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# Re-Engineering of the Computing Curriculum: The Case of University of Technology, Jamaica

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# RE-ENGINEERING OF THE COMPUTING CURRICULUM: THE CASE OF UNIVERSITY OF TECHNOLOGY, JAMAICA AIS SIG-ED IAIM 2008 CONFERENCE PROCEEDINGS

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## ABSTRACT

The current literature on computing education suggests that there is a paradigm shift taking place in the discipline. Evidence of this is in the discipline's rapid evolution and the volatility in the enrollments. This has prompted university administrations to make important strategic decisions as to how to reengineer their curriculum to remain viable, relevant and reflect innovation. This paper uses a case study approach to describe how the School of Computing and Information Technology (SCIT) at the University of Technology, Jamaica, employed a market orientation approach to reengineer its curriculum. In developing the curriculum, SCIT employed among other things; students views, international industry trends, the Joint Task Force for Computing Curricula 2005, local/regional requirements and recommendations from the School's Advisory Committee. The intent was to provide a broader portfolio that would attract and retain a wider student population. This model curriculum program can be a blueprint for small computing programs, especially in developing countries with modest resources.

**Keywords:** Computer Science, Information Technology, Curriculum, Jamaica

# I. INTRODUCTION

The authors of the Joint Task Force for Computing Curricula 2005 alluded to a paradigm shift accruing in the computing discipline. They argued that the discipline has grown in so many dimensions that no single view of the field seems adequate: “The days when the field of computing consisted of only computer science, computer engineering and information systems were over, and the richness and breath provided by the various computing disciplines called for a new way of defining what computing curricula should be”. This evolution in computing prompted the most influential bodies in the discipline, The Association of Computing Machinery (ACM), The Association of Information System (AIS) and Institute of Electrical and Electronics Engineers – Computer Society (IEEE-CS), to develop a schema to provide perspective and to help academics understand the major computing disciplines and how they compare to each other at the undergraduate level.

Tertiary institutions in various countries are therefore undertaking changes to their curricula to accommodate the broadening perspectives in the computing discipline. Australia has already experienced this change in the discipline and made adjustment to their curriculum in the late 1990’s [Pham, 1997]. Pham also argued that the narrow focus of computer science, on formal methods and abstract thinking, has been broadened to encompass Computing and Information Technology (CIT). He defined Computing as an area mainly concerned with technical issues addressed by traditional computer science courses, while Information Technology is concerned with a wider range of issues related to the use of computer technologies.

In addition to this paradigm shift mentioned by the Joint Task Force, the discipline is also dealing with a concurrent or, one may argue, derived development, that of declining enrollment. The Computing Research Association (CRA) Taulbee Survey 2005-2006 indicates that enrollment in Masters and Bachelor’s degree in Computer Science continues to show decline in the USA [Sweben, 2007]. Enrollment in Bachelor’s degrees declined by more than 15%

following a 13% decline in 2004-2005. While there is a decline in Computer Science, there are reports of steady increases in Information Technology enrollments [Granger et. al., 2007].

These two developments mentioned above along with the general push for higher education to be more relevant to the society, more client focused and more economic, were the drivers for School of Computing and Information Technology (SCIT) at the University of Technology, Jamaica in reevaluating its computing program. The catalyst however for the change was students' complaints that the current offerings did not offer much variety and concentrated too much on programming. While enrollment in the SCIT program has not shown any decline in the last five years, the School anticipated that these global market forces will eventually have an effect on the Jamaican market and therefore moved to diversify its offerings.

The universities in Jamaica traditionally developed their computing curriculum based almost entirely on the British and or US model without regard for local market forces. The new curriculum development process employed a market orientation approach. The goal was to create a curriculum that helps to drive the innovative use of emerging technologies and create graduates with the aptitude and skills to develop realistic sustainable value creation in a global economy. These goals are similar to those at the College of Computing at Georgia Tech [Furst and DeMillo, 2006].

The purpose of the paper is to highlight the strategic planning process undertaken by the School of Computing and Information Technology (SCIT) at the University of Technology, Jamaica in the development of its curriculum within the computing discipline. This paper is structured as follows: the development of the current offerings in SCIT, a description of the ICT landscape in Jamaica which will be used to as one of the determinants of current and future skills requirements, an evaluation of the development process of the new curriculum, and finally an outline of the proposed new curriculum.

## II. BACKGROUND

SCIT currently has two degree offerings, Bachelor's in Computing and Information Technology (BSCIT) and a Bachelor's in Computing and Management Studies (BCMS). The BSCIT is offered to full time students only, which constitutes the bulk of the Schools' intake. This curriculum focuses on the technical aspects of computing and aims to provide students with fundamental knowledge of the inner workings of the computer system, problem solving skills, the design and development of algorithms, and software development. It has two specializations, Data Communication and Enterprise Computing. These specializations lack both depth and breadth, as students are required to complete only two courses (subjects) in each specialization.

BCMS, on the other hand, is a hybrid of management and computer science courses, with no specialization. The degree is offered to part time students only, with an aim to combine degree-level computer studies with management studies to meet the needs of the market. This design provides a cadre of computing professionals equipped with management skills to fill managerial positions in the computing industry.

No major revision has been made to either the BCMS or the BSCIT programs since 1998 and 1999 respectively. Full time students have expressed a desire to pursue the BCMS offerings because of its added emphasis on business courses and its reduced emphasis on computer science and programming. This is a major factor that was considered in the curriculum restructuring.

## III. ICT LANDSCAPE IN JAMAICA

It is important to look at the ICT landscape in Jamaica to provide a better understanding of the local infrastructure and factors which have had an impact on the development of the new curriculum. The Ministry of Industry, Investment and Commerce (MIIC), under the Government of Jamaica (GoJ), has the primary responsibility for promoting the use of ICT in Jamaica. A coherent strategy for the development of the Information Communication and Technology (ICT) sector

was developed by the MIIC with the support of the U.S. Government Services Administration (GSA). The overall goal of the strategy was to bridge the digital divide within Jamaica, and between Jamaica and the rest of the World, by improving and increasing Internet access to all in Jamaica. The methodology included ICT related training, improving intergovernmental interaction and efficiency through ICTs, and the establishment of a legal and regulatory framework, to discourage factors that restrict equal access and participation in the ICT sector.

Consequently, there is an increasing number of government online services, as well as the implementation of the pilot phase of an e-learning project which uses ICT in the delivery of a number of subjects at the high school level. The government also passed the Electronic Transactions Bill in Parliament in November 2006. The Bill seeks to create a legal framework by which e-commerce will be governed.

The companies and affiliated institutions in the local ICT industry include software distributors and dealers, suppliers of professional services such as consulting, computer training companies, telecom companies, internet service providers and export service providers. Export service providers are involved in telemarketing, data entry, multimedia and geographic information systems. There are also numerous computer dealers supplying ICT hardware, software, accessories. The most vibrant sector is the telecommunication sector, which constitute Jamaica's core IT sector.

The liberalization of the telecommunication sector in 2003 led to an increase in the number of players in the industry offering a wide range of products and services. The Office of Utilities Regulation (OUR) reports that over 65% of the 2.7 million population has access to cellular phones and 40% of the population has access to the Internet. This number is expected to increase with the government's e-Learning project and the aggressive deployment of broadband technologies. Cellular companies have also started to deploy 3G wireless technologies such as WiMax and ED-VO. The society has become more

network-centric with an increase in the availability and access to computers, and the Internet, mobile phones and related products and services, changing the way in which Jamaicans communicate, share information of a social nature and transact business. Consequently online bill-payment, online shopping, telecommuting, telemarketing, video-conferencing and use of Internet cafes and hotspots, are some of the activities that are becoming increasingly commonplace in Jamaica.

The salient feature of the ICT sector employment market is its dynamism. Jamaica Promotions Corporation data show that the main growth area in 2002 was data processing, where employment increased fourfold within a year to account for 33% of direct ICT employment. The report showed that the ICT sector now employs approximately 14,000 persons many of whom are engaged in export services. Jamaican ICT exports range from relatively low value-added services such as call centers to relatively high value-added services such as computer-assisted design and computer aided manufacturing. Even though call centers are classified as low value added services**,** it is one of the sub-sectors that have recorded the most significant growth and have attracted the most attention to the island. This has been largely due to a mix of policies to stimulate investment in projects focused on employment creation.

Other important areas that exhibited strong growth between 2001 and 2002 were transactions processing (600%), computer maintenance and repair (200%), software development (163%). The software development market continues to be a thriving one in Jamaica, and has also become a viable industry for employment of programmers and other ICT personnel. The majority of companies are engaged in software modification services, training and sales supported by development projects, as financing is often not available from traditional sources.

The GoJ's Strategic Information Technology Plan [Ministry of Industry, Commerce and Technology, 2002] describes the status of the Information Communication and Technology (ICT) industry in Jamaica as one that has

traditionally been limited to data entry, software development, and computer assembly. It sees the local industry as being primarily focused on low value-added services, such as data entry and call centers, for export. According to the Plan, the area with the greatest potential for export growth is that of the provision of information technology services such as programming and networking. It also foresees a fast developing local market for customized software, particularly in the financial sector. The GoJ aims to create several thousand jobs in the industry over the medium term, and increase the sector's contribution to GDP. It also aims to push Jamaica towards becoming the center for ICT activities and investment in the Caribbean.

While the data on the ICT landscape is dated, it was the most current data available on local market trends. The data was used to help inform the development of a curriculum that directly relates to industry practices and the ICT direction of the government.

## IV. THE DEVELOPMENT PROCESS

Lachiver and Tardif [2002] indicated that reforming a curriculum is a major undertaking: the difficulties associated with development, implementation and assessment are colossal. Gruba, Moffat, Sondergaard, and Zobel [2004] mentioned five broad categories of curriculum changes:

- The introduction of a whole new degree program or specialized stream at the undergraduate level.
- Introduction of a whole new (course work) degree program at the post graduate level.
- Introduction of a new subject, or deletion of an existing subject
- Change to or within a first year or other core subject, such as a change in the language taught to undergraduate students
- Change to or within an elective subject such as a change in the choice of an Artificial Intelligence (AI) language used in a third-year subject.

The changes outlined by Gruba et al [2004] indicate the level or degree of change from major to minor changes. The introduction of a whole new degree would be considered a transformational change and would involve a dramatic departure from the status quo [Lachiver and Tardif 2002]. This change done in SCIT would be considered a major transformational change as the entire content and structure of the curriculum was changed. Gruba et al [2004] made reference to the intersection in the discipline where there is strong influence from computer science and mathematics and from software engineering and information systems. The SCIT program before the change reflects this intersection. See the background in Section II for a description of the programs before the change.

Gruba et al [2004] used a taxonomy based on work by Lachiver and Tardif [2002] to evaluate the factors that drive curriculum change. This paper will use the same framework of the drivers of curriculum change to evaluate the change/development process in SCIT. The factors to be addressed are: the change process, needs assessment, students' viewpoints, student abilities financial pressures, staff resources, employer and industry viewpoints, pedagogical arguments, national and international accreditation bodies and academic fashion/enrollment.

## THE CHANGE PROCESS

The main factor that precipitated the change in the curriculum was complaints from full time students (the main cohort). Students complained about the narrow options of the BSCIT course of study which focused on programming and networking. These students indicated that they would have opted for the BCMS degree which offered a mix of business and computing courses similar to the curriculum for information technology. However, the BCMS degree was only offered to part time students. The results of the survey carried out by Gruba et al [2004] identified student viewpoints as the second most important factor influencing the change process and in SCIT's case this was the main driving force.

Lachiver and Tardif [2002] mentioned that it is important to obtain a consensus on the need to reform the curriculum. In the case of SCIT there was a consensus however the nature and extent of the change was not clear. Gruba et al [2004] findings indicated that the main determinant or hindrance to curriculum change was an influential or outspoken person or persons. While this was not the case with SCIT's transformation, we can identify with Gruba et al [2004] that such decisions regarding curriculum change are normally undertaken by a small group of staff. A team of SCIT academic staff led by the head of department was assembled to champion the project, the objective being to instill a sense of shared ownership. We found this to be an effective approach to get general ownership of the project. Consistent with Gruba et al [2004], the project required a massive effort from the project team to take the change through the various internal approval processes.

## NEEDS ASSESSMENT

Needs Assessment was not a factor explored by Gruba et al [2004], however it was prudent in the SCIT's case as it was a requirement of the university. A needs assessment was done to determine the curriculum structure that best meets the needs of our internal and external stakeholders. These stakeholders include students, faculty and administrative staff, as well as employers, graduates of SCIT and local government ministries such as the Ministry of Education, Youth and Culture, and the Ministry of Industry, Technology, and Commerce. They also include the local accreditation body, the University Council of Jamaica, professional organizations such as the Jamaica Computer Society, other universities, international accreditation agencies and the general public. Hence, the needs assessment consisted of an industry and occupational analysis, labour supply and demand analysis, student analysis and an analysis of stakeholder support.

The industry and occupational analysis examined the role that the Government of Jamaica's (GoJ) macro developmental policies and the Computing and Information Technology industry play in the development of the

new curriculum. The GoJ in recognizing the role computing and information technology should play in the development of the nation, has formulated two documents, The Jamaica National Industrial Policy in 2001 and The Five-Year Strategic Information Technology Plan [2002] to provide policy guidelines with regard to transforming the country into a knowledge-based economy through the use of computing and information technology. The GoJ has also embarked on a national E-learning project, through which it hopes to enhance the educational level of the country in order to create a society that will seek to increase the demand for Internet access and data-related services.

The major occupational clusters in the Jamaican industry are in the areas of programming, networking and systems administration, systems analysis, database administration, computer security, data entry, computer science education (trainers/instructors/lecturers), software engineering, computer hardware assembly and repair, and web page design. Based on the student survey, the related occupational clusters in which current SCIT graduates work include that of business analysis, programming, sales, technical support, database administration, web design, teaching and banking. The occupations varied widely with both computing and non-computing areas.

Due to the unavailability of labour demand surveys, the School's Advisory Committee was consulted, along with information gathered from the National Industrial Policy, National Strategic IT Plan and Jamaica Promotion's (JAMPRO's) Opportunities in Jamaica's ICT Sector in order to determine the demands of the market. It was found that the broad areas that demand is expected to be greatest in are that of Business Process Outsourcing: which includes market research, data capture and data translation, Customer Contact Outsourcing: which includes technical support, telemarketing, and telesurvey, and Information Technology: which includes software development, network administration and system maintenance.

On the supply side, there are at least four other local tertiary institutions offering undergraduate degrees in areas such as Information Technology,

Computer Science, Information Science and Management Information Systems. Offshore institutions also offer undergraduate programs in collaboration with post-secondary institutions in some of these areas.

The needs assessment indicated that due to the nature of the industry, the need to keep current could not be over-emphasized. It was therefore of paramount importance that SCIT's curriculum be designed to reflect one of relevance and viability in the environment in which we operate. It is also intended to address the current and projected occupational needs of the society and to allow students to plan their career paths. The concentration on the Information Technology sector, which has the highest technical and domain barriers, is consistent with the potential growth areas for jobs in the ICT sector. The following section will discuss the role of students in the needs assessment.

## STUDENTS' VIEWPOINTS

A study was conducted among students graduating from the BSCIT and BCMS program. The methodology used for data collection included surveys and interviews. The sample consisted of sixty-nine (69) participants. Fifty-six (56) or eighty-one percent (81%) of the respondents belonged to the BSCIT, twelve (12) or seventeen percent (17%) belonged to the BCMS and the remaining one (1) or two percent (2%) belonged to diploma program.

Findings of the student survey included the following:

- The need to improve the course content as it was perceived to be lacking (46% of BSCIT students and 42% of BCMS students).
- The need to improve the relevance to industry of the course content. The rating given by the students was 38% (BSCIT) and 42% (BCMS).
- The need for more involvement of industry within course delivery.
- Industry experience for lecturers.

## FINANCIAL PRESSURES

Gruba et al [2004], to their surprise found that financial pressures were not an important factor in the decision to change the curriculum or its structure. In the case of SCIT financial considerations only played a role in the range of offerings. The university did not have the capacity to offer three separate programs: Bachelor's degree in Information Technology, Bachelor's degree in Information Systems and Bachelor's degree in Computer Science. The final decision was to offer one degree program: Bachelor's degree in Computing with majors in Information Technology and Computer Science. The External Advisory section of this paper describes how this decision was made.

## STAFF RESOURCES

In developing the proposed curriculum, SCIT had to consider the current and future human resource requirements. One of the concern of staff was would they would fit in the new paradigm and the level of retraining that will be required. In order to achieve the curriculum requirements, staff re-training and the recruitment of new personnel will be required. The curriculum structure which will be discussed in section V dictated that very little staff retraining would be required for the first two years of course delivery. The school will therefore have some time to develop the skills and acquire personnel to deliver the specialized modules in years three and four. The following strategies for staff development were identified:

- Training programmes
- Staff internship on projects with the telecommunications industry, multimedia houses, and networking companies.
- Collaborations with international software companies to encourage research, technology transfer and the building of institutional and human capacity.
- Collaboration with other universities with similar programmes.

- The recruitment of staff, both part time and full time, with industry experience.

## THE EXTERNAL ADVISORY COMMITTEE

The External Advisory Committee consisting of 20 persons from a cross section of the IT industry, academia, public sector, past students, and the Jamaica Computer Society, participated in the strategic planning process of the structure and content of the new curriculum. This committee was not formed solely for the purpose of planning the new curriculum, but exists as a representative body of the clientele that we serve, that is from time to time called upon to assist in the strategic plans for SCIT.

The discussions with the committee showed that SCIT students had strong technology skills but lacked the fundamentals of organizational management, planning and business practices. Additionally, the committee urged that the school take an active role in developing linkages with industry to allow students to gain practical on-the-job-experience. It also suggested that there should a close alignment of job roles with the curriculum as technology underlies all commercial, industrial and government activities.

For the proposed curriculum, the committee recommended that the similarities between IS and IT warranted the offering of only one of these programs. After deliberation, the decision was made to remove IS from the structure. The courses were re-aligned accordingly and a new structure was designed. Further discussions with the committee yielded satisfaction with the structure, with reasons given that it was consistent with current and future industry trends and would equip students with a better understanding of how their technical skills should add value to the organization.

## STUDENT ABILITIES

The perennial problem that most computing program has is the high failure rate in the introduction to programming course and other advanced

programming courses. The failure rate for the introduction to programming course in SCIT fluctuates between 29% and 48% not unlike most computing courses [Golding, Facey-Shaw, Tennant, 2006]. There were discussions on a number of ideas to increase performance including increasing the matriculation requirement, conducting pre-semester boot camps, and the introduction of peer tutoring. The performance problem with introduction to programming is not unique to SCIT and was not a factor in changing the curriculum. However, some changes have been made to the delivery structure of the two first year introductory programming courses with the proposed use of the C programming language beginning in the first semester of year 1. Previously, the first course was language-independent and C was introduced in the second semester of year 1. There is further discussion on matriculation requirements in the Academic Fashion section.

## PEDAGOGICAL ARGUMENTS

There were vigorous debates on what subjects were to be included in both IS and CS and what subjects were absolutely core. After extended discussions Computer Logic and Digital Design, previously offered in BCMS and BSCIT and initially left out of the new curriculum, was included as core in both IT and CS. There were also discussions regarding whether to introduce students to a programming language in their first semester or to use algorithm first approach that would teach programming via pseudocode. The decision was to take a programming first approach using C as mentioned in the previous topic. While pedagogy was relevant in developing the new curriculum it was not a driver in the change decision.

## ACCREDITATION

Although SCIT will not seek accreditation from the Accreditation Board for Engineering and Technology (ABET) in the near future, the Board's specifications were incorporated in the design of the curriculum. ABET requires that computer science curriculum should have a minimum of 40 semester hours of up-to-date

study in computer science topics and 30 semester hours of study in mathematics and science. The current BSCIT program satisfied ABET standards with 74 credits of computer science courses, however there is only 22 credits in mathematics and science. The Computer Science curriculum of the new program satisfies both criteria.

Regarding Information Technology (IT) specialization, there is a movement within ABET to accredit IT programs separately, recognizing that there could be technically-oriented programs with less of a business application emphasis [Kohun and Wood, 2003]. Although the IT curriculum is still in its development stage, the Computing Accreditation Commission's Plenary Session Report [ABET Summit, 2007] suggests it should cover fundamentals including: (1) Core information technologies of human computer interaction, information management, programming, networking, web systems and technologies; (2) Information assurance and security; (3) System administration and maintenance and (4) System integration and architecture. The revised curriculum also incorporated the above; however some of the courses are only offered at the introductory level in the current program.

## ACADEMIC FASHION

We concur with Gruba et al (2004) that we would like to have the program chosen based on reputation but we are fully aware that students consider other factors. The reputation of SCIT is that it is academically strong and has excellent industry relevance. The demand for the program is therefore very high over its nine year existence. Students are also attracted to the program because of the matriculation requirements. The minimum requirement is five passes in Caribbean Council Examination (CXC) or the equivalent British, Cambridge or London Ordinary Level Examinations. While persons with the minimum requirements are rarely accepted, students that have a greater number of passes at the CXC/Ordinary Level will have a higher chance of being accepted. This allows students to bypass the two years required to complete Advance Level Examinations and enter university earlier. The matriculation issue, whether to

change the requirements from Ordinary to Advanced level was discussed at length but was not a factor in changing the curriculum.

## V. THE NEW CURRICULUM

SCIT will offer a Bachelor of Science degree in Computing, with majors in Information Technology (IT) and Computer Science (CS). The decision was made to offer the Information Technology major to both day and evening students, while Computer Science major will only be offered to full-time students. The breadth and depth of the IT major, based on the development process, is expected to attract more students to the school than the CS major. The IT major directly addresses the current and future needs of the industry, while the CS major addresses the research and technical aspects. The focus of each major, consistent with the Computing Curricula 2005 Report, is as follows:

- The Information Technology major is designed to serve students who want a computing career that features a mix of technical and business/social issues rather than a unilateral focus on technology.
- The Computer Science major is designed to serve those students who wish to proceed as generalists in computing or who aspire to graduate study, research positions, or cross-disciplinary innovation.

In the first two years, regardless of major, all students will pursue a common set of core modules to create the foundation for basic skills required for graduates. Here, students will concentrate on the breadth of computer knowledge and on UTech's required general education courses.

In the first semester, second year students will be required to attend a seminar, where professionals from industry, along with academic staff, will provide mentorship and guidance in the selection of their career path, and consequently, their major. The selection of majors will be done by the middle of the second year.

In the third (3rd) and fourth (4th) year, students pursuing the Information Technology major will be required to complete modules consisting of a mix of management, organization, human/technology modules. They will also select an area of concentration. Each concentration has five modules to provide the necessary depth. Two modules from each concentration will be done each semester (first semester third year, second semester third year and first semester fourth year).

The areas of concentrations for the Information Technology major include: Information Management, Networking and Multimedia. In Information management, students will investigate and understand the central role information plays in organizations, society, and the broader economy through the examination of information and knowledge management at the strategic, analytical and technical levels [Computing Curricula, 2005]. Graduates of the Networking concentration will have the appropriate knowledge and skills to monitor, analyze, design, implement, and manage networks, in such roles of network administrator, network manager or network architect. The Multimedia concentration prepares students to integrate computer development with audio and visual artistry. We anticipate that there will be strong future demand to develop multimedia content for various industries such as education, entertainment, medicine and communications among others. Graduates will be able to pursue careers as multimedia systems designers, developers, and architects.

Computer Science spans a wide range, from its theoretical and algorithmic foundations to cutting-edge developments in robotics, computer vision, intelligent systems, bioinformatics, and other exciting areas. Students pursuing the Computer Science major will be required to complete modules that will concentrate on computer theory, mathematics, and science, as well as elect any two modules from any of the concentration areas previously mentioned. This major is designed to produce graduates with the required skill to design and implement software, devise new ways to use computers in the areas of

networking, database and human-computer-interface, and develop intelligent systems.

## VI. CONCLUSION

With the rapid change in the computing paradigm, educational institutions must be willing to reengineer curricula and incorporate significant updates to produce technically competent students who have both hard and soft skills. On this premise, SCIT undertook the task of reengineering its computing curriculum. This process was done in a collegial atmosphere but not without strong and divergent views. It was driven by a team from the School of Computing and Information Technology to instill a sense of ownership. The change process was tedious and iterative but necessary to gain consensus and buy-in from staff members. This paper used a framework outlined by Gruba et al [2004] based on work by Lachiver and Tardif [2002] to evaluate the factors that drive curriculum change in SCIT.

The factors addressed were the change process, needs assessment, student viewpoints, student abilities financial pressures, staff resources, employer and industry viewpoints, pedagogical arguments, national and international accreditation bodies and academic fashion/enrollment. The findings show that students' viewpoint was the catalyst for the change. The results of the survey carried out by Gruba et al [2004] identified student viewpoints as the second most important factor influencing the change process and in SCIT's case this was the main driving force. As for financial pressures, it only played a role in the range of offerings. Staff resources were another important factor, and although retraining programmes will be required, little will be required for the first two years of the curriculum. The decision on course offering were also guided by an external advisory committee with the intent to adopt a market orientation approach to ensure that what it being taught is what is required by the job market. To a lesser extent, other factors such as student abilities, pedagogical

principles, accreditation and academic fashion had an impact on the newly developed curriculum.

The development of the new SCIT curriculum has not been without its challenges. This, however, is part of the dynamics of the strategic planning process. The considerable strategic decision that the school and the university faced was 'what niche should it concentrate on to maintain its viability and relevance in this evolving discipline?' This is a question that both large and small universities will have to grapple with in this new paradigm.

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*Editor's Note:* The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
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