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# Knowledge Skills and Abilities demanded of graduates in the new learning environment

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## ABSTRACT

Changes in technology, and employer demands require that we regularly survey our stakeholder communities to ensure the relevance and currency of what we are teaching, and the qualifications we offer to prepare our students for practice.

At a presentation to an IT breakfast of the NZCS Auckland Branch in October 1998, the audience were surveyed in order to gauge how well we were doing in developing tomorrow's practitioners. Topics surveyed were: the relative importance of different technical skills required by employers, the key trends that we need to prepare graduates for, the impact of the Internet on skills required, the most urgent upskilling requirements of employees and the relative value of vendor vs. formal Polytechnic qualifications.

The results of the survey are reported, the key findings analysed and some strategies are suggested which address the identified gaps.

## Keywords

IS curriculum, IS education and research, IS skill requirements, IS training and development, IS staffing issues

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## 1. INTRODUCTION

In October 1998 the three Institutes of Technology in Auckland were invited to give a presentation to a breakfast meeting of the Auckland branch of the New Zealand Computer Society, demonstrating how Polytechnic computing education develops and supports IT professionals. The audience were all not only practising IT professionals, but many were also employers of IT staff and this provided an opportunity to inform the profession about the strengths of our IT graduates. The presentation also included the range of programs offered at the three institutes, the structure and content of the leading edge courses on offer and the new programs being developed for delivery in the new millenium. The presentation was a full multimedia presentation involving presenters from all three institutes. One of the strengths of polytechnic education is the involvement of industry in the development of courses and programs and the valuable advice received from current practising IT professionals. It was therefore decided to elicit some of this valuable advice from the captive audience at the meeting, and a questionnaire was used as the survey instrument.

Twenty four responses to the questionnaire were received so the results do not claim to be statistically generalisable given this small sample size. However, given the nature of the audience and the seriousness with which they filled in the questionnaires, the findings can be given considerable credence and offer a good basis for follow up studies.

## 2. THE QUESTIONNAIRE

The questionnaire was developed in order to update and extend the KSA list of Clear, 1998. It was primarily intended to elicit feedback on technical skills rather than the more managerial and interpersonal. In this respect it was influenced by the comments of Bekesi & Hanson 1998, who suggested that "lately no research has concentrated on the needed specific technical

skills...which, normally would create jobs or vacancies of those jobs”.

A copy of the questionnaire is attached as Appendix A.

### 3. FINDINGS

#### 3.1 Ranking Of Technical Skills

The technical skills selected from previous IT Knowledge Skills and Abilities (KSA) lists (Clear, 1998), are listed below identified by KSA\_ID. These KSA's were augmented in this survey by three omitted items deemed by the authors to be significant omissions or emerging trends. While the established group of KSA's were confirmed as important, the three new KSA's were sufficiently supported to warrant their inclusion in a future expanded KSA list. The level of support for the previous vs. new technical KSA items is shown by the mean scores below for each grouping.

Mean score for OLD KSA\_ID Technical Skills 3.53  
 Mean score for NEW Technical Skills 3.36

These KSA's are tabulated below as new items, but identified as *cognate* with an earlier specific KSA item.

KSA_ID	KSA_ID (cognate)	TECHNICAL SKILLS (first grouping)
20		Structured System Analysis & Design
new	20	Object Oriented Analysis and Design
new	33	Object Oriented Programming
33		3GL programming
28		4GL programming
17		User Training and Support
25		Operating Systems
24		DBMS & Database Design
13		Telecom & Networking Concepts
new	13	Network Management
15		Use & Evaluation of Software Packages
6		Information gathering techniques
8		Project Management Skills

Table 1: Ranking of Technical Skills

#### 3.2 Newest Trends In IT That Should Be Considered For Courses

The categories of critical IS knowledge and skills used in Figure 1, are those from Lee, Trauth & Farwell 1995. The new trends identified from the survey are shown tabulated against applicable KSA categories.

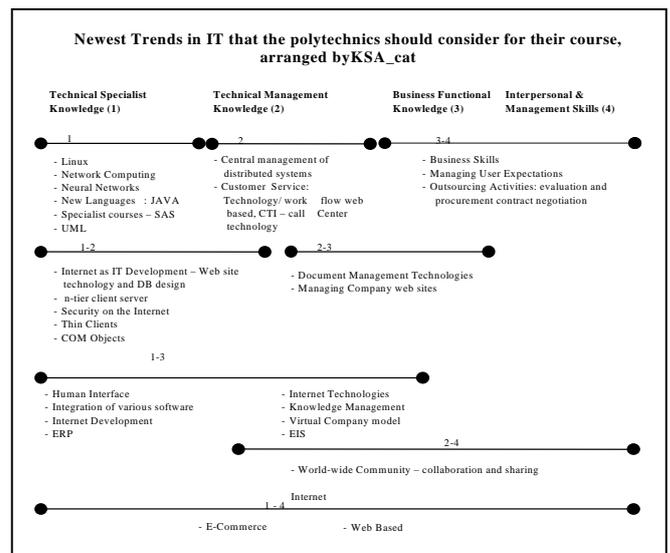
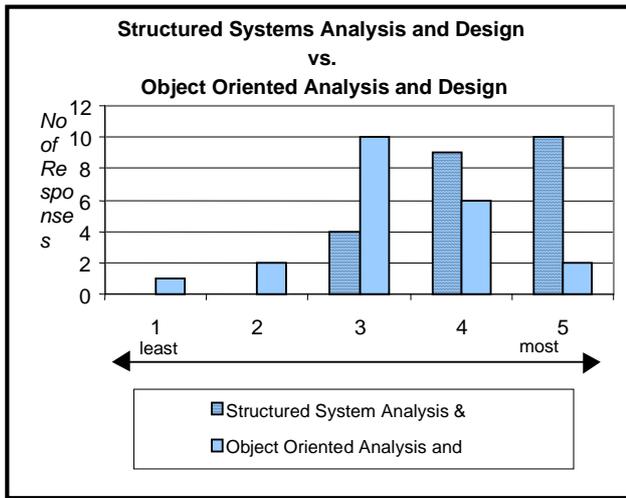


Figure 1: Trends in IT

The survey showed in some cases the growing importance of new skills, but still critical importance of the old. For instance, the scores for the new category of object oriented analysis and design (OOA&D) are interesting to compare with the established structured systems analysis and design. From Figure 2 below it is clear that both paradigms are important, but the traditional structured paradigm still maintains the lead over the newer OOA&D.



**Figure 2: Comparison of design methodologies**

### 3.3 Skills Associated With The Internet Development

A wide range of Internet developer related skills were identified by the respondents. These are shown in *Table 2*, firstly grouped by the most applicable *Generic Job Stream* (Clear, 1998), as a means of ordering them. These Internet skills are subsequently tabulated and related to the previous KSA lists, *Table 3*, where they are mapped to KSA\_ID's judged equivalent. For new skills they are mapped as in 3.1 above to *cognate* KSA's from the prior lists.

Operational support technician	User support Specialist
<ul style="list-style-type: none"> <li>- KISS</li> <li>- How to use it?</li> <li>- Presentation techniques</li> <li>- Video / multimedia awareness</li> </ul>	
<ul style="list-style-type: none"> <li>- Network Management</li> <li>- on-line order status tracking</li> <li>- Server Management</li> <li>- on-line management of bugs</li> <li>- User Applications</li> </ul>	<ul style="list-style-type: none"> <li>- What is it?</li> <li>- Where to find useful stuff?</li> <li>- User Applications</li> </ul>

**Table 2: Association of skills**

Analyst/ Programmer	Technical Analyst/programmer
<ul style="list-style-type: none"> <li>- Web Based Work Flow - E-Commerce</li> <li>- Integrating with other applications</li> <li>- Internet Payment Techniques</li> <li>- JAVA Development</li> <li>- JAVA Programming</li> <li>- Web Development</li> <li>- Web Design</li> <li>- Deployment of search engines</li> </ul>	<ul style="list-style-type: none"> <li>- Database Integration</li> <li>- Web Based Design (techniques)</li> <li>- Graphic Design</li> <li>- GUI Design</li> <li>- How to publish a web page?</li> <li>- HTML - TCP/IP</li> <li>- Human Interface Design</li> <li>- Interactive demo/ examples</li> <li>- Interactivity - Marketing</li> <li>- Transaction based payments</li> <li>- Voice over IP</li> </ul>
<ul style="list-style-type: none"> <li>- Business Analysis</li> <li>- Business fit Analysis Techniques</li> <li>- Business Justifications</li> <li>- How can a business use IT?</li> <li>- Project Management</li> <li>- User Applications</li> </ul>	

INTERNET DEV'T SKILLS MAPPED TO RELEVANT KSA'S		
KSA_ID	Cognate KSA_ID	
5,6,20		Business Analysis
new	5,9,11	Business fit Analysis Techniques
5,11		Business Justifications
new		Customise Web Sites
24		Database Integration
new	6	Deployment of search engines
new	20	Distributed Objects
new	4,5,18	E-Commerce
14,21		Encryption
new	20	Graphic Design
20		GUI Design
5,18		How can a business use IT?
new		How to publish a web page?
5,18		How to use it?
28,33		HTML
new	20	Human Interface Design
new	8	Integrating with other applications
26		Interactive demo/ examples
new	4,20	Interactivity
new	5	Internet Payment Techniques
33		JAVA Development
33		JAVA Programming
new	9	KISS
8		Long-term planning i.e. Project Management

16		Marketing
new	20	Multinational Interfaces
new		Network Management
12		on-line management of bugs
5,20		on-line order status tracking
2		Presentation techniques
8		Project Management
14		Security
new	32	Server Management
13		TCP/IP
new	5,20	Transaction based payments
new	20	Use of thin client technology
17		User Applications
new	24	Video / multimedia awareness
new	13	Voice over IP
new	20	Web Based Design (techniques)
new	20	Web Based Work Flow
new	20	Web Design
new	20,26,28,33	Web Development
5,18		What is it?
6		Where to find useful staff?

**Table 3: Internet Skills and KSA Mappings**

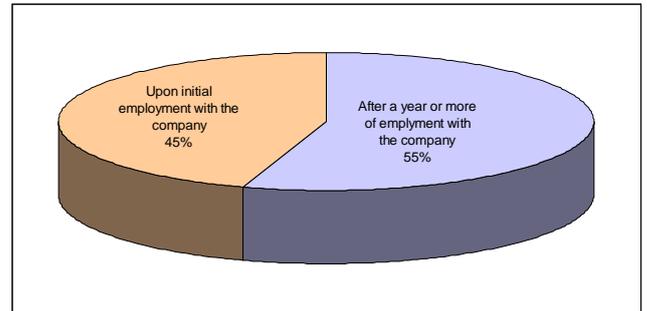
### 3.4 Vendor Qualification As A “Top-Up” Method

A question relating to the importance of staff with formal qualifications attaining vendor certification as shown in Figure 3, indicated a general preference for acquisition of these “top-up” skills as a post experience qualification, after a year or more on the job.



**Figure 3**

Figure 4 below has been created from the weighted totals for Importance of having vendor qualifications for staff with a formal qualification

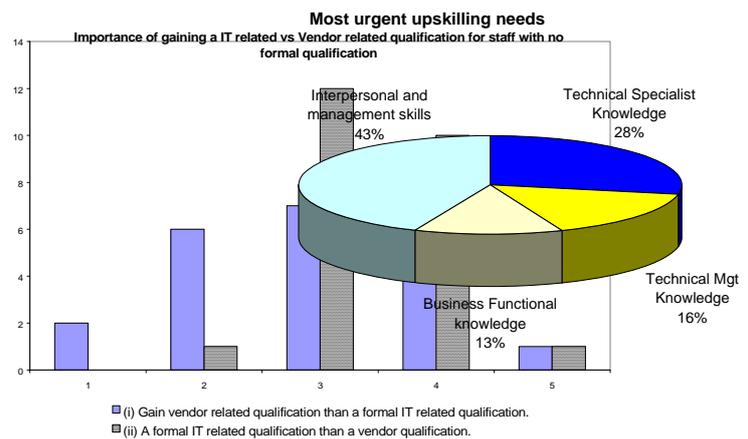


**Figure 4 : Importance of having qualifications for staff with a formal qualification**

### 3.5 Preference Of Qualification For Staff With No Formal Tertiary Education

A question relating to the importance of staff without formal qualifications attaining vendor certification, indicated a general preference for acquisition of the broader skills provided by a formal programme of study, than for the more specific skills afforded by a vendor certification.

**Figure 5**



### 3.6 Most Urgent Skills

The most urgent upskilling needs facing employers at the time of the survey were felt to be those shown in Table 4 below, organised into the four categories of critical IS knowledge and skills from Lee, Trauth & Farwell 1995.

<b>Technical Specialist Knowledge</b>	
- Middleware	- Database Design
- Unix Administration	- GUI Design principles
- Analysis	- MCSE
- Design	- Vendor qualifications
- ORACLE training	
<b>Technical management Knowledge</b>	
- Message and queuing	
- IT Trends	
- Manage requirements of integrated projects, technical/ process/ change	
- Database Administration	
- Network Management	
<b>Business Functional Knowledge</b>	
- Business Analysis - data modelling, process design/ re-engineering	
- Project Management	
- Value for money - how to use it	
<b>Interpersonal management Skills</b>	
- Marketing	- Time Management/ implementation skills
- Communication skills (listening)	- Skills for handling customers
- Consulting with ethics	- Time Management
- Presentation skills	- Quality with communication
- Information finding ability	- Team Building
- English as a second language	- Customer focus quality
- User communication	- People skills

**Table 4: urgent upskilling requirements**

Significantly, given the emphasis of this survey overall on technical skills, the resounding call for strong interpersonal and management skills as shown in *Figure 6*, sends a very clear message about the perceived deficiencies of today's IT practitioners. It reinforces the need for qualifications that develop a well rounded graduate over and above merely producing a technically competent one.

**Figure 6: Upskilling categories**

#### 4. STRATEGIES

Strategies to be adopted to address the issues identified could include the following:

Polytechnic computing programmes need to focus on the development of less “nerdy” graduates, and emphasise the

qualities desired of more “user-friendly” IT career professionals. Therefore interpersonal communication skills, highly developed written communication skills, the ability to present well, build relationships with clients, work effectively in teams and so on, need to be more consciously and consistently emphasised by all their lecturers in the course of their studies. This emphasis needs to become a thread interwoven throughout the technical course of study. This may lose us some students who see computing in very limited terms, but that may be a better outcome for the industry. Some lecturers in turn may need a personal “tune up” and a mind set shift, to set the technology in a context of educational and professional preparation of students.

Focus on positioning computer courses as less “geeky” in the media and in advertisements, in order to attract more well-rounded students. This needs a concerted campaign in concert with schools, and the news media, and may mean that we need to select students based upon broader aspects of personality rather than such narrow measures as aptitude tests.

Address the increasing internationalisation of computing qualifications and the demand for specific vendor certifications (MCSE, CNE etc.), by offering such courses as “top-up” courses of study after students have completed a base educational qualification. These courses could be offered consistent with a range of courses which suit part time student demands, and continuing professional development needs for practitioners engaged in lifelong learning.

Revise existing courses as required to address shifting technologies, techniques and the shortfalls identified. While this survey represents only a snapshot, it suggests a number of areas for course redesign or extension, and Polytechnics should consult with their Local Advisory Committees, their colleagues, through NACCQ and with other industry representatives to clarify the best directions in which to take specific developments.

The findings documented here may also suggest areas in which it is necessary to introduce new courses, or even whole undergraduate programmes (e.g programmes in E-Commerce) to meet demands arising from significant industry developments.

#### 5. CONCLUSION

This survey was carried out in conjunction with a presentation by the three Auckland Polytechnics to an IT

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breakfast of the Auckland Branch of the NZCS. This gave us access to useful information that would not otherwise have been available. We were able to ensure a near 100 percent response rate from a captive audience, who did their classwork well in the middle of the presentation. It was a staged piece of audience participation, set in the context of the presentation and was taken seriously by an expert and informed audience, with a vested interest in acquiring good graduates from our courses. A mailed out survey would not have achieved anywhere near the response rate from such a group of busy professionals.

This proved a most useful method of liaison with key stakeholders in Polytechnic education programmes. The attendees were mostly IT professionals and NZCS members, employers, practitioners and members of the vendor community. Therefore while the numbers may have been low statistically speaking, it was an informed and interested audience of experts, and the responses to the survey can be taken as good indicators of developing IT trends.

The strong emphasis on improving interpersonal skills of graduates and industry practitioners gave a very definite message regarding the need for Polytechnic (or for that matter all computing) programmes to produce more user friendly graduates for the IT industry.

Further research is required to explore the precise meaning of certain findings from the survey.

For instance the web related KSA's need to be defined more specifically, and suitable skill clusters determined so that we can tailor our courses towards areas of identified need.

A deeper insight is required into employer perceptions of the value of different education and training options. The importance and continued relevance of a broad professional education for our graduates, versus the acquiring of an internationally recognised vendor certification in certain specific areas, needs to be much better understood, so that we can market or tailor our courses accordingly.

Finally the nature and significance of the emerging skills identified in the survey need to be assessed to determine their likely impact, and the future demand. For the Polytechnic sector to remain a credible provider of professionally capable work-ready graduates to the IT industry, we need to better understand the nature of the continuing changes demanded of us our staff and our students.

This survey enabled the authors to better understand current developments in IT and their educational implications from the perspective of a group of key Auckland stakeholders. However given the nature of the New Zealand IT industry, regional differences may be considerable. An interesting follow-up study therefore, could involve conducting the same survey with a similar audience in another city.

## 6. ACKNOWLEDGMENTS

Thanks are due to the Auckland Branch of the NZ Computer Society for enabling the three Auckland Polytechnics to present to their management breakfast, and to the willing and helpful respondents who made this report possible.

## 7. REFERENCES

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## APPENDIX A – KNOWLEDGE, SKILLS AND ABILITIES QUESTIONNAIRE

### Question 1:

Assuming that you have a potential employee with highly developed interpersonal and written communication skills how would you rank the following TECHNICAL skills: (Scale of 1-5)\*

Structured Systems Analysis & Design Techniques

Object Oriented A & D

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3GL programming  
4GL programming  
User training and support  
Operating Systems  
DBMS & Database design  
Telecoms and networking concepts  
Network management  
Use & evaluation of software packages  
Information gathering techniques  
Project management skills  
Other: \_\_\_\_\_

**Question 2**

What are the THREE newest trends in IT that the Polytechnics need to consider for their courses?

**Question 3:**

What are the FIVE key skills associated with Internet development/deployment that now need to be considered?

**Question 4:**

Assuming a potential employee already has a Polytechnic qualification, what importance do you place on employees having vendor qualifications such as CNE, MCSE etc

(i) Upon initial employment with your company? (on a scale of 1 - 5)

(ii) After a year or more of employment with your company? (on a scale of 1 - 5)

**Question 5:**

If you have staff with no formal qualifications, what importance do you place on them getting:

(i) A vendor qualification rather than a formal IT related qualification (such as a Polytechnic certificate/ diploma/ degree) - (on a scale of 1 - 5)

(ii) a formal IT related qualification (such as a Polytechnic certificate/ diploma/ degree) rather than a vendor qualification. (on a scale of 1 - 5)

**Question 6:**

What are the THREE most urgent upskilling requirements for your staff?

\*Scale 1 = least important

Scale 5 = most important