

# Specialization in ICT fields

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## ABSTRACT

The debate about "IS curriculum" continues. During 1999, Technikon Pretoria in South Africa conducted surveys to improve understanding of industry requirements regarding skills and qualifications of ICT students. It became clear that industry would appreciate more specialization, especially from Technikons, who typically emphasizes skills development for specific jobs and careers. Technikon Pretoria was the first institution to implement more than seven specialization fields from 2002. This paper shares the experience in South Africa that could be useful for New Zealand Polytechnics, namely the initial survey, formulation of specialization areas, portfolio of teaching subjects, extent of specialization possible and experiences implementing the new degrees. Technikon Pretoria is available for further discussions and advice.

## 1. INTRODUCTION

Albertyn [2001] indicated in her poster paper that staff members at Technikon Pretoria conducted research in 1998 which indicated that industry would prefer that student specialize further during undergraduate studies at tertiary institutions in South Africa. The survey was done by Mess Nina Evans and Joey van Vuuren [Evans, 1999]. In 2000/1 an independent ICT consulting house reported in a study for Technikon Pretoria that the number of fields of specialising during ICT studies was indeed increasing internationally [Miller, 2000]. In the same year, the Technikon Computer Lecturers Association (TECLA) designed nine specialization areas for three and four year studies. The full qualification

is achieved by only studying IT subjects, ie. in one department. The first students will complete their fully specialized studies during 2003. Technikon Pretoria implemented the offering of most of the specialization areas along with three additional qualifications for people with non-IT qualifications and industry experience. This paper summarizes the specialization fields and recent experiences at the institution.

## 2. THE SPECIALIZATION FIELDS

### 2.1 Information Systems curriculum for tertiary education

Historically two BTech degrees in ICT were awarded at many Technikons, namely BTech IT and BTech Computer Systems, with latter being closer to the engineering field. The BTech IT degree now provides for seven specialization fields. However, several Technikons award qualifications only to third year level, ie. National Diploma. The first year of study is common amongst all Technikons and specialization fields with specialization starting from the second year. Exit points are therefore available at the third year, ie. the National Diploma qualification, and fourth year, ie. BTech qualification (equivalent to Hons degree at Universities).

Each specialization develops skills for specific jobs, but the qualification does not limit the student regarding career choices. Specialization in Software Development is very similar to a mix of the classical BSc (Computer Science) and BCom (Information Systems) qualifications, preparing students mainly for programming. Specialization in Business Applications prepares students better for positions as Business Analysts. Specialization in Communication Networks and Web Application Development are self-explanatory.

Preparation for technical and games programming is typically best provided by the Intelligent Industrial Systems specialization. Support Services opens doors to environments related to Help Desks and Infrastructure Management. The Information and Technology Management degree is rather generic, enabling students with non-specialized National Diplomas from earlier years to continue with BTech studies in following years as a transitional arrangement. From 2004, specialization will also be available in Technical Applications towards low-level programming, interface programming and ICT hardware.

Selective specialization is allowed from the second study year, considering pre-requisites of particular subjects. Most specialization occurs during the fourth year where over 40 semester subjects are available at Technikon Pretoria and less at other Technikons. A list of subjects is available in the table for Appendix 1.

## **2.2 What is the extent of possible specialization?**

The extent of specialization differs amongst these degrees. Two of the ten fourth year modules were originally intended to be compulsory for all specialization fields, namely Information and Technology Management and Project Management. These subjects educate students about the broad framework within which they will operate in an IT department. Unfortunately, the use of prerequisite subjects also lower the ability to specialize.

Each specialization field has two unique specialization prerequisites, ie. subjects available only to that specialization field that commence in the second year. For BTech IT: Business Analysis, the subjects at are fourth year level are Business Analysis 4 and Advanced Business Analysis 4. To complement this core of specialization is Projects 4, a double credit thesis or major IT project. And then one could choose subjects closely related to the field, albeit not in the core of specialization. Annex 1 summarizes the possibilities for each specialization degree. Surprisingly the estimated specialization is only about 60-70% for most degrees.

Whether this is sufficient and satisfactory or not, is open for debate. The maximum level of specialization that could be achieved if subjects are chosen well, might position a student very well for placement, being very job specific yet with broader organization exposure. But students are allowed to choose from many non-related subjects, ending up the possibility of doing only 40% specialization, which is clearly less acceptable for specialization.

Technikon Pretoria also implemented additional specialization degrees. The one-year BTech degrees (Business Information Systems and Knowledge Management) for people with non-IT three-year qualifications are far less (IT) technical than the full

BTech IT degrees, but have much higher levels of specialization in the broad field of ICT. The BTech Professional Practice degree is very generic, performing assessment of prior learning to claim credits from a very broad range of IT subject fields. A degree BTech: IT: Multi Media was also implemented, with the first students completing their studies during 2006.

## **2.3 Comparing to international curriculum**

The CC-2001 working document of Computing Curricula by ACM and the IEEE Computing Society states clearly that the discipline of computing is expanding. The proposed curriculum is much larger than the original field of computing even when it identifies "a relatively small set of core concepts and skills that are required of all students". This framework should be read in conjunction with the IS-2002 framework for information systems towards an overview of the IT field. Very few courses for the seven core specialization degrees are not clearly covered by the above frameworks. But the fundamental approach of South African Technikons is different. Whereas above documents advise on the content to be covered by most if not all students in the study of Computing or Information Systems, Technikons clearly identified specialization with standardization at first year but decreasing overlap during further three years. In effect are students aligned to meet specific market needs sooner rather being orientated in standardized fashion.

## **3. SPECIFIC EXPERIENCES**

### **3.1 Academic standards**

The fourth year of the BTech degree has been registered with government at the same level as the Hons degree in Computer Science, Information Systems or Informatics at South African Universities. The teaching approach at fourth year level is different from the lower levels, being very similar than taught courses for mature advanced students. A "thesis" at Technikons is more practical oriented than at typical universities but Technikon Pretoria Technikon Port Elizabeth emphasizes literature study heavily. Several of the external moderators are from Universities and indications from them are that the academic standards are acceptable.

### **3.2 Academic administration**

Degree and student administration has become more complex due to the overlap in degree contents. More time was required to describe the additional degrees in the manuals for students and internal administrative organization. More effort is still spent

to advise students on course selection. More effort is required to ensure the degrees are “coordinated”, but responsibility for a degree is now clearer because they are assigned to specific HOD’s.

### 3.3 Staff

The ideal skills and experience for new courses was sometimes not available, and new courses were developed months and even only weeks before courses started because no money was available to free staff for development. Currently several staff members are working very hard to ensure they remain ahead of students in the courses they offer, but most of them appreciate the challenge. Staff satisfaction was mixed.

### 3.4 Development and Implementation schedules

The challenge to introduce ten new courses per semester for three years was enormous and the schedule was very tight. The offering of three of the degrees was unfortunately cancelled before implementation because of shortcomings in staff experience, lack of time to develop courses, low students interest and in order to revise the exact contents of one degree for more specialization. Shortcomings in standards of those courses implemented for the first time, were soon overcome. It was simply again confirmed that investment is required to have spare capacity for the building of new capacity, especially for radical changes.

### 3.5 Financial performance

The department was also challenged by the business imperatives of minimum class sizes, where a break-even of about 12 students at fourth year and (18 at lower levels due to lower subsidies) are required to cover the incremental costs of presenting the additional new courses. It appears that a total of about 100 fourth year students is not enough to be offering up to nine specialization fields using classical approaches to teaching. Class sizes of students in previous years also decreased as the number of courses was increased. This challenge is probably insurmountable unless creative alternative teaching approaches are used, student numbers are increased or the subjects are strongly linked to the research and development capitalizing on specialization of staff members. Institutional administrative costs for refined qualification structures would also have increased very slightly.

### 3.6 Students and industry

Students informally indicated that they appreciate the opportunity to specialize and that most of them enjoy specialization, including the fact that they do not need to do certain subjects anymore. It could not yet be determined how many students at entry levels chose the institution because it offers a spectrum of possible fields of specialization. Early indications are that industry is satisfied with the specialization of

students. This was evident from the placement of third year students for their six months of industry exposure. The first students will be completing BTech specialization (fourth year) during 2003, and it would be interesting to see how industry responds to students that achieved double the specialization than what is possible at third year level.

## 4. CONCLUSION AND THE FUTURE

The experience of Technikon Pretoria has shown that institutions could be offering a spectrum of specialization fields if they have sufficient numbers of students and sufficiently qualified/experienced staff. Care should however be taken to plan the portfolio of courses, link assignments to research in the department, be more flexible in teaching approaches and have continuous involvement of management and the most specialised staff members.

Further study is required to monitor students after they completed their degree. The first aspect of study would be the response of employers regarding eventually having students available that meets the requirements they previously said they need in candidates. Of course follow-up study is required to assess to what extent the gap was closed towards meeting requirements of industry. Of particular interest would be an assessment of the performance of students comparing to students who did not specialize in previous years. Longer-term assessment is also advisable to monitor the ability of students to deal with a diversity of challenging situations and growth their skills. And finally could one explore possible shortcomings in the specialization degrees by comparing the actual content of each degree with CC-2001 and IS-2002, and by comparing it with practical experiences. Achieving further success lies in the hands of the management team of the newly formed Faculty of ICT!

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### Additional recognition:

Nina Evans completed her MTech studies by undertaking the initial surveys involving Joey Jansen van Vuuren. Currently she is an HOD in the Faculty of IT at Technikon Pretoria.

### Appendix1 – Standard Technikon BTech specialization degrees

Fourth year semester modules	Software Dev.	Business App's	I & T Man.	Supp. Services	Comm. Networks	Web & Appl. Dev.	Intelligent Ind. Sys.
Applied Technologies					x		
Artificial Intelligence							
Business Analysis & Applications		S					
Business Principles		x	x				
Communications Networks					S		
Advanced Communications Networks					S		
Data Administration							
Data Base Systems							
Development Software	S						
Advanced Development Software	S						
Expert Systems							
Human-Computer Interface Design	S			S			
I&T Management	R	R	R	R	R	R	R
Advanced I&T Management			S	x			
Information Security						x	
Intelligence Programming							
Intelligent Industrial Systems							S
Advanced Intelligent Industrial Systems							S
Internet Programming & e-commerce						S	
Advanced Internet Programming & e-commerce						S	
Knowledge Management		S	S				
Advanced Knowledge Management		S					
Operating Systems							
Project A	M	M	M	M	M	M	M
Project B	M	M	M	M	M	M	M
Project Management	R	R	R	R	R	R	R
Research Methodology	.	.	.	.	.	.	.
Software Engineering & Design	S					x	S
Strategic Information Systems		x	S	x			
Support Services				S			
Advanced Support Services				S			
Systems Engineering	x						
Technical Programming					x		x
Advanced Technical Programming							x
User Interfaces	x					x	
Web Management						x	
Standard prerequisites ( R )	20%	20%	20%	20%	20%	20%	20%
Specialization modules ( S )	40%	30%	30%	30%	30%	20%	30%
Research specialization ( S + ".")	20%	20%	20%	20%	20%	20%	20%
"Waste" of research specialization (Res. Method.)	10%	10%	10%	10%	10%	10%	10%
Primary specialization (excl. "waste") (last 3 rows)	70%	60%	70%	60%	60%	50%	60%
Plus recommended related subjects (x)	20%	20%	10%	20%	20%	40%	20%
Estimated maximum specialization	90%	80%	80%	80%	80%	90%	80%
Unique selections (ie. Other degrees excluded...)	0%	0%	0%	0%	0%	0%	0%

Primary specialization: Prerequisites where appropriate + Specialization modules + Research spec.  
(Project Management always included...)