman University expanded when a group of 10 Furman students and 2 Furman faculty spent 6 1/2 weeks in Jamaica, as part of a study abroad program focusing on the impact of technology on globalisation in developing countries. One interesting aspect of the globalisation of business is the increasing integration of developing nations into the global business arena either through competition or co-operation. Information technology is a tremendous driver and facilitator of this globalisation. In keeping with the current emphasis on experiential learning at Furman University, one way to enhance student's understanding of globalisation is to enable them to visit business and technology centres in a foreign location. Not only are they able to experience a different culture but they can also observe first-hand the influence of culture and national development on information technology and business, both locally and globally.

Students participating in the study abroad program were enrolled in two courses through Furman University: Issues in Global Business and Issues in Information Technology and Globalisation. Two Furman faculty members taught these courses using visits to businesses and technology centres in Montego Bay to facilitate discussions within both courses. Related lectures,

readings, and discussions addressed issues of business development and investment in developing countries and how selected technologies have enabled the globalisation of the economy. The material utilised provided general coverage of concepts with the use of specific examples within Jamaica.

In addition to the coursework, Furman students were required to spend 20 hours a week at the CIT training centre engaging in service learning activities. The students interacted with the Jamaican students, leading small group projects, mentoring the Jamaican students, and facilitating lab activities. In some cases, the Furman students led the instructional activities in areas where particular students had significant expertise. Small group activities with the Jamaican students focused on research projects about various globalisation topics and firms who operate globally. The groups then developed web sites about their findings. These types of projects provided learning opportunities for the Jamaican and Furman students as they explored issues of globalisation within information technology and software development and also gave the Jamaican students an opportunity to practice their web publishing skills.

Furman students also made presentations to CIT and the University of the West Indies students about their personal internship and job experiences within the United States. Other interactions with the students were less formal through social gatherings, classroom visits at the University of the West Indies, and on-line interaction with other Furman students still in the US. In addition, Furman students spent several days shadowing a number of the Jamaican programmers who completed the CIT program last year.

The benefits to this component of the CIT program are numerous for both the Jamaican students and the Furman students. The Jamaican students benefited from learning about international businesses and expectations of those businesses. This information will become important when they eventually deal with clients from the US and around the world. They also benefited from the technology expertise that the Furman students brought to the CIT program. The Furman students benefited from these interactions by getting a better appreciation for the lives of computer professionals in a developing country. They also had the opportunity to observe an off-shore training and programming site in operation. Opportunities in these types of training centres will become more prevalent as more developing nations try similar programs.

3. FUTURE DEVELOPMENT OF CIT

The initial phase of the CIT project established a productive working relationship among the project partners and created and implemented a 'proof-of-concept' training program in Montego Bay. On February 8, 1999, 57 students enrolled in the new CIT in Montego Bay, Jamaica. Forty-three of these students graduated 10 months later and were offered employment in a new software development centre operated by one of the project partners, Indusa Global, LLC, in Montego Bay, Jamaica. On November 10, 2000, the second CIT class of just under 100 students graduated. These students have found employment with a number of different software development companies seeking to locate offshore centres in Jamaica. On January 4, 2001, 103 students enrolled in the third class of CIT in Montego Bay.

In October 2000, the first CIT satellite centre opened in Kingston, Jamaica, with 50 students enrolled. An additional centre opened in January of 2001. CIT satellite centres will use the CIT curriculum in an instructional program modeled closely after the original CIT program in Montego Bay. An additional 6 satellite centres are planned to open by the end of 2001. By June 2002, it is expected that CIT will have trained more than 400 programmers.

Because there is a shortage of available computer professionals and instructors in Jamaica, instructors for the pilot program were brought from India and the U.S. A vigorous recruiting effort is underway to staff the CIT satellite with Jamaican instructors where possible. The instructional staff and professors at Furman University and the University of the West Indies will conduct orientation and training sessions for all new instructors.

4. EVALUATING THE PROJECT

The ultimate test for CIT will be the performance of its graduates as software developers. Although CIT is still too young to permit a comprehensive assessment of its graduates, early anecdotal evidence is encouraging. We mentioned above that the 43 graduates from 1999 were hired by Indusa Global, an offshore provider based in Montego Bay. Almost a year later, all but three of the graduates are still employed at Indusa Global and their work has been judged excellent by Indusa Global's managers. Of course, more data will be required before CIT can be declared a success, and follow-on evaluation of the quality of their work will be conducted as a part of the ongoing assessment of the CIT project.

REFERENCES

- Abernethy, K. and Reichgelt, H. (2000a) *Linking with Others: Experiences with the Caribbean Institute of Technology*. Panel presentation to ALO/USAID Synergy 2000 Conference, Washington, DC.
- Abernethy, K. and Reichgelt, H. (2000b) *A Software Development Training Program for Jamaica*, Presentation to ALO/USAID Synergy 2000 Conference, Washington, DC.
- ITAA (1998) *Help Wanted 1998: A Call for Collaborative Action for the New Millennium*. Report of study conducted by the Information Technology Association of America and Virginia Tech.
- OECD (2000) *OECD Information Technology Outlook 2000*. Report from the Organisation for Economic Cooperation and Development.
- Reichgelt, H. (2000) Software Engineering Services for Export and Small Developing Countries. To appear in *Information Technology for Development*.
- Talero, E. and Gaudette, Ph. (1996) *Harnessing Information Technology for Development: A Proposal for a World Bank Group Strategy*. The World Bank, Washington, D.C.
- U.S. Commerce (1998) *America's New Deficit: The Shortage Of Information Technology Workers*. U.S. Department of Commerce.
- U.S. Commerce (1999) *The Digital Workforce: Building Infotech Skills At The Speed Of Innovation*. U.S. Department of Commerce.
- World Bank (2000) *Higher Education in Developing Countries: Peril and Promise*. The World Bank, Washington, D.C.

BIOGRAPHY

Dr. Ken Abernethy is Professor and formerly Chair of Computer Science at Furman University. Dr. Abernethy is currently Director of the Center for Advanced Technology at Furman University. He has been involved in the development of the Caribbean Institute of Technology from its inception and serves on the Institute's Board of Directors. He has assumed primary responsibility with Dr. Han Reichgelt for the development of the Institute's curriculum and instructor training programs.

Dr. Paula Gabbert is Associate Professor of Computer Science at Furman University. She is the co-organiser of a study abroad program for Furman students that is focused on the role information technology plays in economic development in the developing world. She led the first such six-week study abroad trip conducted in Jamaica during the winter of 2000.

Dr. Han Reichgelt is Associate Professor in the newly formed School of Information Technology at Georgia Southern University. He was formerly Professor and Chair of Computer Science at the University of the West Indies, Mona, Jamaica. With Dr. Ken Abernethy, he has assumed a primary role in developing the curriculum and training instructors for the Caribbean Institute of Technology.