Job Skills Inventory for Information Systems Personnel in New Zealand: An Exploratory Study of Change

John Monin

A dissertation submitted in fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in the

Faculty of Business Studies

Massey University

1997

TABLE OF CONTENTS

TABLES AND FIGURES v

ABSTRACT vii

ACKNOWLEDGEMENTS viii

1. INTRODUCTION 1

2. A HISTORY OF THE INDUSTRY 5

2.1 The Data Processing (DP) Era: 1950s - 1970s 7

2.2 The Management Information Systems (MIS) Era: 1970s 11

2.3 The Era of Strategic Information Systems (SIS): 1980s - 1990s 21

2.4 Chapter Summary 29

3. THE SKILLS INVENTORY FOR IS PROFESSIONALS 32

3.1 Application Programmer, Systems Programmer, Data Base Designer 34

3.2 Programmer/analyst or Analyst/programmer 37

3.3 Systems analyst 38

3.4 Project Manager 42

3.5 Data Communications Specialist 42

3.6 Director/executive, Middle Manager of IS 43

3.7 Consultant 47

3.8 Two studies of skill inventories changing over time 47

3.9 Chapter Summary 51

4. DEFINITIONS AND RESEARCH QUESTIONS 53

5. THE RESEARCH DESIGN AND SAMPLE 58

5.1 Model of the Skills Inventory 58

5.2 The Research Design 60

5.3 Developing the Indicators 64

5.4 Finding the Sample 75

6. THE SURVEY INSTRUMENT 78

7. SURVEY ADMINISTRATION AND PROCESSING 89

7.1 Mail-out Administration 89

7.2 Content Analysis of theTask Descriptors 90

7.3 Further Data Collection Procedures 95

7.4 Descriptive Statistics 96

8. ANALYSIS OF THE SKILLS INVENTORY BEFORE DATA REDUCTION101

8.1 The Means of the Total Sample 102

8.2 Tests of Significance 104

8.3 Ranking the Means 108

8.4 The Task Descriptors 111

9. THE MANAGER'S VIEWPOINT 116

9.1 Managers' Assessment of the Importance of Skill Items 116

9.2 Inter-group comparisons by Job Category and Experience Level 124

10. DATA REDUCTION 132

10.1 Validity and Reliability 132

10.2 Psychometric Coherence 133

10.3 Principal Component Analysis (PCA) 134

10.4 The Means of the Components 141

10.5 Task Descriptors Re-visited 144

11. CONCLUSIONS 147

REFERENCES 154

APPENDIX I: THE QUESTIONNAIRE 164

Tables and Figures

FIGURES

Figure 2-1: Ward's Three Era Model Superimposed on Anthony's Hierarchy of Management Model 6
Figure 2-2: Stages of Growth (after Nolan) 20
Figure 2-3: The Impact of Technology (after Sullivan) 23
Figure 2-4: Career Trajectory Map: summary of major roles 25
Figure 2-5: People-oriented IS Experience Curves(after Primozic et al. 1991:51) 26
Figure 2-6: Mix of Technology and Managerial/Organisational Skills by Era 30
Figure 4-1: Strategic Triangle (after Walton, 1989:54) 55
Figure 5-1: Skills Inventory Model 59
Figure 5-2: Retrospective panel design. Source: de Vaus, 1991:39 61
Figure 5-3: Skills Inventory Nomenclature Shift 65
Figure 5-4: Years Experience of Pilot Respondents 70
Figure 5-5: Pre-test Responses 70
Figure 5-6: Pilot questionnaire to Pre-test KSAs 72
Figure 6-1: Questionnaire - Section A 82
Figure 6-2: An example of Survey Instrument Likert Scale 84
Figure 6-3: Questionnaire Schema - Section B 85
Figure 6-4: Questionnaire Instructions for All Respondents 86
Figure 6-5: Questionnaire Instructions for Managers and/or Consultants 87
Figure 7-1: Age Distribution of IS Personnel in NZ: 1978 & 1993 99
Figure 7-2: Years in the Computer Field: 1978 & 1993 99
Figure 8-1: Total Sample Group Means of KSAs Classified into B(usiness) & T(echnology) 103
Figure 8-2: Total Number of Ranked Task Descriptors 113
Figure 10-1: Task Descriptors categorised by Components for All Respondents' Current Jobs 146

TABLES

Table 3-1: Classification of IS Knowledge/Skills after Todd *et al.* 1995:6 50

Table 5-1: Rationale for New KSAs 27-35 74

Table 5-2: Preliminary Job Categorisation of NZCS Members 76

Table 7-1: Task Descriptors Assigned to KSA Names and Additional Codes 91

Table 7-2: Task Descriptor Codes Collapsed into KSAs 94

Table 7-3: Respondents by Job Designation 98

Table 7-4: Respondents by Years in Their Current Job Designation 98

Table 8-1: Business-related and Technology-related KSAs 102

Table 8-2: For All Respondents - Mean Scores and Changes in the Importance of KSAs 106

Table 8-3: Repeated Measures ANOVA of Top 10 Start Means 109

Table 8-4: Repeated Measures ANOVA of Top 10 Now Means 110

Table 8-5: Content Category Count: Business-related and Technology-related Task Descriptors112

Table 8-6: Current Job KSAs: Comparing the Rankings of Means and Task Descriptor Ranked Scores 114

Table 9-1: For Self-selecting Practising Managers (n = 145) - Mean Scores and Changes in the Importance of KSAs 118

Table 9-2: For non-managing respondents (n = 288) - Mean Scores and Changes in the Importance of KSAs 119

Table 9-3: Top 10 t-values of KSAs in Tables 8-2, 9-1 and 9-2, ranked and compared 121

Table 9-4: Top 10 Start Means Ranked 122

Table 9-5: Top 10 Now Means Ranked 123

Table 9-6: Differences in Perceived Importance of KSA: Mean difference scores, Job Category within Years of Experience 126

Table 9-7: Differences in Perceived Importance of KSA: Mean difference scores, Years of Experience within Job Category 128

Table 10-1: Component Pattern Matrix, including α reliability analysis, for Items Measuring: 137

Table 10-2: Repeated Measures ANOVA of Skill Components Ranked by Means: 143

Abstract

Based on a survey of 443 members of the New Zealand Computer Society in 1993, this study examines whether the skills requirements for information systems (IS) professionals have changed in the turbulent economic environment New Zealand has experienced since the mid-1980s. Respondents to the questionnaire were asked to rate the importance of thirty-five skill items during the period they have been working under their present job designation.

The research instrument is based on an extensive review of previous research constructs and upon themes visited by academic writers during three eras of computing. The research expectations are that there has been a definite shift in the skills requirement. The focus is on the categorisation of the skills as business-related or technology-related, this being the distinction traditionally accepted by most researchers to date. The model proposed, however, accounts for more sophistication and blurring of such a dichotomy. It is based on the premises that the core skill competencies for IS professionals have essentially remained constant and that there has been an increase in the requirement for more emphasis on the business-related skills.

As assessment of the skills requirement for practising IS personnel resides in an organisational context, the design incorporates strategies to capture the management point of view. The design of the instrument also caters for textual responses about a respondent's current job in order to validate the rating scores provided in sets of Likert scales.

In the main, the findings confirm a pronounced increase in the importance of business-related skills. Additionally, in the view of the managers this requirement needs to be focused on communications skills. There is no implication here of fewer technology-related skills, but rather more business-related skills in view of the greater demands in rapidly changing environments. According to this sample, business-related skills have always been important for them as IS personnel.

Acknowledgements

My acknowledgements need to include institutions and authors that might seem quite impersonal and remote. For access to their reference material I have to thank the New Zealand university libraries of Otago, Canterbury (my *alma mater*), Victoria and Auckland (especially for holding the *Computer Personnel* journal). Inspiration for the research instrument came from the writings of North American academics P.H. Cheney and J.D. Couger.

I am indebted to The New Zealand Computer Society for permitting me to survey their members, and in particular Ron Henry for carrying out the actual process of mailing out the questionnaire in order to retain confidentiality of members' details.

This thesis would not have been completed without the continuous support of my chief supervisor, Professor Philip Dewe, Head of the Department of Human Resource Management, who was quick to see the inter-disciplinary nature of my topic. I am most grateful for his expertise with the SPSS software package and his ready availability throughout the four years.

My second supervisor, Professor Tony Vitalis, as my Head of Department provided the encouragement of a mentor who also applied his precise and focused Classical mind to my drafts - especially useful when one needs to keep in mind the objectives of the thesis.

It is that same academic training in the Classics that tends to induce a certain terseness and lack of explanation in my writing style. So behind the scenes has been my literary wife and partner, Nanette Monin, who has contributed with invaluable editorial and discursive support.

1. Introduction

ΓΝΩΘΙ ΣΕΑΥΤΟΝ

KNOW THYSELF

How well *does* the computing profession know itself?

Does its assessment of its own skills requirement give any credence to the popular perception: that technocrats are unaware of the people skills required in the modern workplace? What skills are regarded as important by their managers, most of whom are in the same profession and are also from technical backgrounds? What are the competencies required in the workplace? This thesis will explore these questions.

The commercial computing industry is young in comparison with other 'professions'. It has evolved through only four decades. Its activities have been variously described as data processing, business computing, management information systems (MIS) and more recently information systems (IS).

The personnel involved in the production of information systems have typically entered the profession as programmers on the technical ladder, then gained promotion to systems analysts, software engineers or senior programmers, and at a later stage may have transferred to the business ladder by becoming an IS manager. They have been regarded as possessing skills associated more with the disciplines of science, mathematics or engineering.

Consequently, to increase productivity, this fledgling profession has emphasised the development of systematic approaches based on systems theory and engineering techniques: movements such as systems development (1950s), structured techniques and modularisation (1960s and 1970s), and object-oriented analysis (1990s). In addition, 'generations' of programming languages have succeeded one another by offering greater efficiencies. In the 1980s computer-aided software engineering (CASE) was heralded as a breakthrough to speed up the process of delivering software by introducing more automation to the process.

In direct contrast, the users of the information systems produced by the IS professionals are often not necessarily of the same logical, structured frame of mind (Strassmann, 1990:306); nor do they have the time or inclination to appreciate the technical details of such systems. They are more concerned with the organisational imperatives that need to be addressed by, or the operational features that need to be provided in, those systems. From their point of view, the skill required of information systems professionals is simply a matter of routine translation of user requirements into a machine language for the computer. In brief, they would maintain that given that there is adequate communication between the two parties, there is no reason why the IS party could not apply systematic, possibly automated techniques to effect the 'translation'.

Despite such assumptions, commonly made not only by users but also by managerial advocates, and despite the adoption of the latest systematic production 'tools', the IS profession has not shown itself capable of producing satisfactory outcomes. Its high-risk projects are infamous for their failure to meet deadlines and to keep to budgetary constraints (Strassmann, 1990). Users continue to complain of a mismatch between their expectations and the final software product or system (Szanja *et al.*, 1993).

There have been repeated calls from some academics and from employers for more emphasis on human communication and business related skills for IS personnel (Scott & Zawacki, 1989; Watson, Young, Miranda & Seerley, 1990; Hudson, 1992). As more investment is made in information technology the question of productivity arises. It seems that despite the extra expenditure on the technology white-collar productivity has shown no significant increase over the last decade in the United States (Scott Morton, 1991:19; Davenport, 1993:40-44)

Therefore there is a need to examine further the skill competencies of IS professionals. Hence the purpose of this study is to explore over a period of time the inventory of skills perceived by IS personnel as being necessary in their jobs. An since it is intented that the nature this study is to be exploratory (indicated in the sub-title), the approach to the research question is inductive, while the research methodology contains a blend of both quantitative and qualitative techniques.

The precise research questions will be proposed *after* the reader has been exposed to the historical texture of the IS personnel environment. In the interests of comprehensibility and in order to provide a rationale for the research objectives, coverage of myths and popular beliefs is treated as a precursor to the posing of questions to be addressed in the study. Evidence that substantiates answers to the questions will be based on the perceptions of a sample of practitioners in New Zealand. The sample has to be large enough to provide statistical significance and yet also include sub-groups of managers and non-managers. This will enable an analysis of the perceptions of IS managers in comparison with the more technically-oriented operatives. The research instrument that best fits this design is that of the survey. To overcome the issue of capturing evidence to answer questions involving a time dimension, a 'retrospective panel' design will be adopted for the questionnaire.

A research instrument will be developed to include an inventory of skill items the importance of which respondents will be assessing by means of Likert scales. These items will be identified, validated and constructed as the principal unit of analysis. The instrument will cater for both quantitative and qualitative methods to measure the items and to validate the findings. The quantitative techniques will involve statistics to compare and analyse the means and variances of data collected, within and between groups of respondents; the qualitative technique of content analysis will be used to analyse keywords describing each respondent's job activities. It is expected that a variant of exploratory factor analysis will be utilised for two reasons: first, to help make sense of the data involving a large number of skill items by reducing their number, and secondly to validate the coherence and reliability in the selection of the items themselves.

It is expected that the findings will contain statistically significant results as regards the importance of business-related as opposed to technology-related skills, both over time and in the current workplace. Comparisons between managers and non-managers, between personnel of differing experience, and between job designations should carry important messages. Finally, it is hoped that more will be discovered about the nature of the skills themselves.

The issues addressed in the study are important for organisations that employ IS professional staff and may help confirm their hiring policies. They are of value for IS personnel themselves in order to gain an understanding of their promotional prospects. They are also of interest to educational institutions contemplating a curriculum review or offering professional development courses.

In Chapter 2 a review of the literature describes the technological environment in which IS personnel work as professionals. This is a global overview with references to New Zealand throughout. It concludes by proposing the research questions to be addressed. Chapter 3 focuses at a more detailed level on the job designations and skill items as identified in the literature. Once the main issues have been discussed the next chapter defines the terminology and the research questions are confirmed. Chapters 5 and 6 cover the methodological procedures, including the design of the research instrument and provide a profile of the sample. Chapter 7 gives details of administering the survey and the subsequent data collection procedures. Analysis and discussion of the results are contained in chapters 8, 9 and 10 focusing respectively on the initial data, managerial perspectives and data reduction. The final chapter concludes with a summary of the findings, limitations of the study, and suggestions for further research.

2. A History of The Industry

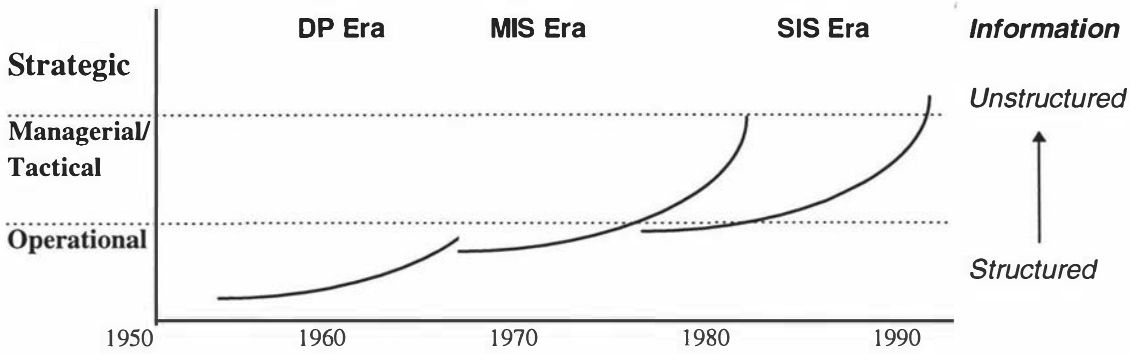
Although this research is centred on the skills requirements of personnel within the computing industry, it is essential to recognise that the underlying driver is the continuous development of more sophisticated hardware technology. The inexorable and rapid advances in the hardware outstrip equivalent advances in the software to service that hardware. Obsolescence of computer equipment is now a well-known phenomenon. As a result, IS personnel, especially those not directly involved with operating systems software for the new hardware, can soon find themselves being pressurised to upgrade their skills.

It is this recognition of the historical milieu which has determined the structure of the literature review into two parts. The first section commences with a historical review of three decades of. progress in computer systems (both hardware and software) in the commercial arena. The second section covers in more specific detail a literature review of research into a skills inventory and job designations for information systems (IS) personnel.

Major themes will surface as the review of the literature develops. Whereas many of the themes relating to personnel are traced throughout the historical review, due to the popularity of topics at a particular time, new themes appear and long-standing ones can acquire differing emphasis. The intention is to provide the 'softer' texture to the central topic of personnel skills.

The Three Era Model presented by Ward (1990:10-19) and the five decades (1950s to 1990s) identified by Robson (1994:320) are typical summaries of the history of the use of computers in organisations. It can be argued that the use of decades as historic milestones is simplistic, but the intention is merely to provide a sense of progression in a time span that includes incremental changes. A large number of small changes when viewed retrospectively can be interpreted as a few momentous changes or 'paradigm shifts' (Kuhn, 1970; Tapscott & Caston, 1993).

Figure 2-1: Ward's Three Era Model Superimposed on Anthony's Hierarchy of Management Model



The model chosen for the review of the literature is that of Ward. The three eras of Data Processing (up to 1970s), Management Information Systems (1970s onwards) and Strategic Information Systems (1980s onwards) reflect the general orientation of the applications as delivered to the users in organisations. In essence, the first concentrated on efficient handling of data, the second moved to improving reports to management, and the third shifted to a level of providing strategic benefit. There is an evolutionary transition from one era to the next, and each era is not superseded or replaced by the next. The three eras are represented in Figure 2-1 as waves of technological advances, each successive wave builds on the previous to carry on the innovative momentum to develop new technologies and to service the requirements of increasingly sophisticated users of those newer technologies. From an organisational perspective IS systems can be seen (Figure 2-1) as servicing the needs of the three levels of management identified by Anthony (1965). Anthony's model comprises the three-tiered levels of management hierarchy: operational, managerial and strategic. The special attributes of the differing levels relate to planning horizons: top-down from long term through medium to short term. In terms of managerial decision making which is largely based on information, the three levels can be seen as degrees on a spectrum from unstructured informational requirements at the strategic level descending to more structured informational needs at the operational level (Robson, 1994:73-75).

2.1 The Data Processing (DP) Era: 1950s - 1970s

This first period up to the 1970s Ward categorises as the Data Processing Era. Most applications were based on accounting systems, such as general ledger, payroll, debtors and creditors. Consequently responsibility for the user requirements lay with an accounting/finance function (described aptly as 'captured function organization': Setaro, 1990:8). 'Number-crunching' was the main activity of most business computer systems. The user had no direct interaction with the computer systems which were housed in air-conditioned large rooms with restricted access. The normal form of information retrieval was monthly reports that were printed on stacks of lineflow stationery. Such hardcopy reports were pre-determined and structured, merely summarising historical data. From an organisational perspective the main benefit of these computer systems was the efficient capture and storage of *operational* (to use Anthony's term) transactions. Now most commentators refer to computer systems that concentrate on the manipulation of data at the operational level as transaction processing systems (TPS). Such systems are still the pivotal point for any modern computerised business. They must be auditable, reliable, secure and hence they need to be constructed by professional computing personnel.

Beyond the shores of New Zealand the 1950s were witness to a training emphasis in the computer industry on programming skills and school mathematics. Computer personnel were perceived to belong to the occupational category of super-clerks whose loyalty lay with the machine. Programming languages were at machine code level, with core memory wired up in kilobits. Computer systems ran in batch mode, with the program instructions read and executed from ungainly storage drums. Some machines, known as 'visual record' computers updated individual hardcopy records and held the master file on paper tape. The computing equipment was usually run by the accounting function.

The 1960s still saw the computing function as reporting to an accounting department, but computer personnel tended to be 'report generators' with their loyalty shifting to their function within the organisation. Their skills now included systems analysis techniques that were often based on tertiary qualifications, and an understanding of on-line as well as batch systems. Programming languages had now progressed to second generation assembler code. The large mainframes required operators skilled in running the batch jobs.

The first computer to be installed in New Zealand was a machine in the Treasury in 1960, the same year that the New Zealand Computer Society was established (Williams, 1985:37). It was an IBM Type 650 Data Processing Centre which

> ... made available for the first time in New Zealand the speed and versatility of a stored programme machine using magnetic tape. The biggest single job initially undertaken was the payroll preparation of some 34,000 public servants....As the machine was stated to generate as much heat as eighty one-bar heaters, an air conditioned room had to be provided, with a dummy floor to take the cables connecting the machinery. (p. 38)

This initiative was soon followed by the private sector:

> it was a matter of virtually uninterrupted exponential growth, despite a severe scarcity of computer expertise...Early business applications were, for the most part, fairly standard tasks - essentially substitutions for clerical work. (pp. 76-77)

By the end of the decade nine government departments had computers. The applications covered public accounts, payroll and accounting systems for trading departments.

The large mainframe mentality led to an argument for centralised efficiencies. The concept of bureau facilities was a popular alternative option to the building of in-house computer facilities. A prime example of bureau operations was the establishment of Databank Systems Limited by the five trading banks in 1967. In another example, the government rationalised separate departmental systems to form in 1972 the Computer Services Division of the State Services Commission effectively to perform as a bureau (Department of Labour, 1986:4-5).

The scarcity of computer expertise referred to in the quotation above continued unabated and worldwide until the 1980s. As an example, a British leader in the area of systems analysis training cites a 1967 government report estimating a shortage of some 12000 analysts by 1970 in the United Kingdom (Daniels, 1968). By this time the

National Computing Centre (NCC) in Manchester was gaining orders for its systems analysis training package throughout the world, including Australia (Daniels, 1968:22-23).

In 1967 the Auckland Technical Institute introduced a full-time course in Electronic Data Processing (EDP) (Turner, 1968). The programming and systems analysis content (18 out of 34 hours p.w.) of the course included three levels of language: a basic language for their 'old ICL 1201 drum computer'; PLAN as an example of an assembly-level language; and onto the third generation languages of RPG, COBOL and FORTRAN. In the context of trainee skills Turner makes a comment that could be interpreted as typically Do It Yourself (DIY) Kiwi. It probably helps explains why the multi-skilled positions of programmer/analyst and analyst/programmer became so popular in New Zealand.

> Programming is rounded off with a Systems Analysis course and discussion of management techniques. Programmers do not necessarily need to learn Systems Analysis, but their tutors have found that their work is performed more intelligently if they have a knowledge of this subject. (Turner, 1968:19)

The first university course in EDP was offered two years later, in 1969, by Victoria University of Wellington. But it was an advanced computer science course and demanded two years of prerequisite papers in mathematics. It is an example of the DP Era approach to education and training of computer personnel. Most of the topics were in operations research with Algol being offered only as a block course in the vacations. (Data Processing in NZ, 1969:19). A decade later Algol was ranked as the least important area of knowledge for commercial programmers (Boswell & Melhuish, 1978b:64).

The first national conference of the NZ Computer Society took place in August 1968 in Auckland. The matter of formulating an effective education policy was regarded by the members at the conference as one of urgency. The ensuing debate raised thorny questions about the Society's role, whether it should be setting qualification standards [as the British Computer Society was in the process of doing (Data Processing, 1971)] or giving advice only. Graham Tate of Massey University said the universities would like a much stronger guide from the computer industry, while Gordon Hogg from

Databank Systems Ltd. suggested that training could be left to the computer suppliers as 'It may be that we will not need a whole lot of systems analysts in the future' (Data Processing in NZ, 1968, p 5). Another speaker argued the now familiar theme that universities should encourage creative thinking, while the technical institutes exist to give training for immediate application.

A three-person sub-committee was set up to produce recommendations, looking ahead to the year 1975. It reported a year later (Data Processing in NZ, 1969). They estimated that there would be about 300 computer systems installed in New Zealand by 1975, conservatively requiring some 550 managers, 600 systems analysts, 900 programmers and 550 operators. The background of all three members (one a university computer scientist, one an engineer and the other from an industrial chemical background) reflects the mathematically oriented approach in the DP Era. The following views reflect the lack of understanding of human resource issues. They envisioned EDP managers being recruited 'by the natural promotion of systems analysts', and the training of commercial programmers and operators as best left to the polytechnics, so 'need not be discussed further here'. Although they proffer advice on the skills required of specialist systems programmers ('skills in data transmission, and information theory'), they are less clear on how universities should train the categories of manager and systems analyst.

During this period research in the area of skills for data processing personnel had not gained prominence in academe. The first conference on Computer Personnel Research (sponsored by the Association of Computing Machinery, USA) was held in 1962, with the first publication of this Special Interest Group's journal did not take place until the mid-1970s. Meanwhile, in the workplace personnel stereotypes had firmly established themselves:

> The computer specialist is usually imagined as young, clever, logical, technologically oriented, ambitious, creative and loyal to his subject; never to his employer. To these some would add "arrogant" or at least "supremely confident in the rightness of his recommendations". (Blake & Price, 1969:483)

Computer people were seen as a different breed, interacting more with machines than with humans, and hence lacking in communications skills. They were seen as mobile, well paid and as possessing specialist skills. Above all they required to be managed. The same authors (Blake *et al.*, 1969) accept the career path from programmer to systems analyst to computer manager, but have the foresight to see the different jobs as an overlapping continuum of tasks, undermining the distinct rungs on the traditional career ladder. At the one end of the skills continuum they put the information services manager, consultants and advisors together with the data processing manager. Here they expect to find the more imaginative, and possibly creative, business oriented people who are skilled in social action. Next come the systems analysts who are somewhat in the middle position requiring both technical and business related skills. As an example, in the first 1969 issue of the same journal, Data Processing, (p. 87) a construction company advertised for systems analysts that were in possession of both recognised accountancy qualifications and also a minimum of two years experience in systems analysis. Next on the continuum are positioned the programmers where 'initiative and imagination is replaced by a certain calm, logical solidity'. On the opposite end are the operators, maintenance staff and tape librarian.

In summary, it was not until the DP Era had thoroughly exploited the technology to store and manipulate operational data that management began to address the issue of education and training for the computing personnel involved in the development process. As a corollary, it means that the skills requirements and occupational milieu for those personnel was not well understood, and so not defined.

2.2 The Management Information Systems (MIS) Era: 1970s

By the 1970s third generation languages (3GLs) such as COBOL represented a breakthrough for commercial systems. The benefits of centralisation were reinforced by the development of sophisticated database management systems (DBMS) which, it was maintained, would eliminate duplication and ensure integrity of the data. The end of the decade saw another breakthrough: the release of relational database products such as IBM's DB2. The latter products promised improved retrieval access to the data and a higher level of integrity.

At the same time, however, more people skills were becoming a requirement for data processing (DP) as personnel found themselves in the role of change agents. These skills were dictated by activities such as project management and the analysis of business requirements (Blake *et al.*, 1969:484).

This was the second era of Management Information Systems (MIS). Obviously the two eras overlapped, but in the second the emphasis moved: from efficient code generation to more effective response to user requirements; from amassing transactions to improved report generation for management. Although the hardware was still mainframes in air-conditioned rooms, more on-line systems were starting to appear.

For such large monolithic systems, the development process had to be a methodical series of time-consuming steps from conception, to the documenting of user requirements, through program writing and de-bugging to eventual 'live' installation (Grodman, 1977). Most projects took at least two years to complete. Based on a biological analogy, this process is known as the traditional systems development life cycle (SDLC). The control of such vast projects required project management methodologies, one of the more popular being IBM's Business Systems Planning (BSP) (IBM Corporation, 1978). In New Zealand a methodology called Spectrum became a standard product used by most government departments at the behest of their bureau, the Computer Services Division. At the systems analysis level a more methodical approach was advocated in the form of 'structured systems analysis' (Yourdon & Constantine, 1975; Gane & Sarson, 1977), and for programmers more 'modularising' of code was demanded.

Early in the decade the Association for Computing Machinery (ACM) made its first curriculum recommendations for the teaching of information systems in graduate (Ashenhurst, 1972) and undergraduate (Couger, 1973) courses. These reports stress the divergence from existing computer science curricula and the emerging need for education in administrative information systems and the effective use of computers in organisations. An important distinction is made between the curriculum suitable for a managerially oriented 'information' analyst and that for a technically trained systems designer. Due to changing technology these recommendations were updated ten years later (Nunamaker *et al.*, 1982). Most universities in New Zealand have since taken into account the ACM recommendations when designing course content.

In the 1970s the literature recognises for the first time the separate employee group of computer personnel whom employers still classified as clerks. Two publications make a noteworthy contribution in this context. The only book devoted solely to the treatment of computer personnel as employees in an identifiable job category is *The Psychology of Computer Programming* (Weinberg, 1971). Although designed as a textbook to stimulate student discussion, this work is a brave attempt to document much anecdotal material with the intention of bringing to the surface many themes familiar to computer practitioners. At the time these themes were still not identified as research topics in many universities. It is a book which both sums up the first 'era' and is also a spring-board of emerging themes in the second era. The only other book in the 1970s that seriously treats the topic of computer personnel is Philip Kraft's *Programmers and managers: The routinization of computer programmers in the USA* (1977). Like Weinberg he recommends adopting a sympathetic, behavioural science approach to researching computer personnel. It was obvious to Gerard Weinberg that programmers exhibit unique skills, different from those displayed by other technicians, but somehow related to problem solving activities based on a programming language. In Chapter 3 he suggests a behavioural science approach to studying such a group: namely methods such as introspection, observation, experiment and psychological measurement. He also proposes the social science stance of observing programmers and their culture as would an anthropologist (p. 39).

Themes and myths abound in both books.

Computer executives, unsettled by a 'mystique' they do not understand, usually attempt to eliminate the human element in programming (Weinberg 1971:4). This fleeting idea could be an explanation for many succeeding developments, often aimed at managerial audiences, such as references to programmers as a dying breed (George, 1970:465; Licker, 1983 p. 4) and automating tools to replace programmers (e.g. Computer Aided Software Engineering or CASE).

Kraft also refers to myth-making by managers:

> It was not so long ago that programmers were made out to be a tribe of magicians.. The "typical" programmer was an unkempt eccentric, part wizard, part misanthrope, who preferred the company of electronic brains to human ones... He worked, like true magicians, mostly at night, making only occasional visits to claim payment for services rendered. (p.64)

> If you take managers at their word, programming remains an undertaking always in chaos. It is populated by either undisciplined anarchists or sullen slackers - or both. Programmers are by their nature .. narrow-minded specialists whose major interests are esoteric games .. and whose primary occupational goals are jobs with regular pay increments and no responsibilities... the managers who, unlike their charges, are "generalists" with a clear view of the "Big Picture", the end to which the work of the programmer will be put. (p.65)

Weinberg also, throughout his book, presents disguised anecdotes underscoring the misalignment of goals and attitudes of groups of programmers and their management. For example, he quotes (without reference) social psychologists who state that there are three basic personality types: the compliant type who likes to be helpful; the aggressive type whose goal is to earn money and prestige; and the detached type 'who wants to be left to myself to be creative'. The majority of programmers, he maintains, lean towards the last category. Managers, on the other hand, tend to belong to the aggressive category (p. 61).

We see here the familiar re-emergence of two conflicting cultures, heralded by Matthew Arnold in 1869, almost a century earlier (Arnold, 1957). Similar to the theme in C.P. Snow's Rede Lecture delivered at Cambridge (1959), Arnold highlighted the intellectual cleavage between people trained in the sciences and those trained in liberal studies. Most authors still prefer to contrast the attitudes and values of 'technical specialists' with those of 'general managers' (e.g. Campbell, 1970; Robson, 1994:322). Others refer to different cognitive approaches: the analytical technician who concentrates on detail and input contrasted with the output-oriented business person who prefers the overview (Stewart, 1971; Benbasat *et al.*, 1978). An earlier writer explains it in terms of the EDP persons' view of themselves as 'a special breed' whose talents elevate them to professional status and so their actions are less questioned (Stymest, 1966).

The same duality becomes operationalised in the dual ladder model for career advancement. Kraft mentions that this approach is used in other technical workplaces (p. 63), and is cynical about its efficacy (p. 87). The job titles indicate only management's efforts to provide the appearance of a technical career path, while the real career paths remain those of managerial and sales employees. On the technical ladder the employees face two choices when they reach the top rung: either face obsolescence or change career by transferring to an area of 'management applications'. For programmers who do not wish to inherit the routine maintenance of software created by themselves, the solution is to move to other employment, every 2 - 3 years (Peters, 1971). This leads to disillusionment with the normal commercial career structure, and gives rise to their reputation as vagabonds who lack company loyalty (p. 430). In the same period in New Zealand demand for computer staff far exceeded supply, and mobility was linked to some extent to remuneration:

> EDP positions are exacting and demanding. A high premium is placed on precision, attention to detail, accuracy and often quite a large amount of repetitive routine work is involved. Under these latter conditions it is not easy to gain full job satisfaction, particularly when the novelty wears off. These conditions are often conducive to employees placing a high premium on monetary rewards, recognition and status. We see this emphasis in other occupation groups as well e.g. airline pilots and freezing workers. (Borland, 1971:7)

Another theme of conflict, the debate as to whether programming (and also systems analysis) is a science or an art has been an on-going dialectic. Donald Knuth, an early authority on programming techniques (1968) bases his Turing Award lecture on the two opposing points of view, but concludes on the following note:

> Computer programming is an art, because it applies accumulated knowledge of the world, because it requires skill and ingenuity, and especially because it produces objects of beauty. A programmer who subconsciously views himself (or herself) as an artist will enjoy what he (or she) does and will do it better. (Knuth, 1974, cited in Knuth, 1992:14)

It's the universal dialectic of structure versus creativity, left brain versus right brain. Often it is manifest in the stance taken by the employer or manager versus that taken by the employee: the former supporting the more regimented automaton approach, while the latter fights for more flexibility, less visible productivity and the space for more lateral activity. Any technique designed to increase productivity can be seen as a Taylorist production line. The programming task was broken into logical sections so that 'coders' could mindlessly write the final computer statements (this class of worker was confined to the USA in the 1970s, and the idea does not seem to have been pursued since).The 'structured programming' movement is seen by Kraft as a de-skilling attempt by management to automate the programming task:

> Indeed, the principle was simple: if managers could not yet have machines which wrote programs, at least they could have programmers who worked like machines. Until human programmers were eliminated altogether, their work would be made machine-like - that is, as simple and limited and routine - as possible. Briefly, programmers using structured programming would be limited to a handful of logical procedures which they could use - no others were permitted. ... This is not to say that it is no longer possible to construct elaborate and complex software systems at all. It means instead that such complex structures will be made up of more, smaller, simpler manipulations instead of fewer, complex ones...Moreover, since the procedures are few, universal, and well-understood, one programming routine will develop much like all others. Mistakes are no longer idiosyncratic but systemic...Both writing and de-bugging are further facilitated by structured programming's logical partner, modularization, which breaks down an entire software system into limited-function, discrete units, written independently and then fitted together in a pre-determined way to form a single system.
>
> Structured programming and modularization thus achieved two long cherished managerial goals at once. They freed managers from dependence on individual high-level software workers. They also made possible for the first time a genuine job-based fragmentation of labor in programming. Until structured programming, the common industry-wide divisions between analyst, programmer, and coder could be no more than arbitrary divisions of authority and control. Actual work tasks overlapped at all levels. ... A hierarchy of authority could now be established by arranging various job fragments in a rank-order on the basis of either skill or an understanding of the task as a whole or both. (Kraft, 1977:57-59)

Kraft assumes the worst as he pursues the de-skilling theme in his conclusions. He suggests that in the USA the pre-meditated actions by management to routinise programming will lead to adverse social stratification (analogous to the scientist-engineer-technician descending scale of status ranking), and that higher paid white males are being replaced by lower paid, less well trained and less skilled female and nonwhite programmers (pp. 105-106). He acknowledges his indebtedness (p.19) to Harry Braverman (1974), who insists that shifts within occupations are as crucial to de-skilling as shifts between them.

Five years later, Paul Licker of the University of Calgary mentions the danger of pigeon-holing programmers by moulding their skills too closely around the business application. He adds a footnote acknowledging Kraft's correct prediction of trends in technology, even though 'the arguments are quite controversial and the study less than scientific' (Licker, 1983:5) and programmers are not assembly-line workers (Licker, 1985:12).

In the academic arena, however, one piece of research that continues to be cited by researchers of computing personnel is that of Couger and Zawacki (1978) who observe that job dissatisfaction and worker alienation is a problem in other professions and that signs of job dissatisfaction are emerging in the data processing field. They examine the job characteristics of applications development, technical management and operations staff using the Hackman and Oldham (1975) job diagnostic survey (JDS). Their subsequent studies of DP professionals still indicate that computer personnel rank significantly lower on social needs compared to other workers, including those in New Zealand (Couger & Monin, 1994). But high growth needs and the high potential for motivation for DP professionals is also apparent. To some extent these results tend to support the stereotype that continues into the 1980s:

> The first two decades of programming history produced the image of the introverted, isolated programmer surrounded by stacks of output. Other workers have left the office but our intense programmer, ignoring the absence of colleagues, scribbles rapidly, with a felt tip pen, in hopes of eliminating the last annoying bug before a 9 AM deadline. Fortunately this image is becoming a wild caricature of reality. (Schneiderman, 1980:124)

But this sentiment is not restricted to only programmers. It seems to apply to the profession as a whole:

> The nature of data processing work has bred experts in systems design, programming, hardware selection and on-line systems. The emphasis on

> technology, however, has often been at the expense of good communications. ..data processing professionals must sharpen their communicating skills. (Young, 1982:67)

But in the mid-1980s there's even a suggestion from some New York DP managers that the high turnover of their staff may be due to cultural rejection by the remainder of the firm (Turner & Baroudi, 1986:3).

Couger and Zawacki report that analysts and programmer/analysts rate their jobs higher on the 'need for growth' dimension of the JDS than do other professional occupations, but that DP professionals rate their jobs as lower with regards to 'social need strength' than other professionals. Additionally, the researchers' results suggest that DP personnel experience the same meaningfulness from their jobs as other professionals, but have lower perceptions of their degree of responsibility and knowledge of results of their work. The main conclusion is that DP supervisors are not giving as much support and feedback as their peers in other fields. Dan Couger has since continued to administer the JDS in many countries worldwide (Austria, Finland, Israel, Singapore) using his large United States database as the baseline for comparison. The conclusion over two and a half decades is that, apart from small differences, the motivational perceptions of IS professionals has remained stable on a global basis, including Australia and New Zealand (Dengate *et al.*, 1990; Couger, 1992; Couger & Monin, 1994).

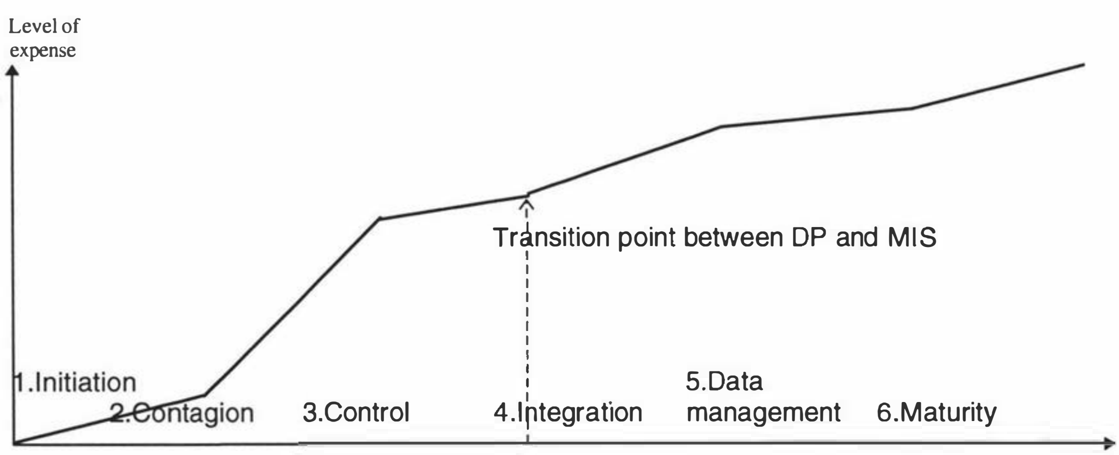
Couger makes the assumption that computer personnel are 'professionals'. But this assessment of their standing in the community and within industry has been a hot topic of debate, still unresolved in many countries including New Zealand. In retrospect the MIS era could be seen as the period when the young computer industry was attempting to arrive at methodologies to legitimize its activities and reputation, hence the need for professionalism (Data Trend, 1972; Canning, 1976; Martin, 1977).

Another seminal theme raised by Weinberg (1971) is that of a team approach to programming. Such a team has to be capable of writing the separate modules of a single program. Problems of coordination and communication have to be resolved, both at the technical and personnel levels. He is a proponent of the 'democratic team': that if it is to have a leader, the leadership role is not confined to a single individual in the team. He claims that normally programming teams are run 'more democratically than typical work teams in many other fields'. It is not surprising, then, that he regards with suspicion the internal IBM report by H.D. Mills on the concept of the 'Chief Programmer Teams'(CPT). In brief, Mills' team is modelled on that of the surgeon surrounded by hierarchically responsive support personnel in well-structured roles. It was F. T. Baker who subsequently published and has since been generally cited as the primary source for CPT principles (Baker, 1972). Kraft is also sceptical of the concept. He sees it as the logical outcome of the 'structured programming' and 'modularization' movements of the 1960s and 1970s (Kraft, 1977:56-60).

On the issues of individual programmers within a group, Weinberg is the first author to attempt to describe the problem solving skills required of programmers and their psychological reactions to common problems. As an example, the tendency not to want to see bugs in one's own programs is explained by Festinger's 'cognitive dissonance' experiments (1957) in which subjects are uncomfortable when required to counter their cherished beliefs. This leads to an exposition on his concept of 'egoless' programming. He suggests the question of an individual's ego has to be addressed especially during the act of debugging programs. It is at this stage that a programmer's personal work of art, the program, is tested for errors and is submitted to scrutiny. Programmers must learn to accept their inability to function like a machine, their humanity. The typical group of programmers might be in the same department or firm, all working on separate projects. Conflict can arise between the more formal structure of a project and the informal communication channels between individual members of the group. The importance of physical environment (now known as ergonomics) in relation to programmer productivity and social interaction is briefly eluded to (p. 51).

In many senses this chapter can be seen as a story tracing the progression of a fledgling industry from infancy to maturity as it learns to provide more services to higher levels of management within organisations. During the DP and MIS eras this phenomenon is best described by the now famous 'stages of growth' model developed by Dick Nolan (Nolan, 1973a; Nolan, 1979). Even though the model is focusing on the growth of expenditure, it is also a convenient way to describe diffusion of innovation and assimilation of new technology in organisations. The first three stages - initiation, contagion, control - of the six stage model can be seen to represent the DP era (Figure 2-2). From the initiation stage the initial take-up of the new technology is instant with high expectation of benefits (contagion stage), but costs escalate until management becomes concerned enough to introduce standards and controls (control stage). This aspect of the model still attracts instant recognition for most observers. The final three stages in order are integration, data administration and maturity. At considerable expenditure existing, disparate systems are integrated (via database). Then the value of information retrieval is finally understood by users, so the DP department changes to provide an MIS service. Frequently a specialist database administrator (DBA) is appointed to manage the complex centralised database. It is indicative of the constant development of the industry that this model itself was extended by Nolan from a 4-stage (1974) to a 6-stage model (1979) to keep pace with the technology.

Figure 2-2: Stages of Growth (after Nolan)



Nolan also suggests that the more mature an organisation is with regards to DP, the more it will perceive a greater usefulness for the more managerial/generalist skills, and the less it will require technical/specialist skills of its DP manager (Nolan, 1973b). He argues that the less mature DP organisations will require managers to perform many of the technical functions of systems analysts and programmers, whereas the more mature organisations will require managers to perform more managerial and administrative functions.

There is an assumption here, echoed by many a subsequent researcher (e.g. Benbasat *et al.*, 1980) that business-related, managerial skills are 'generalist' in comparison with the technical skills that are seen as 'specialist'. This proposal can be extended to include corollary suggestions, building on the idea of maturity. First, as an employee matures in stages through his or her career, the more managerial/generalist will become the skills requirement. Secondly, to generalise from the preceding corollary, it could be argued that the whole computer industry, as it matures, aims to develop hardware and software that is easier to use and hence requires fewer technical/specialist skills of the user. The inverse effect here is that as end-users become more adept at utilising the computer systems, the more the DP specialist needs to acquire a broader set of skills that includes more business-related, user-oriented skills to work with users.

In summary, the MIS era witnessed substantial recognition of the need to broaden the skills inventory of DP personnel. In response to employers' pressure, curriculum developers in tertiary education called for more business-related topics to supplement the computer science core. As computing personnel became more exposed to users at higher levels of organisations, the greater was the requirement for skills to cope with such a shift in orientation. This shift is one from seeing things from the point of view of computer(DP)-based to things being information(IS)-based.

2.3 The Era of Strategic Information Systems (SIS): 1980s - 1990s

The third and current era of strategic information systems commenced with the advent of the flexible ubiquitous micro-computer. Users, instead of waiting for pre-defined, structured reports, discover the ad hoc responsiveness of decision support systems (DSS) such as spreadsheets software. Office automation (AO) facilities include electronic mail, wordprocessing and diary scheduling. In place of telecommunications networks set up with remote terminals, the new client/server topology means that the distributed hardware is physically situated in the regional offices. The intelligent personal computer with its own on-board graphical interface replaces the slow text-based terminal.

In the area of personnel issues in software development Weinberg's ideas are furthered by Schneiderman (1980) whose interests extended into ergonomics and human-computer interfaces. Schneiderman is aware of the shortcomings of aptitude tests to assess the abilities of computer personnel:

> Reliable programmer ability measures are hard to come by, and managerial instinct has not been adequate. Researchers have found between 5 to 1 and 100 to 1 ratios in programmer performance. This means that programmers at the same level, with similar backgrounds and comparable salaries, might take 1 to 100 weeks to complete the same project. This staggering variability makes planning difficult and disrupts program development projects. (p. 9)

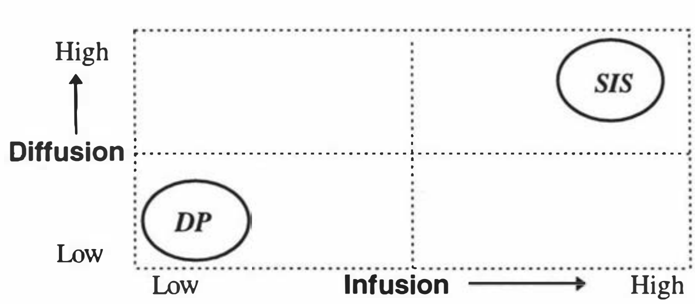
So he brings together strands of previous research and applies human factors research, quality control techniques and statistical measurement to the process of software development. His work has since been refined in areas known as human computer interaction (HCI), and software metrics

Of more importance, however, in the SIS Era is the strategic use of the systems to further corporate goals. Based on the ideas of Porter (1980) information technology is seen at least as a competitive necessity, if not as a competitive advantage (Keen, 1988a). As successors to the earlier decision support systems, executive support systems (ESS) are designed to aid middle and upper management levels. Systems need to be flexible enough to support the changing nature of modern business, and are soundly tied to the vision and strategic intent of the enterprise (McFarlan, 1984; Wiseman, 1985; Keen, 1991).

As a consequence, users are much more in control of software development. The traditional system development life cycle (SDLC) methodologies of the MIS era have proved to be unsatisfactory. They are too slow to realise tangible deliverables. With the advent of much more productive fourth generation languages (4GLs), such as New Zealand's LINC (Williams, 1985:156-157; Crocombe *et al.*, 1991:90), an interactive approach known as 'prototyping' (Price Waterhouse, 1993:5-16) can be adopted. There are, of course trade-offs to the adoption of any new techniques, so such approaches have not yet achieved universal acceptance. Nevertheless both the hardware and software advances have militated against IS personnel demanding technological solutions. An example to bridge the territories of users and computer specialists is the separate function known as an 'information centre'. It houses hybrid staff with knowledge of both technical and business related issues, and became popular in the mid-1980s. The IS function is now regarded more as a 'business within a business' (Jackson, 1987:19), possibly to be outsourced. New technologies are there to enable strategic initiatives, to support customers, to aid quality improvements (Harrington, 1991) or to facilitate business process design (Hammer, 1990; Hammer & Champy, 1993; Davenport, 1993) on a cross-functional front. There is more emphasis on integration, both internally with local area networks (LANs) and externally with global networks. Database systems strive to handle the concept of 'distributed' systems whereby the data are physically on a local server machine and yet are also a sub-set of the integrated centralised database. Strategic planning and management for information systems and information technology assumes an important role (Earl, 1989; Ward, 1990; Scott Morton, 1991; Robson, 1994).

A useful model to describe this movement of information systems outwards is that of Sullivan (1985). He suggests contingency approaches to planning depending upon a 2 X 2 matrix of high/low by diffusion/infusion analysis of functions within an organisation. Diffusion is the extent to which a function has extended its technology away from the centre, while infusion is the impact of that technology on the business itself, that is, how well understood is it within the organisation (see Figure 2-3). As an example an organisation which is rated as low on both counts would have a mainframe that serves centralised internal systems only, and its impact on the whole entity would be minimal. Such a system would belong to the DP era, while one representing the spirit of the SIS era would be highly diffused and infused.

Figure 2-3: The Impact of Technology (after Sullivan)

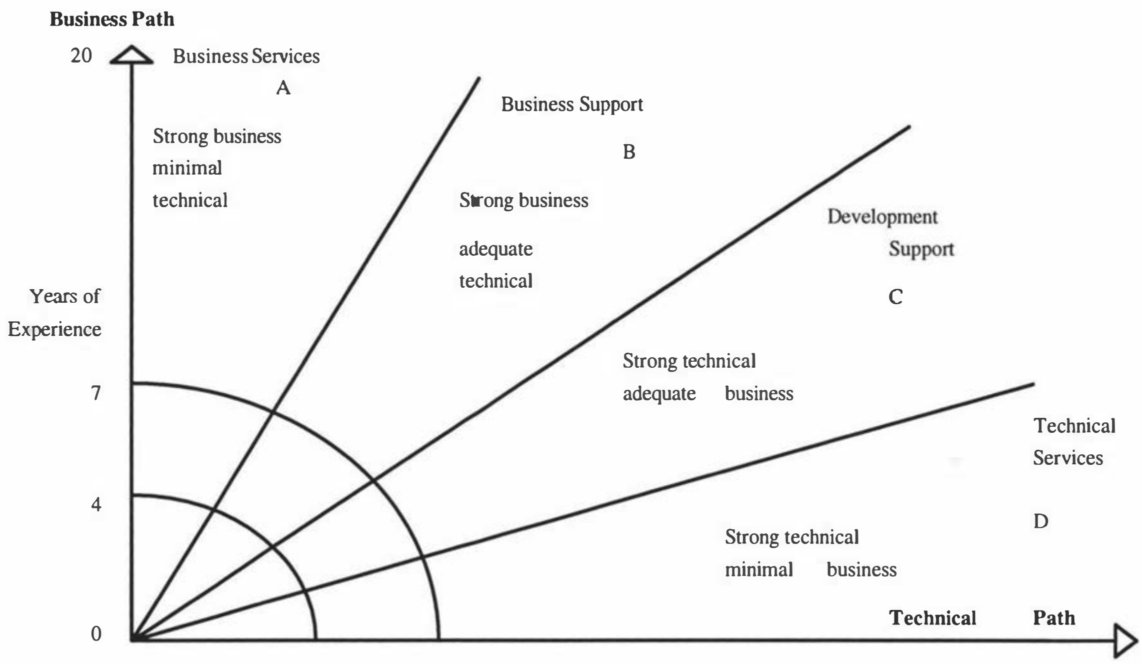


As the traditional systems development (SDLC) model comes under pressure from impatient users, so too does the career path model of rungs on either a technical or business ladder. IS personnel seem to be able to determine their own progression with job titles liable to change (Kaiser, 1983; Rouse & Hartog, 1988b). In New Zealand Jackson makes the point that, due to the rapidly changing environment, job descriptions soon become obsolete. Hence a more sensible approach for employers is to focus on requisite skills and to provide for flexible career paths (Jackson, 1983:65). Developments such as powerful desktop computing, end-user developed applications, off-the-shelf software, increased use of telecommunications, more emphasis on systems integration and outsourcing, and the introduction of the information centre (a separate functional unit to bridge the gulf between user-driven demands and the IS function), all contribute to expanded roles in IS career paths (Couger, 1984; Francis, 1989; Trauth, Farwell & Lee, 1993).

Many of the new positions demand more interaction with users within the organisation. A position in the information centre (IC), for instance, needs to reflect the dual set of skills required of its personnel. Such 'hybrid' personnel need to focus on customer service by demonstrating a blend of business and technical skills (Keen, 1988a:210; Earl & Skyrme, 1992). The most comprehensive analysis of IS career paths has been undertaken by Peter Keen (see Figure 2-4) who sees IS careers having four broad trajectories or role categories (business services, business support, development support and technical services) with more effort required to shift across the role categories the longer the person remains in any one role (Keen, 1988b; Keen, 1991:120-126).

Figure 2-4: Career Trajectory Map: summary of major roles

Source: Keen, 1991:121

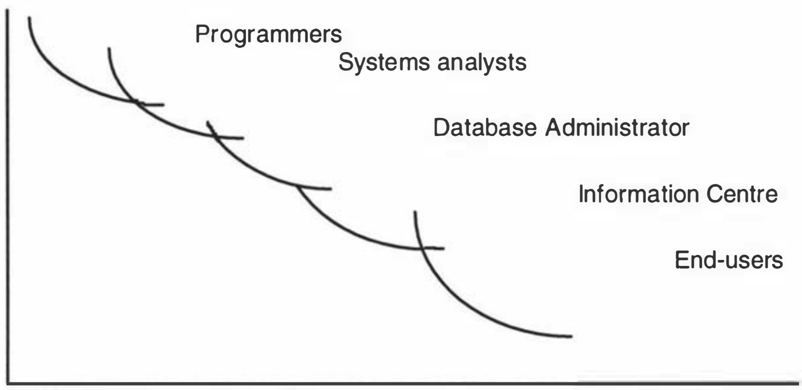


This important model combines both the concept of skills orientation with that of a career path. Skills are here related directly to the application objectives. Implicit, however, is the duality of technical versus business orientation. On the one hand, Keen seems to be advocating personnel able to demonstrate a broader range of 'hybrid' skills, and yet on the other hand he is suggesting what could amount to four more specialised career paths. This view contradicts the earlier commentators' vision of widening career opportunities (Kaiser, 1983; Couger, 1984). Kate Kaiser commences her paper with the comment that most DP people would regard the phrase 'career paths of systems professionals' as an oxymoron. Her study found little evidence of formal career paths.

Still on the theme of the need for IS personnel to continually re-assess their skills, Kenneth Primozic, Edward Primozic and Joe Leben present their concept of 'experience curves', and the importance of keeping abreast or losing. Traditionally, an experience curve states that the cost of using a new technology decreases as the firm gains more experience with it. Primozic *et al.* (1991) see the curve differently - for them it comprises a set of connected curves rather than a continuous learning curve (see Figure

2-5). Each curve represents fundamentally different sets of skills. Switching from one curve to another requires substantial investment, but that decision must often be made if the IS professional is to keep abreast of technological developments.

Figure 2-5: People-oriented IS Experience Curves(after Primozic et al. 1991:51)



Not only does this view seem to reinforce Keen's idea of substantially differing skills in each job area, but it also could be interpreted to support Nolan's (1973b) thesis that the more mature organisation will tend to value the more managerial/generalist skills over and above the more technical/specialist. Here it would imply that the 'end-user' skill set is perceived by mature organisations as more important than the earlier curves.

Academic research reflects the immense effect such change has on IS personnel: themes such as turbulence (Crossman, 1986) and stress (Ivancevich *et al.*, 1985). The fact that increased investment in information technology does not seem to have had a positive effect on white-collar productivity is of concern (Cheney, 1984; Licker, 1985; Doke, 1986; Strassmann, 1990). Elsewhere recurring themes continue to receive attention. These include motivation and job satisfaction (Toledo & Unger, 1985; Crepeau, Crook, Goslar & McMurtrey, 1992; Igbaria & Guimaraes, 1993), cognitive style (Kaiser, 1985), high turnover (Awad, 1977; Labelle, Shaw & Hellenack, 1980; Garden, 1988), continuing shortages (Department of Labour, 1986:15; Nash & Redwine, 1988:12) and personality traits (Mawhinney & Lederer, 1988; Smith, 1989).

Meanwhile the debate as to whether IS professionals require more business related and human relations skills continues. In Wall Street, for example:

> Because many financial professionals, are still wary of computers and the technical people who run them, a systems analyst needs to be skilled at interpersonal relations as well... "Finding that one professional who can straddle both the computer and the business fence is plain tough." (Marton, 1986:212)

And into the 1990s the image of IS professionals as 'techies' or 'nerds' is still of concern (Corbin, 1991).

The same debate is reflected on campuses of tertiary institutions. The key concern of curricula designers is striking the balance between technical and business knowledge (Hartog, 1985; Nelson, 1991; Trauth, *et al.*, 1993). Many believe that the rapid pace in technological innovation demands professionals with state-of-the-art technical knowledge (Jones & Arnett, 1993). Universities are criticised for being out of touch with current developments (Martin, 1985) and perhaps not responding to the marketplace (Crockett, Hall & Jeffries, 1993). During the whole SIS Era calls for more business related topics in contrast to computer science are evident in the USA (Athey & Wagner, 1979; Crawford, 1980; Simpson & Bettinger, 1982; Zawacki, Scott & Zawacki, 1989; Watson, Young, Miranda & Seerley, 1990), in Australia (Hudson, 1992), and in New Zealand (Boswell & Melhuish, 1978b; Jackson, 1983).

Less contentious, however, is the more generally accepted significance of the changing technology for all aspects of business. This is reflected in the publication of a number of influential books produced for popular consumption, but which also serve to summarise research to date. In the area of the effects of technology on office workplaces Shoshana Zuboff's work (1988) is seminal. Paul Strassmann (1990) addresses executives on the topics of productivity and value of information technology in a large, well researched tome. Peter Keen (1988a, 1991) emphasises the strategic opportunities awaiting organisations that adopt and learn how to manage telecommunications for competitive advantage. Keen reinforces the link between the use of the technology with the business imperatives. The five-year US$6 million research project conducted by the MIT into implications of IT for management of the 1990s bore fruit as a sound publication (Scott Morton, 1991). These authors advocate a major shift in human resource practices if organisations are to benefit from the technology, and arrive at a complete transformation of their business direction. The same authors also refer to business process redesign (BPR) as the third step in a 5-stage model on the road to transformation. BPR, as a necessary pre-cursor for the adoption of new enabling technologies, such as imaging and workflow/document management systems, has attracted much popular interest as a result of the two thoughtful books: Hammer & Champy (1993) and Davenport (1993). Finally, the work that best summarises the revolutionary spirit of this era is that of Tapscott and Caston (1993) in which they present convincing arguments. They postulate that the seven key drivers (productivity, quality, responsiveness, globalisation, outsourcing, alliances and responsibility) in the present global environment necessitate a complete re-think of place of technology in organisations, such that we view the scene as a momentous paradigm shift.

Since the mid-1980s New Zealand has undergone a revolution in economic terms, moving from a traditional social welfare mentality to one of global competitiveness. In the interests of reducing public debt the government has put in place policies that have halved interest rates, but conversely have increased unemployment to over 10%. As part of the restructuring many layers of managerial staff have been made redundant, putting pressure on organisations to upgrade their management education and skills. For similar reasons, the information systems (IS) profession have not escaped the same pressure for more organisational and managerial skills. Not only have they been faced with a rapidly changing environment within their organisations on a personal basis, but they have also had to respond to the external pressures of global advances, many of which are caused by rapid changes in the technology.

In the midst of all this turbulence and inexorable change are the software developers and engineers, the programmers and systems analysts, the PC and network support personnel, the data processing and information services managers. Theirs is a young industry that has already witnessed three major shifts in emphasis over three decades. The three shifts are ones of response demanded by an increasingly sophisticated user of IS services; the three are represented by greater user demand from Anthony's hierarchic levels of management (see Figure 2-1). This aspect of a progression of time is important to this research - as it portrays the evolution of a young industry through three major stages of growth. These stages run parallel with higher level applications demanded by more technologically mature users.

2.4 Chapter Summary

All the evidence assembled in this chapter serves to reinforce the picture of three overlapping shifts in a succession of more mature use of information technology within organisations. As a consequence, the skills required of IS professionals reflect those same changes in emphasis from the point of view of the users of the IS applications that represent the job deliverables of those IS workers.

The radar chart (Figure 2-6) below is a conceptual model of the balance of skills required at the three stages of maturity of the application of technology to date. The model represents a number of skill items, divided equally between business-related and technology-related, whose importance in the workplace have been rated on a 5-point Likert scale where a score of 5 indicates a very high importance rating. The chart does not intend to indicate any specific corresponding relationship, or importance rating, between any two skill items. It does make two assumptions, however:-

1) that the skill items within the inventory have not changed over time, and

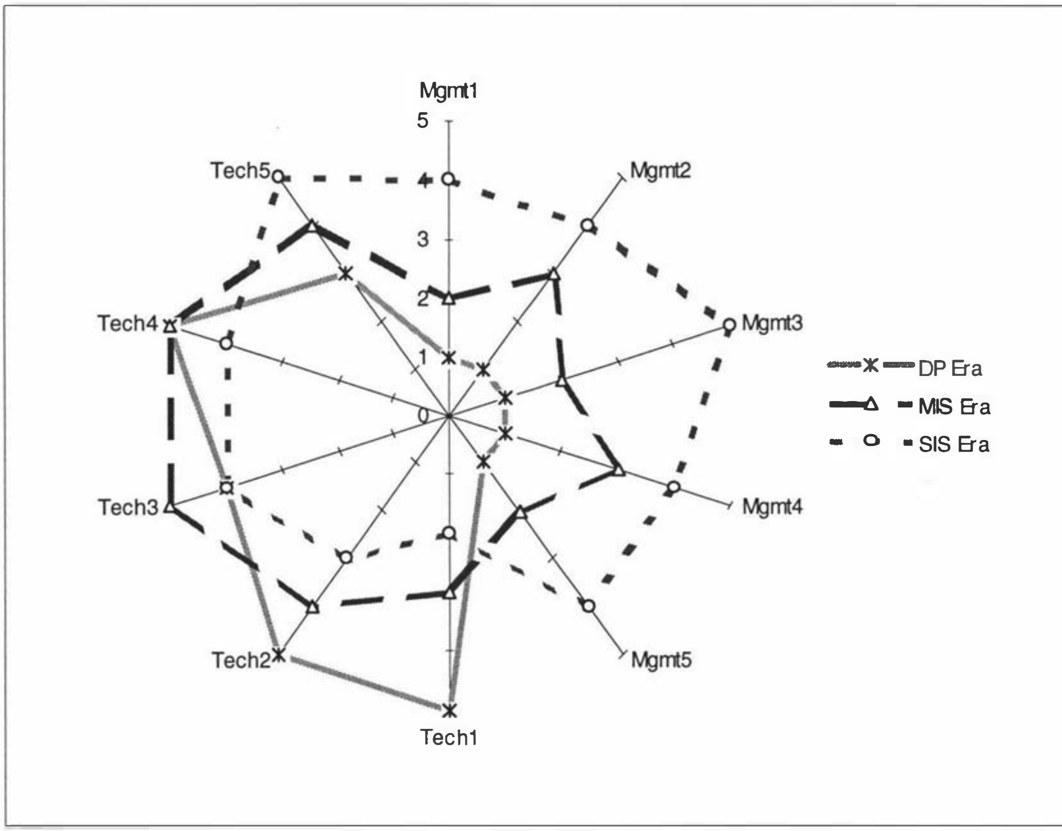
2) that it is the relative importance assigned to individual items that has changed.

Justification for these assumptions will be expanded upon in later chapters of this study.

This chart accepts the general assumption that IS skills fall into two distinct categories: one being of a technical nature, the other being organisational or managerial in orientation. This dichotomy has be shown in this chapter to have a variety of manifestations: for example, left and right brain competences, logical versus intuitive decision making, the 'hybrid' employee, the 'nerd' as opposed to the more sociable user, and the so-called 'dual career ladder'.

This model also indicates the probability that the technical skills themselves have changed to better respond to more sophisticated demands from users in organisations. In other words, the proposal is that not only has change occurred, but that these changes reflect the higher level organisational emphases.

Figure 2-6: Mix of Technology and Managerial/Organisational Skills by Era



Notice, however, that the model is not suggesting fewer skills, but rather that over time greater importance has been attached to those in the managerial/organisational sector of the chart. The historic review has demonstrated how the technology has not only become horizontally 'infused' throughout organisations but has also pervaded vertically by supplying 'strategic' information systems.

The model provides a springboard for three research questions that require investigation:

- are organisational/managerial skills becoming more important for IS professionals in their jobs?

- have IS managers perceived a shift in the relative importance of particular skills required of their IS staff?

- what are the particular skills required for an IS professional in New Zealand?

This chapter by describing the evolution of the computer industry over three decades, has set the scene for the study of the current skills requirement for information systems personnel in New Zealand. The review of research conducted and of the more anecdotal material documented on a worldwide basis has been presented over a period of over 30 years, and includes references to New Zealand. In essence the skills required of IS personnel reflect the environment in which those skills are to be applied.

So far we have been gaining a gestalt view of the general trends in the IS industry with special reference to its personnel. But before the three research questions above can be addressed the primary unit of analysis of 'skill item' underlying the questions has to be clarified. The particular skill items need to be identified. The next chapter moves from the general to the particular by focusing in on research that deals more specifically with the identification of specific skills. As most researchers have chosen to structure their research design around the comparison of IS personnel according to job title, the next chapter adopts the same approach. The search for a generalised set of skill items is conducted within the context of a categorisation of job designations.

3. The Skills Inventory for IS Professionals

The previous chapter provided the organisational context for the information systems professional. Inevitably global technological change soon impacts on the internal structures and culture of the organisations in which computer personnel function It portrays a historic series of eras in an evolving development of applying information technology into organisations. The professionals are seen as maturing from the knowledge base of programming as an inchoate discipline. Commentators cannot agree on career paths, nor on the contents of curricula for the new area of knowledge.

There is no dissension, though, that this category of professional possesses a unique set of specific job skills. So it is the intention in this chapter to continue the historic overview, but on the more personal level of the job incumbent. By commencing with a list of generic job designations for computer personnel, it addresses the question: what items are seen to be essential in an inventory of skills? Relevant technical terminology is defined as part of the review.

The application of EDP principles does not gather momentum until the latter half of the DP Era. Historical patterns of career development take time to evolve. Most of the personnel engaged in the industry are young and looking for advancement. In most organisations, therefore, the management challenge is to accommodate the new breed of personnel (Ditri, Shaw & Atkins, 1971:194).

By the MIS Era in the 1970s the industry is much more organised and so proposes formal career paths (Grodman, 1977; Idema, 1978). If one commences with the premise that an organisational structure is in place which incorporates an EDP function, then:

> First, the data processing organization, its relationship to user departments, its internal distribution of responsibilities and accountabilities and its own line and project management needs must be considered and analyzed in a well-structured manner.

> Second, the job classification within the several components of the EDP function should be delineated and clearly understood. This requires an analysis of the tasks and skills required of each job, resulting in accurate job profiles. (Grodman, 1977:26)

Grodman presents a model which structures the tasks and skills by linking them to the major steps or phases in the system development life cycle (SDLC). Hence in the first phase systems analysts require the skills that enable them to conduct initial feasibility studies, analyse and specify user requirements, and diagram conceptual design. Programmers read the specifications and diagrams produced by the analyst(s) and then draw logic flowcharts and/or re-interpret directly into a programming language. This implementation phase also includes testing, de-bugging, the writing of documentation for the user, installation and acceptance. Once the system goes 'live' a system review takes place and on-going maintenance is required for the remainder of the system's life. Much of this maintenance may include enhancements caused by natural change. Some estimates indicate that as much as 75 - 80 percent of the programming work in a typical EDP department involves 'maintenance programming' (Schneiderman, 1980:44; Strassmann, 1990:20). A decade later there are an estimated 800,000 COBOL programmers in the United States doing little more than maintaining old programs (Carlyle, 1989:14).

Still linked to the SDLC are other essential activities. Once the system is running, the operations sub-unit of the computer department controls all data capture and output distribution of reports. Operators are required to run the jobs. On the more technical side, the large mainframes often require specialist programmers to write software to interact with the operating system software. These programmers are known as 'systems programmers'.

All groups of activities require management.

Grodman maintains that once a company has clarified its organisational structure, and its component job classifications and grade levels are clearly understood, it is possible to generate meaningful and achievable career ladders.

The SDLC-based model of how to arrive at job designations and rungs on career ladders best sums up the computer industry's classification of computer personnel in the DP and MIS eras. Today the basic model still applies. Exploration of subsequent literature simply adds more detail to this basic model. The skills that will be discussed relate to the job designations of applications programmer (as distinct from systems programmer), programmer/analyst, database designer, systems analyst, project manager, data communications specialist, manager of the IS function, and consultant. Others such as computer operator, data capture personnel and managers of sub-sections within the IS function are not directly treated. The literature has either not seen fit to include them as central to the profession, or it regards them as a subset of one of the major designations.

3.1 Application Programmer, Systems Programmer, Data Base Designer

Most researchers have identified programming as the distinctive occupation at the centre of the new occupational class of computer personnel. Schneiderman (1980:41-44) suggests that the complex job of programming includes the following tasks: learning (by which he means knowledge of programming languages and tools), possible involvement in analysis and design, composition, comprehension, testing, debugging, documentation and maintenance. Under the task of learning he ranks a novice programmer as having less than one year's experience, and an intermediate as having from one to three years. This would equate with the 'minimum of two years' experience' (Boswell & Melhuish, 1978b:69) still demanded by most employers in job advertisements seeking to attract a trained programmer. When explaining the difficulties inherent in writing up good documentation, Schneiderman points out that some installations employ separate professionals for this activity.

Pivotal to the learning outcomes for a programmer are the skills of writing code in one or more computer languages. Each language tends to be designed with a bias towards a particular type of application. For example, FORTRAN has been popular with engineers because of its mathematical functions; COBOL's strength has always been its file-handling capabilities, essential for business applications. Academic institutions tend to favour more 'purist', well structured languages, such as Algol and Pascal, because they are better vehicles for problem solving. These are now known as third generation languages (3GLs). In environments where speed is of the essence, it is often necessary to drop to a lower level of language. Programmers at Databank in New Zealand in the 1970s, for example, wrote code for telecommunications software in an assembler (2GL) language. It could be argued, however, that since this type of software is more hardware based and more like operating systems software, this task is more suited to a *systems* programmer, rather than an *applications* programmer. The position of systems programmer can be defined as a programmer who writes software purely for the operating environment of the machine.

In the centralised mainframe milieu most jobs were run in batch mode usually in the second and third shifts. This meant that programmers needed to have more technical knowledge of data capture systems which were often stand-alone disk-to-tape devices. In addition, their knowledge had to include an understanding of the computer operators' tasks when it came to running those jobs after hours. A series of pre-programmed instructions had to be set up by the programmers in a job control language (JCL).

The MIS Era also sees the development of software languages known as database management systems (DBMS) to handle the complexity of large centralised data bases. They interface with traditional 3GLs to provide facilities beyond simple file-handling. The complexity of large centralised 'warehouses' of data led to the need for an administrative gatekeeping role for a person in the IS functional area. The job designation for such a position is known as the database administrator (DBA) or Data Base Designer.

At this time the knowledge required is very technically oriented, but it should also be noted that the programmer still needs to communicate with systems analysts and operators. If a programmer is looking to advance into a position as systems analyst, where human communication is always important, then these skills need to be present (Boswell & Melhuish, 1978b:65).

In 1978 Colin Boswell and Peter Melhuish conducted a survey of 20 New Zealand DP managers for their views on curriculum topics relevant to the skills requirement of commercial systems analysts and programmers. A total of 36 topics were selected, based on 31 topics in an Australian survey conducted in 1976 (Whittet, 1976 cited in Boswell & Melhuish, 1978b:66). Respondents were asked to rank the topics on a 5-point scale. Validity of the results is strengthened by the fact that the findings of the two surveys are surprisingly similar given the differences in time and environment. The New Zealand survey gives the following rankings in descending order of importance for data processing skills for programmers - as separate from systems analysts - (with my italics to highlight people skills; bold to highlight business skills; and a '/' to indicate a substantial break in the ranked mean scores assigned):

> COBOL, program structure and design, /
>
> *human communication*, batch processing techniques, data base techniques, file design, computers and peripherals, **application software**, telecommunications, /
>
> systems analysis and design, data preparation equipment and techniques, operating systems, **business systems**, **projects**, job control languages, /
>
> systems programming, **management information systems**, **financial accounting**, programming languages, minicomputers, social implications of computing, assembler programming, mathematics, statistics, /
>
> **business psychology**, **economics**, information systems theory, /
>
> compiler construction, microprocessors, PL/1, FORTRAN, Basic, algebra, artificial intelligence, calculus, Algol.
>
> (Boswell & Melhuish, 1978b:65)

At the same time a United States survey of 45 DP managers produces the following list of 26 skill areas for the education of programmers, ranked in descending order of importance:

> introductory computer and information concepts, file design, applications programming languages, job control languages, operating system characteristics, database management systems, system design topics, telecommunications, hardware characteristics, *human relations in systems development*, sorting, **information gathering techniques**, minicomputer characteristics and uses, Human Factors in equipment design and work layout, **computer security controls and auditing, planning and control of systems projects**, list processing, computer scheduling, **software package analysis, improving computer centre productivity, legal**

aspects of computing, computer simulation, introductory statistics, statistical decision theory, regression analysis, sampling theory.

(Cheney & Lyons, 1980:42)

It is noteworthy that in both lists the higher priority items are job specific skills relating to the technological environment. Although people skills (as italicised) is a high third in the New Zealand list, knowledge of the business environment (as bolded) is generally seen as less important in both lists. Knowledge of COBOL and DBMS (p. 43) and batch processing on mainframes is important, but mathematical and statistical techniques are seen as relatively unimportant as part of a skills inventory for programmers.

In a survey aimed at predicting MIS skills for the 1990s Leitheiser (1992) produces a list of 54 systems development skills and 26 technical specialist skills. Respondents to the survey are 107 IS managers in the United States. Naturally, many of the specialist technical skills are in the programming knowledge domain. It is worthy of note that amongst the 12 skills rated as of most importance at present include [in descending order]: database design; telecommunications systems; user-friendly system design; systems integration; systems programming; local area networks; 4GLs. Even though CASE features as 17th, it is expected to increase in importance dramatically together with prototyping (p.86).

3.2 Programmer/analyst or Analyst/programmer

The difficulty of stratifying personnel into clearly defined job designations is highlighted by a job position that straddles two rungs on the promotional ladder. The job designation of programmer/analyst was sufficiently popular in the early 1970s for Arvey and Hoyle (1974) to compare 112 programmer/analysts with 87 systems analysts in a large computer manufacturer. As part of the research to develop rating scales for job performance, the two groups of DP personnel are compared on 12 'job behaviour dimensions'. Of importance in this study is the realisation, after a series of workshops, that both jobs exhibited basically the same dimensions.

> One point worth noting, however, is the fact that the basic job dimensions of the two job areas were very much the same. Thus, it was decided to develop one set of rating scales to evaluate individuals in these two nominally different jobs. However,

> the basic task dimensions of the two jobs were suspected to be the same, but what differentiated the two jobs would be the relative importance of the dimensions. This reasoning corresponds closely to the statement by Mayer and Stalnaker (1968). (Arvey & Hoyle, 1974:62)

Most subsequent research has made this an assumption, namely that the skills inventory for personnel in the computing industry is essentially the same, whether comparing programmers and analysts (e.g. Boswell & Melhuish, 1978b; Cheney & Lyons, 1980) or IS managers and analysts (Benbasat, Dexter & Mantha, 1980) or all three (Todd, McKeen & Gallupe, 1995). What differentiates the job designations is the relative importance placed on individual skill items.

Thus in Arvey & Hoyle's survey, analysis of the supervisors' rankings of the relative importance of the job dimensions shows aggregate differences between the two job areas. The t tests reveal statistically significant ($p < .05$) differences on 7 of the dimensions: three considered more important for programmer/analysts are documentation, debugging, and program and/or system modification and/or development; the four considered more important for systems analysts are maintaining customer relations, maintaining communications, assessing customer needs, and conducting presentations (p. 63). Four dimensions rated important for both jobs are: technical knowledge; job commitment and effort; planning, organising, scheduling; training others. The last dimension, providing supervision and leadership, is rated is least important for both job designations - perhaps it is seen as more in the area of DP manager?

Even the distinction between the job of programmer and that of programmer/analyst could in itself be questioned. Todd *et al.* in a draft version (1992) of their research note that when further analysing their sample 'the two groups behaved almost identically', they decided to treat them as a single group called 'programmers' (p.10).

3.3 Systems analyst

Hence, as this early Arvey & Hoyle study shows, the job specific areas of knowledge for systems analysts can be seen as a movement on a spectrum away from programming skills towards an analytical understanding of organisational systems. This shift of emphasis brings the analyst into more contact with many parts of the organisational at various levels in those phases of the SDLC that precede maintenance and operations (Robinson, 1968:228). More so than the programmer, the systems analyst must anticipate human reactions in different situations, must listen, understand the feelings of others and possess good interpersonal skills (Stymest, 1966:6; Blank & Barratt, 1988). But there must also be a bias for action in the role as change agent (Fougere, 1991). The training of systems analyst ought to include training in commerce (Data Processing in NZ, 1969) or business (Blake & Price, 1969:487).

In *Data Processing in NZ* (1969) was published the sub-committee of the New Zealand Computer Society's recommended course content for university education. It includes the following statement, suggesting that systems analysts may not require any knowledge of programming:

> Many people consider that systems analysts should have some familiarity with programming languages, and suitable short courses could be given by the Polytechnics, or by the universities. (p 23)

This was quite a popular notion at the time. During the early 1970s the State Services Commission employed personnel with the job title of Systems Planners, who possessed no specific computing knowledge, to undertake feasibility studies and initial user requirements. Their specifications were then passed onto teams of systems analysts and programmers in the Computer Services Division to translate into workable systems. The academic concept of education in analysis skills without technical knowledge did not gain favour with employers in the workplace (Boswell and Melhuish, 1978a:39).

The same three surveys (Whittet, Boswell & Melhuish, and Cheney & Lyons) conducted in 1976-78 reinforce the need for systems analysts to possess a significant understanding of technology issues. Human communication skills for systems analyst was perceived as being of greater importance than for programmers. In the latter two surveys they are ranked immediately after systems analysis techniques. In the New Zealand survey [in descending order of importance] the core set of 36 skill items is ranked for systems analysts as follows (with my italics to highlight people skills; bold to highlight business skills; and a '/' to indicate a substantial break in the ranked mean scores assigned):

> systems analysis, design and implementation, file design, batch processing techniques, *human communication*, application software, data preparation techniques, **business systems**, database techniques, computers and peripherals, **management information systems**, telecommunications, data preparation equipment and techniques, projects, COBOL, /
>
> financial accounting, program structure and design, /
> minicomputers, statistics, operating systems, /
> **business psychology**, social implications of computing, job control languages, information systems theory, economics, mathematics, programming languages, /
> microprocessors, systems programming, algebra, Basic, assembler programming, calculus, FORTRAN, compiler construction, artificial intelligence, Algol.
>
> (Boswell & Melhuish, 1978b:65)

And the United States set of 26 items are ranked as follows for systems analysts:

> introductory computer and information concepts, system design topics, information gathering techniques, file design, *human relations in systems development*, applications programming languages, database management systems, Human Factors in equipment design and work layout, telecommunications, planning and control of systems projects, hardware characteristics, operating system characteristics, job control languages, **computer security controls and auditing**, minicomputer characteristics and uses, **software package analysis, computer scheduling**, computer simulation, **improving computer centre productivity**, **legal aspects of computing**, introductory statistics, list processing, sorting, statistical decision theory, regression analysis, sampling theory. (Cheney & Lyons, 1980:42)

The requirement for knowledge of business or commerce appears as 'business systems' and 'management information systems' in the former (as bolded). Because Cheney and Lyons do not include specific skill items for this category their survey fails to detect the phenomenon. They do, however, categorise a group of skill items they call 'information systems management' as highlighted in bold above.

A piece of contemporaneous research that does clearly categorise people, organisational and societal skills, for both systems analysts and IS managers, is based on questionnaires consisting of 97 skill items (Benbasat, Dexter & Mantha, 1980). The authors, however, do not name the items which they acknowledge are sourced from a 1973 University of Minnesota study to empirically test the first ACM curriculum recommendations for DP courses. A total sample of 105 questionnaires from 35 companies are processed, representing one IS manager/executive and two analysts from each company. Respondents perceive, via 5-point Likert scales, the skill categories of People, Organizations and Society to be ranked significantly ($p < .05$) more useful to managers than the more technical categories of Systems, Computers and Models. Their perceived rankings for systems analysts differ from managers only in that Systems and Society are interchanged in the rankings.

The most comprehensive study of specific skills for systems analysts is that of Vitalari (1985). His exploratory research involves asking 18 analysts to describe aloud how they would solve an experimental task in the requirements determination phase of systems development. The verbal transcripts are then codified according to 252 knowledge skill categories and 52 case specific categories. Vitalari identifies the following top 20 skills as being core knowledge for systems analysts:

> functional requirements, procedures, types of reports, requirements for information, requirements for systems function, process of analysis, development issues, data element definitions, design of system, organizational responsibility, database issues, description of organizational activities, purpose of system, information technology issues, organizational structure issues, error control within system, requirements for report formats, documentation issues, source data, user involvement. (p. 231)

On closer inspection most of these skills are central to the activity of systems analysts interacting with users. The findings tend to confirm that IS personnel perceive an epistemology for systems analysis that includes more behavioural than purely technical skills. This is supported by Green (1989) who adds the observation that, on the contrary, users' perceptions are that systems analysts exhibit important programming skills. His research instrument contains 20 job roles, 10 non-salary incentives and 21 skills (diplomacy; assertiveness; speaking, sales; politics; non-verbal communication; interviewing; directing; patience; leadership; programming; writing, listening; empathy; management; training; cooperation; functional application knowledge; organizational communication; analysis and design; and sensitivity). Approximately 400 users and 470 systems analysts responded to the questionnaire. A multivariate analysis of variance (MANOVA) reveals significant differences in the perceptions of the two groups in regard to the importance of the skills for analysts. While systems analysts perceive the first 6 of these skills as more important than do users, users regard the analysis skills of directing and programming as more important (p. 124).

3.4 Project Manager

The study by Cheney and Lyons includes the third job designation of Data Centre Manager, defined as a person who supervises both the systems development staff (i.e. analysts and programmers) and the operations staff (i.e. operators, librarians, input/output clerks and data entry personnel). For this job those 'information systems management' skills are ranked as the most important together with 'human relations' and 'planning and control of systems projects'(1980:42).

In 1988 the authors conducted a second survey in which they did not comment upon their re-naming of the job title from Data Centre Manager to *Project Manager*. This new position seems to have gained popularity in the second half of the 1980s, and probably grew out of that of project leader - a title mentioned in association with the systems analysis function (Jackson, 1983:56; Department of Labour, 1986:1).

3.5 Data Communications Specialist

The burgeoning area of telecommunications as a result of moves to devolve systems away from centralised large machines has meant predictions of skills shortages in all jobs associated with data communications equipment (Jackson, 1983:56; Department of Labour, 1986:12; Leitheiser, 1992:91). 'Communication (network) management' features at the top of the areas of importance for IS managers in the 1990s (Broadbent, Hansell, Lloyd & Dampney, 1992:7). Positions in this category can include a wide spectrum of tasks from operations, to programming, to network management. Knowledge skills will need to be extended to embrace the integration of mobile computers, cell phones and telephony services. No research into the specific skills inventory for this group has been found in the literature.

3.6 Director/executive, Middle Manager of IS

The job category of information systems manager, can include middle and upper levels of management. The job title tends to change to reflect the tone of the era, and so could be information systems manager, DP or MIS manager, information services manager or Chief Information Officer (CIO) in the United States. Ivan Jackson suggests that the ever expanding role of EDP will see the emergence in New Zealand of the position of information resource manager (Jackson, 1983:61), but even if organisations regard data as a resource and an asset, few have elected to adopt this title. Likewise, a position that has not survived in New Zealand is that of manager of what is known as an information centre (IC), a separate function in large companies dedicated to end-user support (Department of Labour, 1986:11).

This managerial group has received little attention from researchers. The reason may be that they fall into the category of any other line manager in a functional area where it is a case of blending general management skills with more specific functional skills. For the IS manager it is a matter of how he or she approaches the issue of technical skills. Metzger, as part of a lengthy discussion of first and second level managers' need to understand things technical, makes the following observations:

> Many newly anointed first-level managers immediately distance themselves from the nuts-and-bolts technical work and begin empire building....
>
> Some managers distance themselves from the technical work for another reason: They are insecure and feel incapable of both supervising the work and supervising the people.....
>
> ....One reviewer of this manuscript pointed out that very often even *second-level* managers must be very technically competent, as well as good people-managers. As you "climb the ladder," you'll find some rung at which you'll need to concentrate on the essence of the product, not its details. The further up you go, the more the balance shifts away from technical work and towards planning, setting goals, measuring progress, appraising, reviewing, inspiring, hiring, and firing. (1987:11-14)

Ironically, it is those same technical skills that seem to cause cultural resistance in their workplace:

> CIOs are often portrayed as victims of merger mania, decentralization and cost-cutting programs. But the 1989 Coopers & Lybrand/DATAMATION CIO survey of 550 IS leaders clearly shows otherwise. What CIOs say they are really victims of, the survey reveals, are unsympathetic corporate cultures, uncertain job expectations and the stigmas attached to IS because it is an immature discipline. In fact, the survey reveals that IS is not even viewed by the executive suite as a real profession. Instead, it is thought of as a poorly managed craft.
>
> Furthermore, the survey reveals that leading IS executives are mourning their inability to penetrate the inner circle of top management at their company. Many feel like outsiders looking in; only 12.7% believe they strongly influence overall corporate strategy. (Carlyle, 1989:12)

If the manager has risen from the ranks of systems analysis or programming, the tendency will be to emphasise technically-oriented skills. Another approach is to appoint a manager from outside the IS profession in preference to the 'technical types' (Jackson, 1987:6). In an effort to arrive at a balance between business-related and technology-related skills the concept of a hybrid manager has been actively supported by the British Computer Society (Earl & Skyrme, 1992). Earl and Skyrme define hybrid IS managers as a 'breed of managers who blend information management skills with general management skills'. In an earlier work Earl also suggests that they could be in line or functional jobs:

> ..people with strong technical skills and adequate business knowledge, or vice versa... hybrids are people with technical skills able to work in user areas doing a line or functional job, but adept at developing and implementing IT application ideas. (Earl, 1989)

This emphasis on sound managerial skills for an IS manager is confirmed by a study conducted in New Zealand by Ivan Jackson (1987). As a result of questionnaires mailed to over 200 organisations and interviews with 15 of them, Jackson lists a comprehensive inventory of skills for DP managers, grouped under eight headings:

Administration

- allocate resources

provide desired level of service

manage change

manage computer environment

monitor performance against plans

make decisions

Communication

communicate at all levels

contribute to corporate management

marketing (rather than selling)

make presentations

Contract

negotiate with users

negotiate with suppliers

Education

develop user management awareness

implement IS staff training programme

implement user training programmes

Finance

prepare cost benefit analysis: understand financial management

Personnel

ensure adequate working environment

motivate staff

develop career paths

Planning

forecast business environment impact

investigate marketing opportunities

establish strategic objectives

plan to meet strategic objectives

research and forecast technological directions

Apply Technology

maintain an awareness of technology advances

(summarised from Jackson, 1987:16-18)

The IS managers who participated in this study are acutely aware of the need for what Jackson terms 'generalist' and 'detailed' management issues as distinct from a single grouping of 'technical' issues (pp. 13-14).

More recently an Australasian survey of over 200 senior IS managers from large organisations includes 12 per cent of respondents from New Zealand. A part of the research focuses on the skills gaps for IS personnel. Participants are given a list of ten skill areas and are asked to indicate both the current and required skill level on a three point scale (Low, Medium, High) in their organisations. The list is presented here in descending order of ranking from the results of the survey (p. 8):

aligning business and IS strategies
marketing of IS services
project management
management of IS professionals
business cases for IS projects
enterprise, business data modelling
systems development techniques including CASE
information broking, linking requesters
knowledge based or expert systems
organisational politics (Broadbent, *et al.*, 1992).

Only three can be classed as purely requiring technical skills (6th, 7th and 9th) while the top four are concerned with issues external to the IS function and are management oriented.

In conclusion, the management rung could be that of IS manager, manager of IS development, information centre (IC) manager or project manager, positions that require a more diverse set of skills primarily due to the cross-functional nature of IS (Perry, 1991:12). Perry details the technically-oriented challenges of the modern IS manager as: changing technology, when to abort a project, executive management ignorance of MIS, user ignorance of MIS, audit requirements, use of consultants, ability to keep current technically, complexity of systems, new system development standards, how to evaluate MIS products, professionalism (pp. 11-16). The set of skills are very people-oriented and yet are still very much technically-based.

3.7 Consultant

The final job category to be considered is in the area of consultancy. The need for consulting skills for many IS personnel has been noted in the United States (Rouse & Hartog, 1988a:10). The job designation of consultant may include the descriptor 'management' or 'computer' depending upon the incumbent's perception of his or her skill strengths.

The phenomenon of a substantial group of self-employed consultants is now present in New Zealand. As a by-product of the restructuring that has been taking place since the country has become more globally competitive, organizations have been downsizing their IS human resources. Many IS staff are now self-employed consultants, often on contract back to the organisations that used to pay their salaries. As evidenced in recent publicity, the Inland Revenue Department is claiming that such workers should be regarded as salaried for tax purposes (Wallis, 1993). In times of economic restraint outsourcing is often seen as a cost-effective alternative to the development of in-house skills.

3.8 Two studies of skill inventories changing over time

In the literature search only two studies could be found that attempted to analyse IS skills inventories over a period of time. To an industry, that could be seen to be changing too rapidly to benefit from hindsight, the value of historic trends may seem minimal, but the evidence presented here attests to a certain stability over time with regards to the skill items themselves. Thus, it is argued in this thesis, that retrospective research in this context has considerable value to the IS industry.

The question of whether skills have been changing over time is addressed in a seminal piece of research already referenced in this chapter. Paul Cheney and fellow researchers conducted a two-part survey in the form of closed-form structured interviews, the first in 1978, the second in 1987. The sample sizes were relatively small: 45 DP/IS managers for the first and 56 interviewees for the second, but the subjects were not from the same population. This study, however, is the only longitudinal study documented in the literature.

It contains the only attempt to define what constitutes a 'skill'. Cheney defines the items in the skills inventory as a composite of knowledge, skills and abilities (KSAs), based on engineering and R&D antecedents:

> *Knowledge* refers to the content or technical information needed to perform adequately in a job and is normally obtained through formal education, on-the-job training, and information media, such as manuals. *Skills* are the specific psychomotor processes necessary to meet the current requirements of a specific job... *Abilities* refer to the cognitive factors that represent present capabilities or achievement levels. (Cheney, Hale & Kasper, 1990:238)

The 26 items arrived at in the first part of the study are documented earlier in this chapter. In the second part, due to the revised ACM curriculum recommendations (Nunamaker *et al.*, 1982) in which quantitative management has a decreasing role, six of the original KSA are eliminated (i.e. improving computer centre productivity, introductory statistics, regression analysis, sampling theory, list processing, sorting). The wording of others is updated: hardware characteristics is changed to *mainframe hardware*; computer scheduling to *computer operations*.

In 1988 Cheney polled a further 79 managers to compare with his first two samples their predicted changes in importance of these KSAs in 1995. Despite the small sample sizes, the findings from the Cheney three-legged study have important implications for educators and IS practitioners. In New Zealand no such primary research has followed the Boswell & Melhuish interviews on the profile and skills requirements of IS personnel. Cheney's findings are summarised here in bullet format for clarity:

- IS managers believe that human factors and managerial KSAs have increased and will increase for all IS workers, particularly project managers.
- There is an increasing need for personnel with KSAs of advanced technologies, such as DBMS and data communications.
- The emergence of more distinct sets of KSAs may indicate a clearer division of labour for IS workers, possibly attributable to advanced software development techniques, the increasing complexity of systems, and project management procedures that exceed the KSAs of any individual.

The second longitudinal study is based on the content analysis of actual IS job advertisements over the 20-year period 1970 - 1990 (Todd *et al.*, 1995). Samples of IS job ads were drawn from two Canadian and two U.S. urban newspapers at 5-yearly intervals, with between 5 and 10 ads selected for each month per newspaper. The authors chose to focus on 1234 ads representing the three predominant job titles of programmer (*n*=581), systems analyst (n=348) and IS manager (*n*=305).

In the tradition of previous researchers (e.g. Benbasat *et al.*, 1980) the authors have related their selection of skill items to the ACM framework of six broad categories (see Table 3-1) with

> ..some minor modifications. Specifically, two ACM categories were subdivided: "computer" into "hardware" and "software", and "organizations" into "business" (which focuses on industry and functional area knowledge) and "management" (which includes such skills as organizing, planning, controlling, and the like). Two ACM categories were combined: "people" and "society" into a single category called "social." This was done because we could not determine significant differences between the two categories as they pertain to job skills. In addition, the ACM category called "systems" was enlarged to include all knowledge pertaining to development methodologies...(p. 26)

The authors are very aware that their results 'are, to some extent, at odds with the prevailing thinking', especially the main finding that for systems analysts more technical skills have appeared in advertisements over time. Otherwise, the general picture is one of no radical change in the mix of skills for IS personnel. They pose six possible explanations for the 'somewhat unexpected' findings two of which are important to this study. The first suggestion is that it may be a question of more *specialised* technical skills, rather than technical skills in a general sense that constitutes the right mix from the point of view of the employer. This would reflect the more complex user environments of the modern organisation. The second possible explanation is related to the first: that IS personnel need more technical skills to be able to support a more sophisticated user population. The other explanations are more to do with external factors or limitations with the research instrument.

The outcomes from the two longitudinal studies are somewhat contradictory, due partly to methodological issues. In the first study the samples are relatively small and the longitudinal questionnaires are not administered to the same population. In the second study, there a number of limitations in the research method of content analysing newspaper advertisements.

Table 3-1: Classification of IS Knowledge/Skills after Todd *et al.* 1995:6

Class	Category	Skill	ACM Category
Technical Knowledge	Hardware	Mainframe Mini Desktop	
	Software	2GL 3GL 4GL COBOL Database CASE Operating systems Packages	**Computers**
Business Knowledge	Functional	Industry specific Function specific	**Organizations**
	Management	General management Leadership skills Organizational skills Project management Planning Monitor and control Training	
	Social	Communication skills Independent/motivated Interpersonal skills	**People, Society**
Systems Knowledge	Problem Solving	Quantitative/logical General problem solving Technical expertise Creative/innovative	**Models**
	Development Methodology	Analysis Design Programming Implementation Operations/maintenance General development General technology	**Systems**

3.9 Chapter Summary

At the outset there are a number of shortcomings in the literature, and there is a relative paucity of research material on the topic of relevant skills for IS personnel in New Zealand. Though worldwide trends are important as global indicators, it is nevertheless equally important that information on local conditions and environment are augmented by up-to-date research. Research to date does not differentiate between middle and executive levels of IS management, nor has the emerging group of consultants been identified. Most of the research is based on survey opinions of IS managers commenting on their IS operatives. No research has been conducted comparing the perceptions of both groups, first: to assess the relevance of skills in the individual's job; and second, an assessment by those who are managers, of the importance of skills of IS personnel for whom they are responsible. This study aims to take account of these shortcomings.

The findings in this and the previous chapter must be set in the context of the historical environment of continuous change. But it does not follow that environmental change necessarily implies change in the *perceived* roles or skills required of IS personnel. In fact, as most surveys have canvassed the views of managers, this historical review of the literature reveals little change in management's view of career paths and hence the corresponding job designations for personnel in the IS function. On the other hand, the same managers seem to agree that external pressures have substantially changed the relationships between the IS function and other parts of the organisation, as shown by user demands for changes in the skills inventory over the three 'eras'. The literature tends to confirm that this shift involves more recognition of business-related skills, and that as organisations and the computer industry matures there is perceived to be less emphasis on the more technology-related skills. Throughout the message is that IS personnel need to keep abreast by cultivating a more general, broader set of skills - skills that are more people-oriented and more directed at supporting organisational imperatives.

In other words, while it seems that career progression and job titles may appear relatively static, the underlying job skills seem to have shifted in emphasis. These two topics of job designations and the skills for the IS occupation is discussed further here.

Consistent throughout the literature review is a relatively static view of a dual ladder approach to IS career development. The evidence here confirms the core of job designations as comprising: programmer, systems programmer, analyst/programmer, systems analyst, and middle/executive manager of IS. More recent positions are those of data base designer, project manager, data communications specialist, and consultant. The contention of more recent researchers, however, that the dual ladder concept is being undermined by more flexible organisational structures has not yet been tested empirically (Ginzberg & Baroudi, 1988:591). Nevertheless, judging by the wide variety of skills suggested by researchers in this review, it seems that the traditionally accepted nomenclature for job designations cannot be equated with correspondingly well defined groups of skills. Rather than concentrating on job titles *per se* it seems more important to analyse the skills requirement more in terms of the person's function within an organisation, whether it be in the role of servicing the client, developing systems or training end-users. As in the case of the traditional career ladder, however, for a person to change roles Keen and Primozic *et al.* would maintain is not an evolutionary process - it requires investment in time and re-training.

There is a general acceptance by researchers that the skills inventory is the same common pool of skills for all job areas within the IS profession. What differs between individual jobs is the relative importance and weighting of the skill items perceived to be required to fill the position. As portrayed in Figure 2-6, all IS personnel need to exhibit a combination of business-related and technology-related skills, but the importance attached to each skill will be contingent upon the nature of the precise job.

The historical review of the literature has revealed that the topic of IS personnel has attracted research interest over the three eras of the computing industry. A number of trends and models have been identified that help to provide direction to this research study. The next chapter will posit a set of definitions that will become part of clarifying the research questions to be addressed.

4. Definitions and Research Questions

The preceding chapters have provided the background texture to the topic of job skills for IS personnel. An overview of the general arena on a global basis lead to a number of preliminary research aims at the conclusion of Chapter Two, while Chapter Three provided a more detailed treatment of the specific skills in the context of the workplace. This chapter is focused on refining the research direction. The nomenclature for framing the research questions is clarified, and the scope of the study is specified in terms of limiting parameters.

The first of two units of analysis that are central to the study is that of job designation. Due to the evidence accumulated in the preceding chapters, this study needs to accommodate a wide spectrum of job designations to account for all personnel who regard themselves as part of the IS function in organisations, including managerial positions. Although the earlier literature refers to positions such as 'operator' and 'tape librarian', positions now that have all but disappeared (Strassmann, 1990:16), these are not considered by this study as contained within the more modern IS job environment. 'IS professional' is defined as 'any person, including those in managerial positions, who regards themselves as a member of the computing profession'.

The second unit of analysis that is of paramount importance is that of skill item - referred to as a 'KSA' - an item that can exhibit aspects of the three concepts of *knowledge*, *skill* and/or *ability*, as proposed by Cheney. The Cheney longitudinal study provides a useful definition of an item in an inventory of IS skills.

> *Knowledge* refers to the content or technical information needed to perform adequately in a job and is normally obtained through formal education, on-the-job training, and information media, such as manuals. *Skills* are the specific psychomotor processes necessary to meet the current requirements of a specific job. They are manifested through behaviors such as conducting an effective information gathering interview, writing a well-structured COBOL program, or developing a structured system specification. Skills also include the facility to select from among a repertoire of possible actions those that are most appropriate for a particular

situation. *Abilities* refer to the cognitive factors that represent present capabilities or achievement levels. (Cheney, Hale & Kasper, 1990:238)

If we accept the definition of KSA, the literature reinforces the undeniable fact that the *knowledge* domain of IS personnel has been based on fluency with at least one computer language and related hardware concepts. Their most prominent *skills* would be those of problem solving in a logical fashion, and they exhibit unique cognitive *abilities* (Weinberg, 1971).

On closer inspection, Cheney's second set of skill items is the most optimal set for the core of an inventory. As these skill items are based on two revisions of ACM curricula for information systems, they have longitudinal significance. They are of a sufficiently high level of area definition to be generically useful for analysis, and they reflect the direction of other researchers.

Implicit in the dual career ladder concept is the dichotomous tension between a set of so-called 'technical' versus 'business' skills; and yet nowhere in the literature can definitions be found to clarify the distinction. On the other hand, the previous chapter of this historic review provides examples where numerous authors make the assumption that it is a fact and a basis for research. Even the 1972 and 1973 ACM curricula, although emphasising the technological knowledge required as core for students, nevertheless explicitly recognise the requirements of two types of graduates:

(1) technically trained systems designers, and

(2) managerially oriented IS analysts.

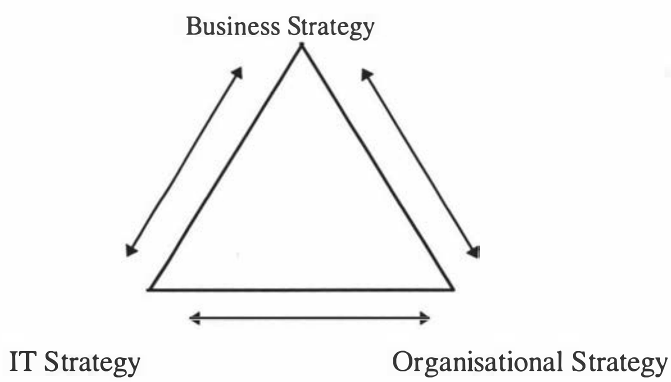
Couger extended the distinction to include one's motivational attitudes in the workplace. The weight of evidence tends to indicate a shift of emphasis towards the latter group of skills over time.

Words used to describe the non-technical group of skills are 'managerial', 'business' and 'organisational'. All three refer to the application of IS/IT to a real world situation in a living organisation, hence the concept of 'enabling technologies'. Anthony's model (1965, referred to earlier) of the three levels of management adequately covers the positions and skills inherent in the word 'managerial'. It must be remembered that all three levels can be represented in the IS function as well as in the non-IS part of an organisation. Differentiating between the other two words has become more clear in the era of strategic information systems, as explained by Richard Walton (refer to Figure 4-1):

> The business strategy-technology relationship began to receive attention in the late 1970s, as academics and managers came to recognize that process technology, including advanced IT systems, must address key success factors and, conversely, that new capabilities of advanced IT could influence the choice of business strategies....
>
> The remaining relationship - between IT and organization - was recognised in the business literature later, and less systematically than the other two. (Walton, 1989:55)

By 'business' is meant the integrated overview of an organisation with concentration on the externals and holistic matters. The 'organisational' view is more people oriented, more behavioural in emphasis.

Figure 4-1: Strategic Triangle (after Walton, 1989:54)



This study accepts that there is a valid differentiation between the two categories of skill. By 'technical KSA' is meant knowledge about hardware and software, skills that originated from the programming domain, and ability to problem solve within the IS environment. By 'business, managerial or organisational KSA' is meant knowledge about the business/organisational domain, skills to be able to work and manage effectively in an organisation, and the ability to succeed within the business/organisational environment.

These definitions will help clarify the three preliminary research questions posed in Chapter 2, namely:

1. are organisational/managerial skills becoming more important for IS professionals in their jobs?

2. have IS managers perceived a shift in the relative importance of particular skills required of their IS staff?

3. what are the particular skills required for an IS professional in New Zealand?

Each question contains underlying issues that require refinement to arrive at more tangible research strategies. The intention is to pinpoint 'operational' sub-objectives from which answers may derive to address the higher objectives.

First of all, the subjects for the research are IS professionals currently practising in New Zealand. In keeping with the definition above of 'IS professional' they should be self-proclaimed members of the computing profession which in New Zealand is represented by the New Zealand Computer Society (NZCS).

As pointed out previously, the respondents in most surveys have been IS managers assessing the skills requirements of their staff. While this viewpoint is still important, it is equally important that this research captures the individuals' perceptions of which skills they see as important in their jobs. If the respondent is a manager, then he or she has two, probably differing, sets of requisite skills - both of which need to be recognised in the study.

The first two questions above include time as a variable which in itself is dependent upon a subject's working experience in an IS position in the workplace. In addition, the timespan is further reduced by the need to relate particular skills to the current position of the incumbent. So, rather than attempt to retrospectively limit the timespan, the study has elected to focus the respondent's mind on the time within the current job designation only, and disregarding any change of employer. This same timeframe is applied to a manager commenting on his or her IS staff - that is, skills as relating to a particular job designation.

The literature has suggested that job content may not relate to specific categories of skills for any particular job designation. A research mechanism is required to investigate this issue. If respondents are requested to furnish keywords or 'task descriptors' in a prioritised order to describe their job, then a content analysis may help elucidate the suggestion.

The next chapter follows the steps taken to choose appropriate methods to conduct the research. It describes the design of the instrument and the selection of the sample of subjects upon which the research depends.

5. The Research Design and Sample

At this point it is clear that IS personnel require a wide range of skills in the two broadly defined domains of business and technology. This chapter commences by posing a model to conceptualise how such skills may be plotted in terms of these two domains. In order to explore the model in the New Zealand context, it then describes the process of selecting a research design, developing indicators, and finding a suitable sample.

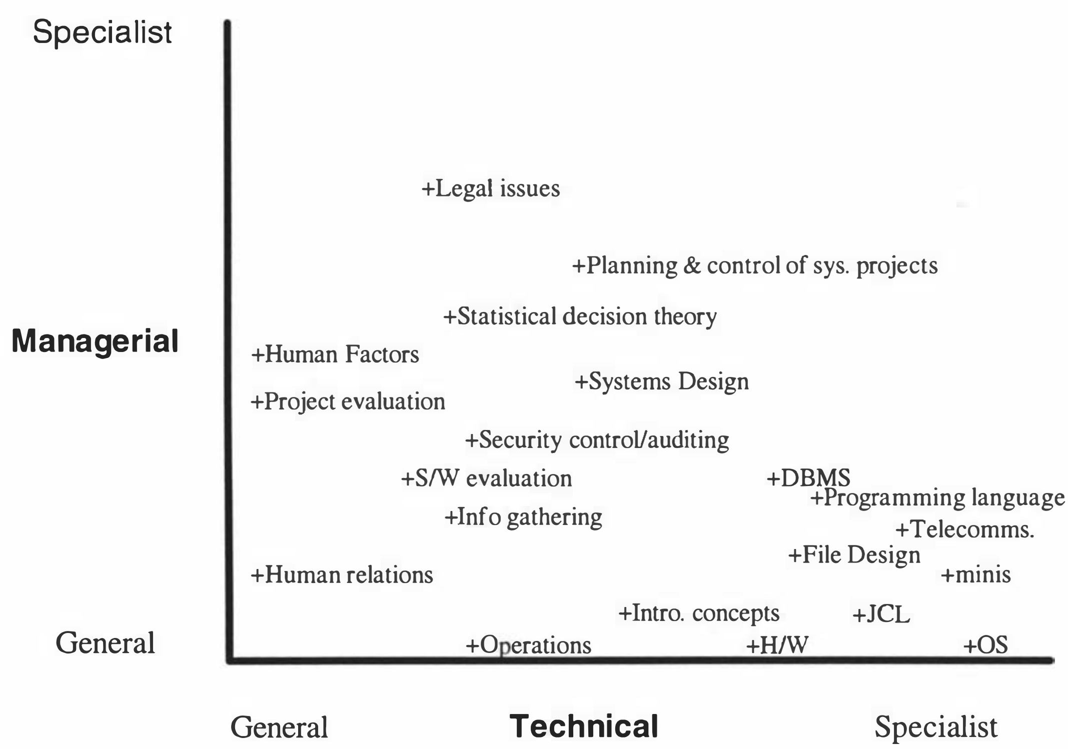
5.1 Model of the Skills Inventory

The nature of the dual-ladder in a technically-oriented profession such as IS means the technology ladder has been reserved for systems analysts/designers and programmers. Traditionally, promotion for a senior analyst/designer on the top rung has often demanded a jump across to a management rung on the business ladder. But dual categories of specialist/technical and general/managerial that most researchers have adopted for analysing the technical ladder (Benbasat, Dexter and Mantha, 1980; Leitheiser, 1992; Jones and Arnett, 1993), are too limiting to allow for research of all IS positions. In place of two such polarised, somewhat confrontational, black and white ladders, allowance needs to be made for shades of grey as proposed by Keen (1991).

As attested to in the literature, IS jobs are similar enough in nature to comprise KSAs identified as arising from a common pool. Yet there are substantial differences placed upon the relative importance of KSAs in the particular mix for any one job, so much so that transferring from one job to another could be difficult (Keen, 1991; Primozic *et al.*, 1991).

Consequently this thesis is proposing a Skills Inventory Model for researchers who are analysing *all* IS positions and not just the technical ladder. The 2-dimensional axes in Figure 5-1 caters not only for the dual-ladder categories of specialist/technical and general/managerial but also for the additional categories of general/technical and specialist/managerial skills. Both axes are best regarded as representing degrees of intensity on continua of general to specialist. The model caters not only for the ever-changing managerial ladder but also for a diverse range of new job positions that have arisen due to end-user pressure or technological developments. By its flexible structure it offers the potential too for accommodating any future positions. What it does not show, however, are the barriers that may exist between each position in terms of advancement and career movement; a feature that makes the dual-ladder model attractive even though it seems simplistic.

Figure 5-1: Skills Inventory Model



Using Cheney's 1987 set of 20 skill items as an illustration, the items, or KSAs as already defined, have been plotted on the model on an *a priori* basis. As an example, the KSA OS (operating systems) which is highly technical, but low on the managerial continuum is very much a skill item for a systems programmer - a person whose job does not involve interacting with non-technical members of an organisation. A case of mid-intensity on both axes, would be the KSA 'planning and control of systems projects' which presupposes a sound understanding of both strategic planning as well as technological issues and developments.

This model provides a framework for this study for which the prime unit of analysis is the KSA, a variable central to the research propositions.

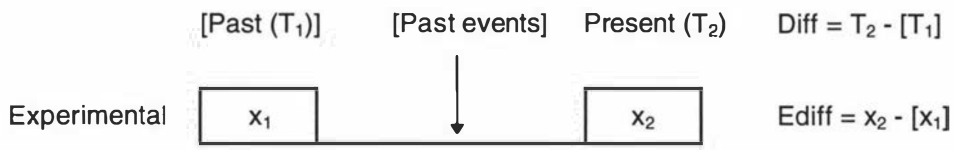
5.2 The Research Design

The research questions involve the gathering of information over a period of time. The question of interest is how IS skills may have changed in importance to an incumbent's job while that person has been working in the particular position. Given the inherent difficulties of attempting to demonstrate *actual* change, this study's aim is to gather information to show *perceived* change from the perspective of IS professionals who have practised during a time zone.

Certain design constraints were applied to the gathering of data about the change taking place during a respondent's time in a job. The logical end-point for the time zone would be the 'current' point in time, that is, when the information is gathered. The other end-point should be at the discretion of the respondent, dependent upon that person's start date in a particular job. The time zone is completely variable, contingent upon an individual's years' experience in his or her current job designation. Over the total sample a picture would emerge of change over all three eras (i.e. during a 30-year period). So at the one time rather than at set intervals some years apart, data would be gathered on change that has taken place over an extensive timeframe. The retrospective single-shot, in preference to a multiple-shot, longitudinal approach for eliciting the data was determined more by time constraints than for methodological reasons. But even if time had not been an issue the multiple-shot approach would not necessarily have proved to be methodologically superior, as discussed further below.

A design in the form of a 'retrospective panel' (de Vaus, 1991:39), was chosen to explore the research questions. The approach is as follows: to elicit information at one time only; to ask questions about two or more points in time; and during the questioning process to explore how identified variables may have changed between these two times.

Figure 5-2: Retrospective panel design. Source: de Vaus, 1991:39



As in Figure 5-2, at both time one and time two an experimental group is measured in relation to the dependent variables that are of interest in the study. The variables as measured at two points in time are indicated as x_1 and x_2. We can measure the difference (Diff) between time one (T_1) and time two (T_2) and also the difference (Ediff) between the two sets of variables x_1 and x_2.

The main shortcoming of this design is the difficulty of selective memory, as it is possible for persons to reinterpret the past events in the light of current perceptions. A preferable design may seem to be a longitudinal study, based on a 'panel design' whereby the same sample of subjects are surveyed (de Vaus, 1991:38), but due to time constraints, and the introduction of the Privacy Act in 1993, it was not feasible. The longitudinal design moreover is not without its difficulties. There is the administrative problem of keeping track of the panel members, and without a control group one could not draw conclusions about the precise cause of any change detected.

It is the author's contention that in fact there is a strong case to be made for the validity of selective memory for this particular study. Where the data are gathered at particular points in time as 'snap-shots', the perception of the relative importance of a variable may be coloured by current issues that historically could later seem to be of minor significance. On the other hand, the retrospective re-call of the same variable would tend to highlight issues that have withstood the test of time. The historic overview can serve to by-pass minor fluctuations, while spotting major trends. For a number of reasons then the retrospective panel design was deemed the most appropriate to address the scope of the exploratory research.

With the aim of helping to validate the retrospective panel results, and also to provide verification for the choice of variables in the domain of skills, the intention from the start of the study was to conduct a second piece of research in parallel. As Weber (1985) comments on 'validity':

> For example, if the same construct is measured by two different methods and the resulting variables are highly correlated, then these variables are valid indicators of the construct. (p. 18)

The author had planned to analyse newspaper job advertisements over a decade by using 'content analysis' (Weber, 1985; Kaid & Wadsworth, 1989). The national dailies, the *NZ Herald* and the *Dominion*, for many years have printed a special section on IS topics one day each week. The research plan was to retrieve all IS job advertisements in one issue per month for both newspapers between 1983 - 1993. The words and phrases in the ads would be codified and categorised according to skill items as the indicators. The results from the content analysis could be compared with those from statistical analysis of the retrospective data.

Coincidentally, Brent Gallupe's working paper entitled "The evolution of IS positions: A content analysis of IS job advertisements from 1970 to 1990" (Todd *et al.*, 1992) was published at about the same time. This seemed to add credibility to a research technique that had not been hitherto applied in the IS research field, and job advertisements appeared an obvious secondary data source that had been overlooked by IS researchers. But Gallupe in an electronic mail message to the author, dated 26 May 1993, said that he was mailing a copy of his latest revision and referred to concerns expressed about the methodology:

> ...We just got back the reviews from MISQ and the paper was a revise and resubmit, so we will make the revisions suggested (there is a fair number of them but nothing appears to be major) and send it back. On first reading of the reviews, there are the standard concerns about methodology and the use of the job ad as the unit of analysis. There is also concern about some of our analysis but I think we can clarify and substantiate our approach.

The author recalled a similar reaction after talking to academics at an ACM SIGCPR conference at St. Louis, USA two months prior. On reflection the concern related more to the use of newspapers as the source of data acquisition than to the methodology of content analysis. The technique has been used extensively to conduct research in the areas of communication and journalism since the 1950s. Although some researchers see it merely as

> a method of data-gathering, most users see content analysis as a set of full-blown research procedures. The most widely accepted definition of *content analysis* is that offered by Berelson. "Content analysis is a research technique for the objective, systematic, and quantitative description of the manifest content of communication" (Berelson, 1952, p. 18). (Kaid & Wadsworth, 1989:197)

In the end, it was decided to retain content analysis as a secondary methodology in the design for this study, but to discard newspapers in preference for an open-ended request for keywords and/or phrases from IS practitioners. The keywords would refer to key skills in the person's job. They would help clarify and elucidate just what the person saw as being the primary tasks undertaken by the person with a particular job title/designation. The keywords would be 'task descriptors' which would be prioritised by the respondent according to their importance in the job.

The classification and categorisation of the task descriptors will relate to the skill item indicators developed for the retrospective panel. But instead of pre-supposing that those items would be exhaustive in terms of categories for the codifying of the descriptors, it was planned to adopt a 'grounded theory' approach whereby the data is allowed to generate new codes if the evidence warrants. This is not grounded theory in its purest form where the theoretical construct itself can be generated out of an analysis of the data (Glaser & Strauss, 1967), but rather a means to make allowance for the fact that there is no advantage to be gained by straightjacketing the data into a set of pre-determined codes. While it is hoped that the skill indicators will cover most categories of skill, unless there is provision for the unforeseen 'other' categories, it is more likely that the coder may be tempted to force a descriptor into one of those pre-determined codes.

At this stage in the design process it was clear that the basic research construct, namely that in the minds of IS professionals change has been taking place in their jobs, would be measured by indicators that have been identified as skill items. Those indicators were developed as follows.

5.3 Developing the Indicators

As portrayed in the model in Figure 5-1, the primary element of interest in this study is the skill item, defined by Cheney as a variable called a KSA (being either an area of Knowledge, or a Skills or an Ability). The concept of change in this case has to be traced via an empirical indicator. Research outcomes rely on measurement of identified KSAs as indicators of change between time zones. This section examines the steps taken to develop the variable KSA as the prime indicator.

Cheney's 1987 and most recent list of 20 KSAs (see Figure 5-3) was used as the basis for the construction of a more up-to-date and comprehensive set whose construction occurred in three phases. First, Cheney's items were scrutinised, updated and amended, also taking into account his comments; then four more were added to reflect more modern trends, and finally eleven more KSA arose out of a pilot questionnaire. In this third phase, as a result of further feedback, the wording for many of the original KSA were refined again. This entire construction of the inventory is elaborated upon below as a triple-staged process.

The first phase of the process was as follows (in reference to descending down the first column in Figure 5-3):

1. In order to eliminate possible ambiguity between the words 'analysis' and 'design' which are often (incorrectly) regarded as synonyms, especially when the KSA is a basic skill for the job of *analyst*, it was decided to rename the item as **2. Systems Analysis & Design techniques.**

Figure 5-3: Skills Inventory Nomenclature Shift

Cheney's 1987 Inventory	**Pilot Inventory**	**Final Inventory**
1. Information gathering techniques	→	→
2. Systems Design Topics	Systems Analysis & Design techniques	→
3. File Design	Oral communication skills	Verbal & presentation skills
4. Planning & Control of System Projects	Project management skills	→
5. Human Relations in Systems Development	Interpersonal skills	People skills
6. Human Factors in Equipment and work layout	Ergonomics, equipment & work layout	Health & safety
7. ~~Introductory Computer and Information Systems Concepts~~	Written communication skills	→
8. Application Programming Languages	3rd generation programming	→
9. Job Control Language	4th generation programming	→
10. DBMS	DBMS & database design	→
11. Operating Systems	Operating Systems on all hardware	Operating Systems
12. Mainframe Hardware	Mainframe systems	→
13. Micro/Minicomputer Hardware	Micro/minicomputer systems	Mini-computer systems
14. Telecommunication concepts	→	Telecomms & networking concepts
15. Computer security, controls, auditing	→	Computer security & disaster recovery
16. Software Package Analysis	Use & evaluation of software packages	→
17. Computer Operations	Computer Operations, JCL, data capture	→
18. Legal aspects of computing	→	Understanding legal issues
19 . Computer simulation	→	Prototyping techniques
20. Statistical Decision Theory	Statistical techniques	Statistical & simulation techniques
	21. Decision support systems	→
	22. Strategic Info. Systems Planning	→
	23. CASE techniques	→
	24. Knowledge of the business or functional area (e.g. accounting, manufacturing)	→
		25. Personal computer systems
		26. Computer controls & auditing
		27. Marketing skills
		28. Quality management concepts
		29. Project evaluation & justification
		30. Negotiating skills
		31. Use & evaluation of hardware
		32. Documentation writing skills
		33. User training & support
		34. General management skills
		35. Keeping abreast with new technology

2. Due to his observation that KSA **3. File Design** was often interpreted as meaning database design by his interviewees (Cheney *et al.*, 1990:244), the wording of KSA **10.** was extended to **DBMS & database design.**

3. Cheney comments (p.245) on his omission of 'oral and written communication abilities', so the now vacant KSA **3. File Design** became **3. Oral communication skills,** while **7. Written communication skills** replaced **Introductory Computer and Information Systems Concepts** which related more to course curriculum than to the workplace.

4. His **4. Planning and Control of Systems Projects** was updated to the now more well understood skill of project management, hence **4. Project management skills.**

5. 'Interpersonal skills' is a more up-to-date term than 'human relations', and the skill is of general import, not be restricted to the systems development process, hence the renamed **5. Interpersonal skills.**

6. Cheney's **6. Human Factors in Equipment Design and Work Layout** was renamed for New Zealand readers who may confuse the U.S. 'human factors' with 'human resources' as **6. Ergonomics, equipment & work layout.**

7. The mainframe-oriented **9. Job Control Language,** no longer in current usage, was combined with computer operations to become: **17. Computer Operations, JCL, data capture.**

8. **8. Application Programming Languages** was expanded into two KSAs to reflect more up-to-date programming environments: **8. 3rd generation programming** and **9. 4th generation programming.**

9. The wording of **11. Operating Systems** was rendered more inclusive, to include modern personal computers, by the addition of **on all hardware.**

10. **16. Software Package Analysis** was re-worded to include the shift to end-user servicing: **16. Use & evaluation of software packages.**

11. To avoid confusion the new KSA, **21. Decision support systems** (see below), **20. Statistical Decision Theory** was simplified to read **20. Statistical techniques.**

In the second phase four concepts that have been stressed in the literature as important in the SIS Era, were added:

21. Decision support systems	**22.** Strategic Info. Systems Planning
23. CASE techniques	**24.** Knowledge of the business or functional area (e.g. accounting, manufacturing)

At the commencement of the SIS Era the advent of the personal computer with the spreadsheet package Visicalc marked the arrival of decision support systems (DSS) on the desktop. The decisions they support are those of middle management who need help to arrive at solutions, including 'what-if' scenarios. The managers' informational requirements are only partly structured (see Figure 2-1), and the skills to use this type of technology go beyond that required to utilise the report generation software of the earlier eras. Benbasat and Nault (1990) define DSS as

> a computer-based system used by managers as an aid to decision making in semi-structured decision tasks through direct interaction with data and models. (p.203)

They regard the technology of DSS as closely related to those of group decision support systems (GDSS) and expert systems, all of which they collectively label as managerial support systems. Another technology that developed as part of DSS is that of executive information systems:

> As the evolution of computer support for organizational personnel is considered, one group is conspicuously missing: the senior executives of a firm. They have not been omitted by design, and in fact, previous advances were originally thought to potentially serve them (e.g. MIS and DSS), but for a variety of reasons, little support has been provided. This lack of support is rapidly changing, however, as executive information systems (EIS) or executive support systems (ESS) are being developed in a growing number of firms. (Watson *et al.*, 1991:13)

Both journal articles trace the antecedents of DSS/EIS/GDSS back to pioneering work carried out respectively by Gory and Scott Morton (1971), Sprague (1980), Rockart and Treacy (1982), and Nunamaker *et al.* (1987). Given the evidence, the KSA **21. Decision support systems** is intended to be a generic term that is inclusive of a wide range of support tools for management.

The next skill item, **22. Strategic Info. Systems Planning** (SISP), is also a well recognised area of skill and knowledge in the SIS Era. It has gained prominence as the IS component of the more generic business area of strategic planning and management. Porter's (1980) concept of competitive strategies was recognised by IS writers (McFarlan, 1984; Wiseman, 1985; Keen, 1991). Other luminaries stressed the planning aspects (Earl, 1989; Scott Morton, 1991). Textbooks have been published on the topic of SISP for courses in tertiary educational institutions (Ward *et al.*, 1990; Robson, 1994), and the UK government has published a guide for practitioners (Bunn *et al.*, 1989).

The next KSA that was added, namely **23. CASE techniques,** is in the category of technical/specialist. Computer-aided software engineering (CASE) is a tool that promises to speed up the software development cycle (SDLC) by automating much of the programming done in a third generation language (3GL) such as COBOL. The consultancy of Price Waterhouse describe it as:

> The term CASE was first coined in the early 1980s with the automation of manual structured analysis and design techniques and methods. By the mid 1980s, code generators linked to analysis and design tools were put under the CASE umbrella...In the 1990s, software engineering will become a formal engineering discipline...and all software engineering tools will be called CASE tools. (Price Waterhouse, 1993:5-4)

The New Zealand made product called LINC, marketed in the 1980s under the auspices of Burroughs (now Unisys), is an example of a code generator or a fourth generation language (4GL) that could be classed as 'under the CASE umbrella'. The question may be asked as to the reason for a CASE KSA when there is already **9. 4th generation programming**. The reason is that fourth generation programming represents an environment that is associated more with end-user development (Price Waterhouse, 1993:3-54), and for many practitioners the term is well known from the mid-1980s.

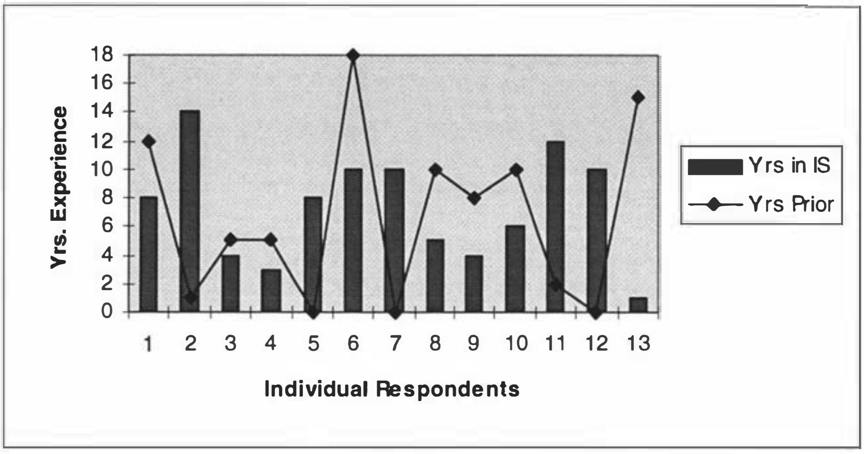
Justification for the inclusion of **24. Knowledge of the business or functional area (e.g. accounting, manufacturing)** is based on a view often expressed by employers, namely that IS personnel need to be much more aware of the particular departmental or functional context in which they install or support computer systems. Remember that the ACM curriculum is designed only for IS courses, the assumption being that students would acquire the necessary knowledge of business functions from supplementary courses. Cheney's omission of this KSA could be explained because he was relying on the ACM recommendations. So its importance was recognised by Vitalari (1985) as 'functional requirements', by Green (1989) as 'functional application knowledge', and by Todd *et al.* (1992) as 'business knowledge, function specific'(see Table 3-1).

At this stage, phase two of the process to develop the KSA as an indicator, the wording of the 24 KSAs are as listed in the second column of Figure 5-3.

In the third and final phase of the process, the content validity of this initial inventory was addressed. The procedure involved a pre-test to check the wording of the KSAs and to verify their completeness by requesting further suggested candidates for inclusion in the inventory. The representativeness of the skills inventory was assessed by subjecting the 24-item inventory to pilot testing by a class of experienced IS students in a final 3rd-year undergraduate management on-campus course for extramural students during May, 1993. The purpose of the questionnaire was to reduce the likelihood of ambiguity in the nomenclature of the KSAs, so the 24 skill items are presented initially as applying only to the positions of systems analyst, programmer, analyst/programmer and programmer/analyst. Only in the last question is each respondent asked to suggest additional skill items for the job titles of IS Manager and IS Consultant (see Figure 5-6).

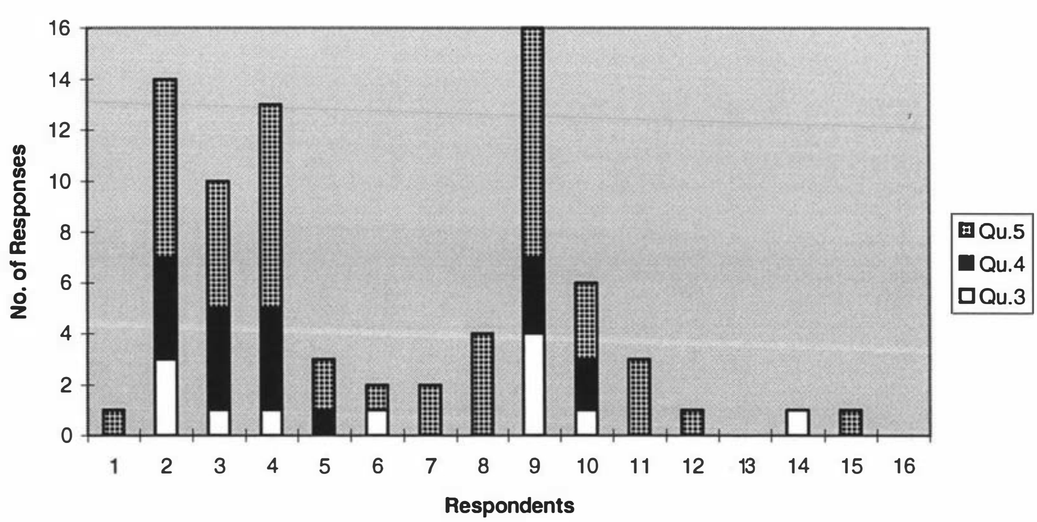
All students in the class of 35 were offered the one-page questionnaire after the purpose and voluntary nature of the pre-test was explained to them. Sixteen questionnaires were returned, most with detailed comments. Three respondents chose not to answer the first two questions concerning their years' experience 'in the computing industry' and in the workplace 'before entering the computing industry'; but as shown in Figure 5-4 for the other 13 what a person lacked in computing experience he or she made up by having prior workplace experience. Due to the fact that participants showed their interest by volunteering to take part in the pre-test, and also taking into account the substantial work experience of the respondents, the replies were considered as a valuable feedback to help validate the wording of the KSAs.

Figure 5-4: Years Experience of Pilot Respondents



The next step was to analyse the responses to further refine the inventory nomenclature. As can be seen in Figure 5-5, five respondents made comments on all three questions, while six made none or only one comment. In total from the 16 respondents, only 12 responses were received for Question 3 on the questionnaire (see Figure 5-6), and 18 from Question 4, while Question 5 attracted 47 suggestions for new (but of course not all different) skill items. It seems that extra interest was shown because Question 5 introduces the additional job titles of IS Manager and IS Consultant.

Figure 5-5: Pre-test Responses



The description which follows explains the individual steps, working down the right-hand column of 35 KSAs in Figure 5-3 in conjunction with the pilot questionnaire itself (Figure 5-6):

1. Skills such as 'presentation skills' 'chairing meetings' and 'listening' were suggested as additional managerial skills; hence **3. Oral communication skills** was extended in meaning to become **3. Verbal & presentation skills**

2. The existing **4. Project management skills** was regarded as sufficiently all-inclusive to incorporate addition skills of 'project planning', 'conflict resolution skills - resource & personnel' and 'systems implementation'.

3. Due to nine suggestions that dealt with skills that seemed to go beyond **5. interpersonal skills,** (such as 'personnel management', 'team management' 'people skills', 'people management') it was decided to opt for the more generic **5. people skills.**

4. Even though there was only one suggestion of a skill called 'health and safety', in view of the recent Occupational Safety and Health legislation, it was decided to rename the ergonomics KSA to reflect the wider area of compliance.

5. One suggestion that the word 'language' should be included in KSAs number **8.** and **9.** was not heeded as it's the 3GL and 4GL *environment*, rather than the language, that is important.

6. On reflection, after a suggestion that **11. Operating Systems on all hardware** should be qualified by specific hardware, it was decided to remove the ambiguous, too all-inclusive, 'on all hardware'.

7. As a result of comments on PCs, 'standalone versus network', and 'open systems', it seemed that personal computing is important enough to be a separate KSA. So **13. Micro/minicomputer systems** became split into **13. Mini-computer systems** and the new **25.**

Personal computer systems. Rather than a separate KSA, however, networking was included as an extension of telecommunications, hence the amended **14. Telecomms & networking concepts.**

Figure 5-6: Pilot questionnaire to Pre-test KSAs

57.301 Extramural 1993 - Pre-test of PhD Skills items.

How many years experience have you had in the computing industry? [ ]

How many years did you work before entering the computing industry? [ ]

1. The job titles that we are considering here are:

   Systems Analyst — Programmer/Analyst
   Programmer — Analyst/Programmer

2. Listed below are a number of areas of knowledge, skills and abilities, applicable *over the last decade* to the job titles above:

   1. Information gathering techniques
   2. Systems Analysis & Design techniques
   3. Oral communication skills
   4. Project management skills
   5. Interpersonal skills
   6. Ergonomics, equipment & work layout
   7. Written communication skills
   8. 3rd generation programming
   9. 4th generation programming
   10. DBMS & database design
   11. Operating Systems on all hardware
   12. Mainframe systems
   13. Micro/minicomputer systems
   14. Telecommunication concepts
   15. Computer security, controls, auditing
   16. Use & evaluation of software packages
   17. Computer Operations, JCL, data capture
   18. Legal aspects of computing
   19. Computer simulation
   20. Statistical techniques
   21. Decision support systems
   22. Strategic Info. Systems Planning
   23. CASE techniques
   24. Knowledge of the business or functional area (eg accounting, manufacturing)

3. Can you improve on the wording of any of them eg to clarify or remove ambiguity?

4. Have I omitted any items that you feel are significant?

5. Now consider adding the job titles of IS Manager and IS Consultant - what further items would you add to the list?

Thanks for your time.

8. Similarly, in face of additional suggestions such as 'emergency preparedness/disaster recovery/backup', 'risk assessment' and 'disaster recovery planning' it seemed that an important distinction should be made between the concepts of auditing/control and security. Consequently, a new KSA **26. Computer controls & auditing** was created, while **15. Computer security, controls, auditing** became more focused on security: **15. Computer security & disaster recovery.**

9. The broader issue of an increasing need for legal advice was reflected in three respondents referring to 'legalities of computing', 'IS consultant - legal liability' and 'contract/commercial law'. It was clear that **18. Legal aspects of computing** was too restrictive, and so was amended to **18. Understanding legal issues** to suggest the need for knowledge about commercial law without being a lawyer.

10. It was suspected that one respondent had interpreted 'computer simulation' as referring to the concept of an interactive approach to systems analysis such as rapid application development (RAD) or the more generally accepted term of 'prototyping' which is commonly associated with 4GL products (Sprague & McNurlin, 1993:280). In fact, the ambiguity is understandable, as seen in the following definition:

> Rapid Prototyping and Simulation Tools
>
> An increasingly popular method for verifying user requirements is rapid prototyping. Tools are available to help analysts define reports, screens and database access requirements. What results is a simulation of the report preparation and screen generation process...Builders of real-time systems use prototyping and simulation tools to test design efficiency and performance relative to simulated hardware and external events. (Price Waterhouse, 1993:5-16)

But to reduce the chance of ambiguity, simulation (in its more traditional mathematical context) is incorporated with statistical techniques: **20. Statistical & simulation techniques** and prototyping is a separate, renamed item: **19. Prototyping techniques.**

Table 5-1: Rationale for New KSAs 27-35

Pre-test suggested KSAs	New KSA Name
Marketing/selling skills including persuasiveness Possibly marketing skills, business networking skills	**27.** Marketing skills
Ability to work to standards, quality management	**28.** Quality management concepts
cost benefit analysis, project evaluation techniques feasibility study, studying IS of an organisation and making recommendations	**29.** Project evaluation & justification
service level agreements, writing/answering Response for Information (RFP) and Request for Proposal (RFP), tender response, contract negotiation, negotiating	**30.** Negotiating skills
use and evaluation of hardware	**31.** Use & evaluation of hardware
documentation skills - technical & user	**32.** Documentation writing skills
training/education/coaching, user support	**33.** User training & support
account management, budgeting skills, time management MBO, management skills, interaction management managing the information coming in and out of the org. vision, adaptability. credibility, self-motivation, methodical, ability to finish	**34.** General management skills
office automation systems, process control systems, records management & imaging, SCADA systems, CAD/CAM/CIM, GIS keeping up with current trends in IT	**35.** Keeping abreast with new technology

11.The remaining 9 KSAs were all created as a result of suggestions from the pre-test. The rationale was to accept as many of the ideas as possible to make the skills inventory as representative as possible. The suggestions and comments from the respondents have been combined by the author into what seemed logic groupings of ideas out of which a single new KSA was created for each group. For ease of presentation the suggestions are tabulated in Table 5-1 alongside the new KSAs created as a result.

As can be seen above, consequential upon the inspection of Cheney's 1987 set of KSAs and after feedback from the pre-test, the original set of 20 KSAs was substantially modified and extended to become the set of 35 KSAs as in the third column in Figure 5-3 and as in the final version of the research instrument. This was the process to validate the primary indicator for this study.

5.4 Finding the Sample

The human subject for this study is defined in the previous chapter as: 'any person, including those in managerial positions, who regards themselves as a member of the computing profession'. For the purpose of this study with its focus on the workplace, it was preferable that the subjects be selected from a population of professionals who were at the time practising in New Zealand.

The sole professional body that represents IS personnel in New Zealand is the New Zealand Computer Society (NZCS). The Society believes that approximately ten per cent of IS professionals working in New Zealand belong to it. The low participation rate can be partly explained by the voluntary nature of membership. A wide cross-section of the profession, from upper management to operator on both career 'ladders', are represented although the subscription may discourage young entrants to the industry.

In order to obtain access to a mailing list for a quota of practitioners that would include a cross-section of IS personnel in as many job designations as possible, it was decided to approach the New Zealand Computer Society, and the idea of a survey of its membership was mooted. The response was very positive, so much so that the Society was prepared to be seen as supporting the research by allowing its logo to appear on envelopes and letterhead, but on the following conditions:

1. that their committee approve the questionnaire
2. that in the interests of confidentiality the Society would run the mail merge from their computerised database
3. that the Society would charge for postage, envelopes, stationery and the labour cost of administering the mail-out, and
4. that one notice could be placed in the Society's newsletter, but that no reminder notice be permitted.

A preliminary analysis of approximately 50% of their membership, carried out by the Society's office manager, revealed the following (Table 5-2) breakdown of members by job designation. The search of the database, written in Borland's database package called Paradox, was a query-by-example (QBE) query by non-exclusive keyword within the title, so duplicates are possible:

Table 5-2: Preliminary Job Categorisation of NZCS Members

Keyword	***n***	**%**
..analyst..	135	14.3
..program..	102	10.8
..manager..	364	38.6
..project..	41	4.3
..consultant..	301	31.9
	===	===
Total	**943**	99.9

This cluster of potential respondents, while not claiming to be representative of the IS population, comprised a good balance of approximately a third on the technology ladder (analysts and programmers), a third on the managerial, and a third on what might be considered a 'hybrid' ladder (project managers and consultants).

If a survey instrument was to be chosen as the research method, then it was important to ensure a reasonable sample size so as to increase the power of any statistical testing. In 1993 the Society had 1794 non-student members. If an expected response rate was 25 to 30% (there being no reminder), and allowing for 300 non-practising members, then one would expect the return of approximately 375 to 450 responses. According to David de Vaus (1991) to achieve a confidence level of 95% the sample size needs to be at least 400, but he points out:

> Second, the size of the population from which we draw the sample is largely irrelevant for the accuracy of the sample. It is the absolute size of the sample that is important. The only exception to this is when the sample size represents a sizable proportion of the population (e.g. 10 per cent). In such cases a slightly smaller sample is equally accurate...(pp. 71-72)

Given the NZCS' estimate of its membership as approximately ten per cent of the total IS population in New Zealand, the expected sample size would be statistically adequate at the 95% confidence level. To obtain a national sample of this size by any other means seemed very unlikely, especially when one recalls the small sample sizes found in the literature.

As pointed out in the review of the literature Couger has conducted surveys in a number of countries including Australia (Dengate *et al.*, 1990), where his samples of IS professionals were all taken from computer society members in those countries. This approach added more weight to the research direction of using the survey methodology (Converse & Presser, 1986), and that the subjects be drawn from computer society members.

Now that the sample has been decided upon and the research indicators have been identified to satisfy the research questions, the next chapter describes the creation of the questionnaire as the research instrument for this study. This instrument is predicated on the research design that has also been discussed in this chapter.

6. The Survey Instrument

This previous chapter explained why the survey method was selected as the most appropriate research technique to explore the questions posed. Based on the method a questionnaire was developed to obtain national cross-sectional data from a 'panel' of professional members of the New Zealand Computer Society. This chapter discusses the rationale for the design of the questionnaire as the research instrument.

During the 'gestation' period of thinking about the design of the research, and as the overall layout of the questionnaire evolved, it grew to demand a number of sections:

a) the title page
b) the purpose of the survey
c) instructions on how to fill out the questionnaire
d) demographic data
e) task descriptors about a respondent's current position
f) a retrospective panel of *all* respondents assessing the importance of the skill items, defined as KSAs
g) a retrospective panel of managers and consultants, who are in charge of information systems (IS) personnel, assessing the importance of KSAs.

The construction of each section will be discussed in detail with pictorial representations of the various parts of the questionnaire form. The questionnaire in its entirety and at full size is to be found in Appendix I.

a) the title page

The first page of the questionnaire features the date of the survey, June 1993, and the title:

A STUDY TO DETERMINE
JOB & SKILLS CHARACTERISTICS OF
INFORMATION SYSTEMS PROFESSIONALS
(including managers & consultants)
IN NEW ZEALAND

It was necessary to include the parenthetical statement to remind respondents that IS professionals are not restricted to the technical ladder as is often the assumption in the literature.

b) the purpose of the survey

The purpose of the survey was expressed in a personalised covering letter using the University letterhead:

> The enclosed questionnaire is part of my PhD for which I am conducting research into the skills required of Information Systems personnel in New Zealand. This research is concerned with investigating which skills have been required over the past decade, and those seen to be relevant now.

The involvement of the NZCS, the issue of privacy and the voluntary nature of the survey were addressed:

> The New Zealand Computer Society, in support of this research, has agreed to mail out this questionnaire independently to its members. In the interests of confidentiality and anonymity I have had no access to the mailing list.
>
> The information which you provide will be held in the strictest confidence at Massey University and will be seen only by those involved in the statistical analysis. Your anonymity is assured, and only summarised information will be made available when reporting this research. I will report the findings at a future NZCS conference.
>
> Participation is voluntary, but you will appreciate the statistical validity of a high response rate.

The letter concluded with a request to use the Return Paid envelope, and an invitation to help research that 'I hope will be of practical benefit to our industry'.

c) instructions on how to fill out the questionnaire

Page 2 of the questionnaire is devoted entirely to preparing the respondent for the types of questions to expect and to clarify the researcher's expectations of the respondent. It commences with:

INSTRUCTIONS

There are no right or wrong answers; we are simply interested in your opinion. Please answer each question as honestly and frankly as possible.

We apologise for the similarity of a great many questions. This is necessary to produce statistical validity of the questionnaire.

All responses to the questionnaire will be kept completely confidential. Only summary, aggregate information will be reported.

First impressions are often accurate - don't dwell too long on your answer. You will be asked to respond in one of three ways: circle a number on a scale, write your answer in the brackets or write your comments on the line provided. Below is an example of each.

Examples of the types of questions to expect are then provided, whether it be drawing a circle on a Likert scale or as one option from a list of choices, supplying a numeric in a bracket, or writing a phrase in response to an open-ended question:

These are Sample Questions ONLY:

A. To what extent does your job require you to work with mechanical equipment?

1 ________ 2 ________ 3 ________ 4 ________ 5 ________ 6 ________ 7

Very little: the job requires almost no contact with mechanical equipment of any kind.	Moderately	Very much; the job requires almost constant work with mechanical equipment.

Please **circle** the number which is the most accurate description of your job. If, for example, your job requires you to work with mechanical equipment a good deal of the time - but also requires some paperwork - you might indicate the number six, as was done in the example above.

B. How many years of Management experience have you had? [5]

Please provide your answer in the brackets

C. Your sex?

Male 1
Female 2

Please circle the appropriate option.

D. Any items that you feel we have omitted - please list here......

Thinking skills

Please write your comments on the lines provided.

This page terminates with a statement of encouragement in the hope that the reader will continue to the questionnaire itself:

Thank you for your help!

d) demographic data

It was deemed necessary to identify a generically acceptable series of questionnaire items that included demographic data and codes for job designations. The latter included all those discussed in the literature review. Since Couger has been conducting international surveys of IS personnel, his Australian version (Dengate *et al*., 1990) of his standard survey instrument is used here, with his permission, as the basis of the first eight questions in this study. This is section A of the questionnaire entitled 'Background Data' - see Figure 6-1.

Questions 2, 4 and 6 are designed for personal demographic data: gender, age and number of dependants.

The first and fifth questions are concerned with the number of years a respondent has been working, whether it be in managerial roles and/or in the computing industry. These variables relate to the research questions that require knowledge of the IS professionals' total years of experience in the workplace.

As New Zealanders are known for their low participation rate in tertiary educational institutions, the level of education is of interest in question 3. As Couger's codes were not relevant in the New Zealand context, the codes for this variable had to be re-constructed to reflect national educational qualifications.

Figure 6-1: Questionnaire - Section A

A. Background Data

In this section we are interested in recording information as to your background, job position and the tasks in your job.

1. How many years of Management experience have you had? [ ]

2. Your sex?

Male	1
Female	2

3. What is your highest level of education? 4. Your age? [ ]

School Certificate	2
Seventh Form secondary school	3
university undergraduate diploma	4
bachelor's degree	5
master's degree	6
PhD	7

5. How many years have you worked in the computer field (to the nearest year)? [ ]

6. How many dependents do you have? [ ]

7. What is Your Current Job Code?

CIRCLE ONE (Choose one where at least 75% of your time is spent)

Director/Executive	01	Programmer	10
Middle Management	02	Systems Programmer	11
First Line Supervisor and Project Manager	03	Data Base Designer	12
Consultant	04	Data Communications Specialist	13
Clerical	05	Data Communications Operator	14
Secretary	06	Computer Operator	15
DP Trainer	07	Data Control (Output Distributor)	16
Systems Analyst	08	Operations Scheduler	17
Programmer/Analyst or Analyst/Programmer	09	Data Entry	18

8. How many years have you worked in the Job Code indicated above? [ ]
(**Note** here that you may have changed employment *without necessarily changing the job code*).

9. What are the major tasks in your current job?
If you were to identify the major tasks in your current job code, please list below in ***descending order of importance*** *up to four(4) tasks that you consider best describe what you do (use keywords or phrases):*

Task 1. ______________________

Task 2. ______________________

Task 3. ______________________

Task 4. ______________________

Page 3

Questions 7 and 8 on the survey form are concerned with the respondent's identification of current job designation, and the time period spent working in that designation, ignoring changes in employment. In this study the 18 job designations, taken from Couger's Australian study, are codified into Job Codes, as in the research instrument. The other important variable relates to a retrospective unit of time: the length of time in years that the incumbent has worked in the current job designation. The fact that the incumbent may have had changes of employment is of no interest in this study. But of immense interest is the actual length of time of change in the skills inventory for each respondent in a particular job code. This variable in Question 8 is the indicator used to measure this unit of time. It was identified in the research design (see Figure 5-2) as essential to the calculation of the difference in time (Diff) between the retrospective point in time (T_1) and the current point in time (T_2).

e) task descriptors about a respondent's current position.

The final part of section A of the questionnaire relates to the research design involving a secondary method of research, content analysis. This method was used to help verify the KSAs to be used in the survey instrument. Aware of the definitional difficulties of job titles and in order to cross-reference with skill items, Question 9 is designed to elicit from respondents, via keywords and/or phrases, more descriptive data about the major tasks in their jobs. Such 'task descriptors' will serve to clarify the implicit job skills, or KSAs, for a position with a particular job designation. Respondents are requested to consider the major tasks in their current job and to list in *descending order of importance* up to four 'tasks that you consider best describe what you do (use keywords or phrases)'. The element of prioritisation is included as part of the design to add a degree of definition to the analysis. By being able to weight the descriptors into four ranks, comparisons with the retrospective panel scales in the next section of the questionnaire become possible.

The research intention is to codify *a posteriori* the prioritised words and phrases into an exhaustive set of KSAs, using the instrument's set of 35 KSAs in the next section B as the minimum set. This is where a 'grounded theory' approach is adopted so that the data is not constrained by a pre-determined set of 35 codes. Instead, if respondents happened to consistently suggest task descriptors that could lead to additional KSAs, this has been allowed for in the design of the questionnaire.

f) a retrospective panel of *all* respondents assessing the importance of KSAs

The retrospective panel questions are in section B of the instrument. This section is divided into two parts: the first to be completed by all respondents, the second is to be filled out by managers or consultants who manage at least two personnel on the traditional technical ladder (with the job designation of systems analyst, programmer, analyst/programmer or programmer/analyst). This is designed to permit analysis of the perceptions of personnel on differing career ladders. The overall layout of the whole section with its two parts is portrayed graphically as a schema in Figure 6-3 - three actual pages have been condensed into one.

The retrospective nature of the questionnaire relates to the use of two 7-point Likert scales for each KSA item. For each scale, 1 represents a low importance rating for the item and 7 represents a high importance (see Figure 6-2).

Figure 6-2: An example of Survey Instrument Likert Scale

	When you first started	**At the present time**
5. People Skills	1 ____2 ____3 ____4 ____5____6____7	1 ____2 ____3 ____4____5____6____7

The 35 KSAs that feature in the scales have been validated by a pre-test as a result of which Cheney's were updated and extended. Nevertheless, consistent with the 'grounded theory' approach to the mechanism of task descriptors as already adopted in this study, it seemed important to give the respondents ample opportunity to suggest further items. With this aim in mind, it will be noticed that there is room on the questionnaire for three open-ended blank KSA entries at the end of both sets of scales for additional items.

Figure 6-3: Questionnaire Schema - Section B

B. Part I Your Job Skills

Instructions

1_______2_______3_______4_______5_______6_______7

Not important — Quite important — Extremely important

	When you first started	At the present time
1. KSA name	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
35. KSA name	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7

Any items that you feel we have omitted - please list here..... .

36.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
37.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
38.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7

STOP!

If you are not a manager nor a consultant please finish.
Otherwise, please continue below.

B. Part II Job Skills from the point of view of Managers or Consultants

Answer this Part if you are a Manager or Consultant who has reporting to you at least two personnel with one of the following job titles:

Systems Analyst — *Programmer/Analyst*
Programmer — *Analyst/Programmer*

Instructions

1_______2_______3_______4_______5_______6_______7

Not important — Quite important — Extremely important

	When you first started	At the present time
1. KSA name	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
35. KSA name	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7

Any items that you feel we have omitted - please list here......

36.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
37.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7
38.	1 ___2 ___3 ___4 ___5 ___6 ___7	1 ___2 ___3 ___4 ___5 ___6 ___7

The first Likert scale is used by the respondents to rate the importance of the skill at the time when they first entered a position with their current job designation. The second scale is for their assessment of the same skill at present in their job. It is very important that the respondents understand that their responses relate to their current job code as selected on the previous page, and so the instructions are as precise as possible (see Figure 6-4).

Figure 6-4: Questionnaire Instructions for All Respondents

In this section you are being asked to make *two responses*. First, we want you to think back over the time you have been in your job code (even though you may have changed employment) and indicate on the scales below how important each skill item was **when you first started**. Secondly, we would like you to go through the same process, but this time indicate on the scales below how important the skill items are in your job **at the present time**.

g) a retrospective panel of managers and consultants, who are in charge of IS personnel, assessing the importance of KSAs

Part II of this section seeks to gain data on the perception that managers or consultants have of the importance of job skill items with regard to IS personnel reporting to them. To be eligible to answer this part of the questionnaire they should be currently managing at least two IS personnel.

It could be argued that the job codes in Question 7 in section A (see Figure 6-1) would be adequate indicators of a person's job as a 'manager'. Not only however is there the endemic problem of whether job titles, as emblems of status, represent their actual job activities, but also in New Zealand, where organisations are small, there is the possibility that self-employed managers have no operatives. This study needs to ensure that it captures data from persons who are actively involved in the process of managing other people. The research objective here is to enhance the analysis of the construct of change by introducing the perspective of those involved in the process of managing personnel with those same KSAs.

The 'other people' in this case are IS personnel that are non-managers drawn from the job categories that most commentators in the literature regard as the core of the technical ladder: those of Systems Analyst, Programmer, Programmer/Analyst, and Analyst/Programmer. They feature in the prior section of the questionnaire as Job Codes 08, 09 and 10 in Question 7, Part A (Figure 6-1), and were selected in preference to other technically oriented job titles due to their generally accepted importance on the technical ladder. For this reason, as part of the research design, these were the job titles initially specified in the pre-test questionnaire as the basis for scrutiny of IS skill items (see Questions 3 and 4 in Figure 5-6). To give respondents time to think on the traditional IS skills inventory, it was only in the later Question 5 of the pre-test questionnaire that they were asked to consider extending the inventory by including the jobs of 'managers and consultants'.

Figure 6-5 contains the instructions in the questionnaire for this group of clearly identified managers to fill out the retrospective and current Likert scales.

Figure 6-5: Questionnaire Instructions for Managers and/or Consultants

This section is like Part I above. It asks you to make two responses.

First, we would like you to think back to the time when you first became a manager. Consider the job skills of **information systems staff** for whom you were responsible. Please indicate the importance of each skill as **required by you then.**

Secondly, we would like you to indicate the importance of these skill items as required by you from those working for you **now.**

The questionnaire terminates with the statement:

The End. Thank you.

Please mail using the Return Paid envelope.

The research methodology and the contents of the questionnaire and the covering letter were approved by both the Ethics Committee of the University and by the New Zealand Computer Society.

1500 questionnaires were printed on buff coloured paper, and pre-paid envelopes were acquired in preparation for the mail-out from the Wellington office of the New Zealand Computer Society.

This chapter has demonstrated how the research design discussed in the previous chapter has been operationalised by the survey method into an instrument in the form of a survey questionnaire. In the next chapter the discussion covers how the mail-out was managed and how the returned questionnaires were processed.

7. Survey Administration and Processing

Once the questionnaire had been finalised and printed, the process of distribution could now take place. This chapter follows the steps in this process. It commences with the exclusion of New Zealand Computer Society members who were deemed not suitable to the research objectives, through to the mailing of the questionnaire and covering letter, and on to the processing of the returned responses. It concludes with the demographic features of the sample of IS professionals who chose to respond to the survey.

7.1 Mail-out Administration

The author travelled to the Wellington office of the NZCS to oversee the procedure of selecting a panel of subjects in keeping with the research requirement for 'IS professionals currently practising in New Zealand'. The computer database was the same that had earlier provided the preliminary profile of members (see Table 5-2). Due to these selection criteria, members eliminated from the survey were those whose mailing address was a teaching institution (n = 178), or those who were students (n = 47), retired (n = 33) or overseas (n = 52).

The NZCS was commissioned to print the personalised letters on University stationery as part of a mail merge from their members database, and to insert the letters with pre-paid envelopes and questionnaires into NZCS 'postage paid' envelopes. A total of 1479 questionnaires were mailed out over a period of a week commencing on June 17 1993. It was hoped that the inclusion of a pre-paid envelope would encourage a response. An earlier strategy that was considered but rejected, had been to save costs by inserting the questionnaire into a regular monthly issue of *Quickface*, the Society newsletter. But this would have lead to difficulties with the insertion of covering letter and pre-paid envelope. It was also argued that the more personalised nature of the direct mailing would be treated more seriously by the recipients.

The NZCS turned down a request to insert a reminder notice in its newsletter. A total of 470 replies arrived, a response rate of 31.78%. Given the one-shot mail-out with no opportunity for a reminder notice this is a satisfactory response rate. On further inspection 27 questionnaires were rejected on the grounds of the same elimination criteria applied in the initial mail-out, resulting in a total of 433 questionnaires to be processed, or a usable response rate of 29.28%.

7.2 Content Analysis of theTask Descriptors

As the questionnaires arrived each was assigned a sequential number. This number was later keyed in as the first field of each record to permit identification of the source document in case of later queries or errors that might arise out of the stage of computerised data capture.

Also as part of the initial stage the 'task descriptors' in Question 9 (see Figure 6-1) were codified by hand by the researcher. The process was to regard the existing 35 KSAs as a core of codes to which would be added as many additional codes as required to satisfy all incoming keywords and phrases used to describe respondents' current jobs. It was recognised that many of the additional codes *might* be further elaboration or further definition of the core set of 35, but this inspection was not carried out until a later phase. The third column in Table 7-1 contains all new codes that resulted from processing all questionnaires. The list was built up in a chronological sequence as the need for new codes or phrases arose. As can be seen in the list the nomenclature contains a series of phrases and synonyms which describe a particular concept. This activity of semantic classification was a subjective decision made by the researcher as content analyst. The researcher as sole judge resolves the issue of the reliability of more than one coder, known as 'reproducibility, sometimes called *intercoder reliability*' (Weber, 1985:17).

For a number of reasons this process of 'hand-coded or interpretive' content analysis (Weber, 1985:41) was chosen by the author in preference to using a computer program to aid in the analysis. A computer program could be regarded as providing perfect coder reliability and consistency in the classification of words or phrases within the text to be analysed. Once the rules have been properly defined the machine will always apply them in the same way - the assumption being that the rules themselves are semantically accurate. But as Weber points out

> In content analysis, reliability problems usually grow out of the ambiguity of word meanings or the ambiguity of category definitions or other coding rules. (p. 15)

To overcome the problem of words that have more than one meaning (homographs) the more recent programs and dictionaries have incorporated what are technically known as *disambiguation rules*, but errors will still occur because of subtle semantic, idiomatic or contextual ambiguity (Weber, 1985:30).

Table 7-1: Task Descriptors Assigned to KSA Names and Additional Codes

KSA	*n*	Additional New Codes	*n*
1	2	36. accounting/financial, financial planning	26
2	57	37. administration, paperwork	13
3	4	38. advising clients, users, guiding own management	40
4	115	39. auditing, reviewing performance, monitoring, SLA	25
5	10	40. budgeting, funds management	16
6	0	41. business analysis, analysis, business procedures, workflow	20
7	8	42. capitalising on IT - innovating, investigating new technologies/opportunities	15
8	0	43. clients relations, service managementt, provision of user needs	38
9	0	44. communicating, listening, presenting, liaison role	37
10	13	45. consulting (professional), management consulting	43
11	2	46. contract management, quotations	1
12	2	47. controlling, managing expectations	4
13	0	48. data & database administration	10
14	17	49. systems development, software development	43
15	6	50. user requirements, requirements analysis, needs identification	38
16	7	51. implementation (generic)	18
17	7	52. testing, fixing bugs	16
18	1	53. installing, purchase/procurement of hard or software	23
19	0	54. maintenance and enhancements	49
20	3	55. management of IS/IT function	21
21	1	56. managing outsourcing or external contractors	2
22	29	57. planning - strategic, medium-term, short-term, setting direction, aligning policy	93
23	3	58. policymaking, setting & maintaining standards/policies	18
24	1	59. problem solving and/or resolution, conceptualising	32
25	6	60. 'product' (could be IT) evaluation, marketing	15
26	8	61. programming(application and/or systems), construct	52
27	36	62. reporting to management, providing reports	11
28	16	63. sales, new business	35
29	12	64. staff management, directing, HR management, change management	79
30	4	65. support - pre/post sales, clients, technical, users	56
31	1	66. systems admin, facilities management, managing resources	37
32	7	67. team leadership, stimulation, support, manage 'team' or 'group'	15
33	31	68. technical expertise	16
34	60	69. tender document (RFP, RFI) preparation & response, develop proposals	8
35	9	70. training, coaching, educating own management	30
		71. troubleshooting	12
		72. research, R&D	9
	===		===
	478		1016

Computer programs are less likely to overcome the more serious problem of the validity of variables based on the classification technique.

> A content analysis variable is valid to the extent that it measures the construct the investigator intends it to measure. As is the case with reliability, validity problems also grow out of the ambiguity of word meanings and category or variable definitions. (Weber, 1985:15)

Weber quotes Krippendorff and refers to this as *semantic validity*: 'which exists when persons familiar with the language and texts examine lists of words (or other units) placed in the same category and agree that these words have similar meanings or connotations' (p. 21). This task demands human understanding and judgement, qualities that computer programs cannot emulate.

For this reason, in this study the classification process and the phraseology was subjected to scrutiny and semantic analysis by a second person with research experience in transactional communication.

Hence the interpretive content analysis process adopted was:

1. to inspect the task descriptor;
2. to compare it with the 35 KSA names (see Appendix I);
3. if the match was not obvious, to look to the list of new codes;
4. if this failed, to create a new code or additional phrase for one of the 'new' (i.e. not one of the 35 KSAs) codes;
5. to hand-write the 2-digit codes in descending order of importance alongside the four lines of task descriptors ready for keypunching.

As can be seen in Table 7-1 a total of 478 task descriptors were assigned to the 35 KSAs, with **4. Project management skills** (n = 115) attracting most descriptors. In order to be categorised as a KSA the descriptor wording had to be almost identical to the KSA name. At this stage the 'grounded theory' approach was justified since 1016 descriptors were not readily categorised in the first instance into the 35 KSA items. It is of interest that the two most popular new codes are **57. planning - strategic, medium-term, short-term, setting direction, aligning policy** (n= 93) and **64. staff management, directing, HR management, change management** (n= 79.

Task descriptors that appeared only once and also appeared to be somewhat indeterminate were not codified, namely: ‘politics’, ‘integrating applications’, ‘punctuality’, ‘issue management’, ‘operations management’ and ‘meetings, meetings, meetings!’.

Further semantic analysis was necessary at this point in order to resolve an apparent research problem. It seems that the ‘grounded theory’ approach has indeed caused additional KSA to surface beyond the 35 that have been postulated as sufficient to encapsulate all skill items requisite for IS personnel. The codifying process had intentionally resisted attempts to look for all but obvious semantic and synonymous relationships between phrases as they arrived. There had been no attempt to look for hierarchies of meaning or larger sets of phrase with inclusive meaning. So when the so-called ‘new’ codes were at this stage inspected by the researcher, it was found that they could readily be collapsed back into the original 35 KSA codes. The new were words and phrases that elaborated upon or were sub-meanings of the higher-level or generic KSA names and concepts.

As judged by the researcher, Table 7-2 contains only those 15 KSAs that attracted the 37 new task descriptor codes. These codes can be regarded as sub-level KSAs, in that they add subliminal meaning to the superior KSA. The semantic analysis was validated by the intercoder reliability score of 91.89%, as a result of a second analysis carried out by another communications academic who was not a member of the IS profession. The fact that this second coder could so naturally assign the secondary codes to those primary KSAs without being an expert in the field helps to confirm what Krippendorff terms *semantic validity* (Weber, 1985:21).

Table 7-2: Task Descriptor Codes Collapsed into KSAs

2. Systems Analysis & Design techniques
- **41** business analysis, analysis, business procedures, workflow
- **49** development, systems development, software development
- **50** user requirements, requirements analysis, needs identification
- **59** problem solving and/or resolution, conceptualising

4. Project management skills
- **51** implementation (generic)

5. People skills
- **44** communicating, listening, presenting, liaison role
- **47** controlling, managing expectations
- **64** staff management, directing, HR management, change management
- **67** team leadership, stimulation, support, manage 'team' or 'group'

7. Written communication skills
- **62** reporting to management, providing reports
- **69** tender document (RFP, RFI) preparation & response, develop proposals

9. 4th generation programming
- **52** testing, fixing bugs
- **54** maintenance and enhancements
- **61** programming(application and/or systems), construct
- **68** technical expertise
- **71** troubleshooting

10. DBMS & database design
- **48** data & database administration

22. Strategic Info. Systems Planning
- **57** planning - strategic, medium-term, short-term, setting direction, aligning policy
- **72** research, R&D

24. Knowledge of the business area
- **36** accounting/financial, financial planning
- **40** budgeting, funds management
- **45** consulting (professional), management consulting

26. Computer controls & auditing
- **39** auditing, reviewing performance, monitoring, Service Level Agreements

27. Marketing skills
- **60** 'product' (could be IT) evaluation, marketing
- **63** sales, new business

28. Quality management concepts
- **43** clients/customer relations, service management, provision of user needs
- **58** policymaking, setting standards, maintaining standards/policies

29. Project evaluation & justification
- **42** capitalising on IT - innovating, investigating new technologies/opportunities
- **53** installing and/or purchase/procurement of hardware or software

30. Negotiating skills
- **46** contract management, quotations
- **56** managing outsourcing or external contractors

33. User training & support
- **38** advising clients, users, guiding own management
- **65** support - pre/post sales, clients,technical, users
- **70** training, coaching, educating own management

34. General management skills
- **37** administration, paperwork
- **55** management of IS/IT function
- **66** systems administration, facilities management, managing resources

As a consequence of this further semantic analysis the 35 KSA developed as indicators for the research instrument are still the primary items in the skills inventory to be explored. The task descriptors, however, in later analysis in this study will inevitably add further definition and semantic variety to those 15 KSAs to which they were attracted.

7.3 Further Data Collection Procedures

As an adjunct to the coding process of the task descriptors, as just described, all comments made by respondents were noted. Most of these comments related to the respondents' unease at either their job title or the appropriateness of their job in the IS profession. For example, 24 pointed out that they were the sole person in their business, 3 were contractors, 3 were in publishing, one was an engineer, another was an account manager, two were IT personnel consultants, and one was a solicitor. Two respondents suggested that a job code for 'systems administrator' should have been on the questionnaire. Two made the point that KSA **Knowledge of the business area** should have much more weighting in importance, while another made a similar statement concerning KSA **Telecomms & networking concepts.**

In most cases the numbers of respondents making these comments are not significant in comparison with the total sample. The 24 sole operators, however, warranted further investigation. It was found that 20 of them had placed themselves into the first four job codes, that is with titles of manager or consultant. This phenomenon had been foreseen in the design of the questionnaire by the construction of the second retrospective panel in which to qualify as a 'manager' the respondent could not be a sole practitioner. On the other hand, their job classification is still valid for the first panel which was designed for all practitioners to assess the importance of KSAs in their own jobs.

After all questionnaires were codified with the task descriptors and visually checked for coding errors or unclear numerics, they were handed over for keying by a professional keypunch operator in the University computer centre. It is very easy for a keypunch operator to skip a column or insert a space when the data fields are in fixed format as is usual with input into most statistical computer programs. In order to detect any such mis-keying the computer program that had been written by a colleague to edit the data successfully located a number of keypunching errors.

When the disk file was pronounced clean, source code was prepared in the computer program Statistical Software Package for the Social Sciences (SPSSX) to accept the data for analysis. The first step was to print out summary descriptive statistics to 'get a feel' for the characteristics of the sample.

7.4 Descriptive Statistics

The profile of the 443 respondents in relation to their job titles and experience are summarised in Tables 7-3 and 7-4. Closer inspection of the first four job codes in Table 7-3 reveals that 38.6% of the sample are in upper and middle management with 37.1% in the project management/consultancy areas. The low percentage in the traditional systems analyst/programmer job categories is most likely explained by the re-classification of personnel as consultants engaged in 'business analysis' (as predicted in Australia: Hudson, 1992:75). The results are in keeping with the pre-survey expectation of a panel of more senior and managerial stratification (see Table 7-3).

These results are very similar to those from a survey of NZCS members conducted in 1994 by Strategic Research Services reported in the November Issue of the NZCS newsletter, *Quickface*. A response rate of 31% produced 527 replies. That survey, it should be noted, did not exclude educators (as is the case with this study) who represented 13.7 % of the sample. The most frequently listed work areas were Management (38%), Advisory/Consulting (36.8%) and Applications (21%).

There appears to be relative stability in and allegiance to the profession. An average of 7.3 years has been spent in the current job designation with well over half the respondents having remained there for more than 6 years (Table 7-4). It must be pointed out, however, that this does not negate a widely held view that IS personnel often have less allegiance to their employer than to their profession - this study does not enquire into employment stability.

It seems that nearly 20% of respondents (Table 7-4) could have been in the industry at the time of the Boswell & Melhuish survey which revealed that half their respondents were aged 30 years or younger (see Figure 7-1). Not surprisingly then, 19% of their respondents were in managerial positions compared with over 38% in this study.

Worthy of note is the low percentage of female respondents: only 12.9%; and it appears that the industry has remained male-dominated in New Zealand since the mid-1970s. In the Boswell & Melhuish's survey 18% of respondents were women (Boswell & Melhuish, 1978a:23)

New Zealand is well-known for its low participation rate in terms of tertiary education. In this survey 27.5% of respondents do not hold any tertiary qualification, while 45.4% have a bachelor's degree, 12.4% a master's, and 2.7% have a Ph.D. So, whereas 32% had a university degree in 1978 (Boswell & Melhuish, 1978a:26), by the 1990s the percentage of IS professionals with degrees has almost doubled to 61.5%.

These figures seem to be suggesting that managers in the IS industry are more highly qualified than their peers in general. Hooley and Franko's (1990) sample of over 400 randomly selected practising managers reveals that 34% of managers have no formal qualifications while 44% have degrees. The apparent difference may be due to the age distribution of the sample and the fact that technologists would tend to graduate to managerial positions at a later stage in their careers.

The average age for the sample is 41, with 13.8% aged 30 years or younger. While 12.9% have no management experience, 49.2% have between 2 and 10 years managerial experience. The average number of years 'in the computer field' is 16.3 compared with the Boswell & Melhuish results that showed half their respondents with fewer than 6½ years spent in the field (see Figure 7-2).

Table 7-3: Respondents by Job Designation

Job Designation	Number of Respondents	%
Director/Executive	82	18.5
Middle Management	89	20.1
First Line Supervisor and Project Manager	44	9.9
Consultant	121	27.2
Clerical	0	0
Secretary	0	0
DP Trainer	6	1.4
Systems Analyst	19	4.3
Programmer/Analyst or Analyst/Programmer	52	11.7
Programmer	6	1.4
Systems Programmer	10	2.3
Data Base Designer	5	1.1
Data Communications Specialist	4	0.9
Data Communications Operator	0	0
Computer Operator	2	0.5
Data Control (Output Distributor)	0	0
Operations Scheduler	1	0.2
Data Entry	0	0
Systems Administrator	2	0.5
Total	**443**	**100**

Table 7-4: Respondents by Years in Their Current Job Designation

Number of Years in Current Job Designation	Number of Respondents	%
1 to 2	57	12.9
3 to 5	143	32.3
6 to 10	154	34.7
11 to 30	89	20.1
Total	**443**	**100**

Figure 7-1: Age Distribution of IS Personnel in NZ: 1978 & 1993

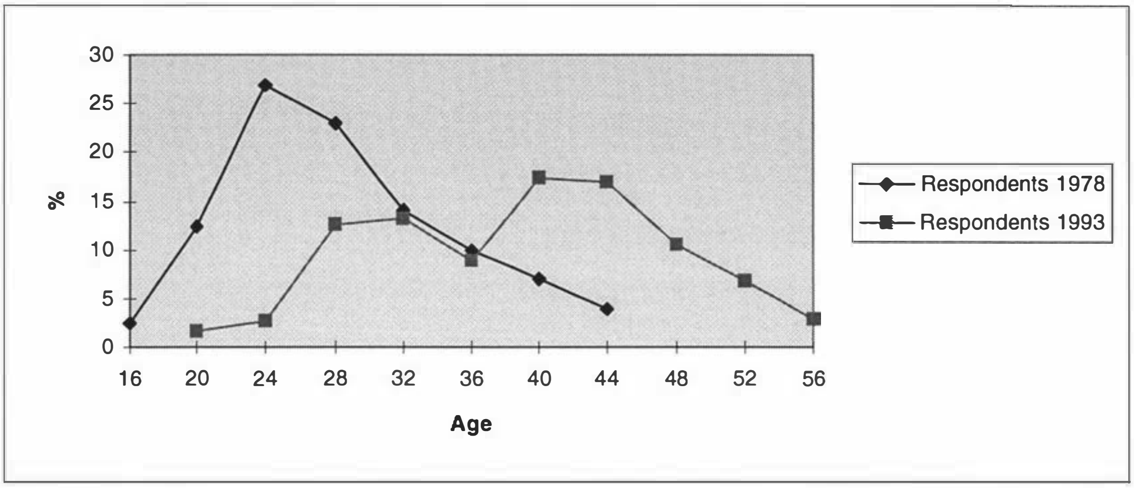
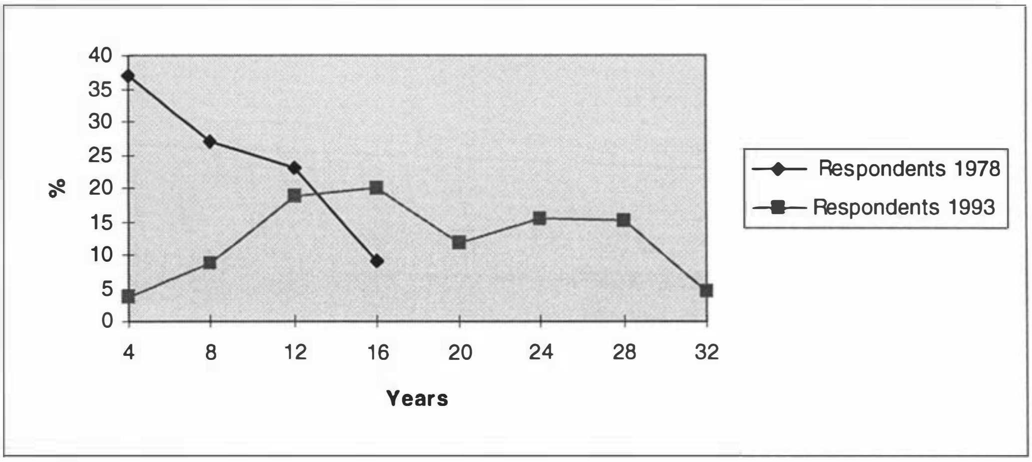


Figure 7-2: Years in the Computer Field: 1978 & 1993



To summarise, the demographic analysis shows that the IS profession remains predominantly male with a higher level of tertiary qualifications. The age distribution has moved from a youthful population to a mature one with a corresponding shift of personnel from the technical ladder across to the rungs on the management ladder. This must also imply a corresponding shift in the skills inventory for the profession as a whole.

At this stage in the research process the external activities of survey administration has been completed. The retrospective panel of subjects has responded to the research instrument. This chapter has traced the sequence of events in this procedure. It has also provided an overview of the profile of the panel in their jobs as professionals. The next chapter will re-visit the research questions to be explored; because it is in this context that it will elaborate upon strategies to be adopted to conduct analyses of the data collected in the survey.

8. Analysis of the Skills Inventory before Data Reduction

The aim of this chapter is to report on initial results in order to further the exploration of the underlying research construct of change. In this context this chapter addresses the underlying research question: has there been a discernible shift in the skills requirements for IS personnel in New Zealand over the last three decades? This period can now be reviewed retrospectively as approximately 20% of the sample have worked in their current job designations for two to three decades (Table 7-4). At this stage then the research question will be answered in general terms so that a gestalt appreciation of the skills inventory of all 35 items is gained before they are reduced to composite items for more detailed analysis. The emphasis of the chapter is on the sample as a whole. Once it has been determined whether change has indeed occurred, further analysis can proceed.

Additionally, even at the level of a general overview, the issue of the relative significance of each KSA item arises. As soon as results are reported the reader inevitably looks for answers that involve attributing significance or weighting to those results. In this study the primary indicators and hence measures for the results are the KSAs. As suggested in Chapter 5 the orientation (or significance to the workplace) of a KSA is best described as a coordinate on the two axes, the one business-related and the other technology-related (see Figure 5-1). At this stage of this study such a degree of sophistication has not been reached. So to progress the general nature of the inquiry and to keep faith with the literature, the traditional dichotomous, uni-dimensional distinction is made between two bifurcated sets of skill items: those that are business-related and those that are technology-related.

On an *a priori* basis the author classified the 35 KSA into the two groups. The same communications academic who had helped with the semantic validation of the task descriptors (in Table 7-2) was then asked to act as a second coder. The result was an intercoder reliability of 91.42%, probably due to the fact that as a non-IS professional she tended to place three of the items (KSA 1, 15 and 26) into the business-related category in contrast to the author. On consideration of the second opinion, KSA **1. Information gathering techniques** was re-classified as business-related. Table 8-1 contains the business versus technical classification of the KSAs for analysis purposes.

Table 8-1: Business-related and Technology-related KSAs

Business-related	Technology-related
1. Information gathering techniques	**2.** Systems Analysis & Design techniques
3. Verbal & presentation skills	**8.** 3rd generation programming
4. Project management skills	**9.** 4th generation programming
5. People skills	**10.** DBMS & database design
6. Health & safety	**11.** Operating Systems
7. Written communication skills	**12.** Mainframe systems
18. Understanding legal issues	**13.** Mini-computer systems
20. Statistical & simulation techniques	**14.** Telecomms & networking concepts
21. Decision support systems	**15.** Computer security & disaster recovery
22. Strategic Info. Systems Planning	**16.** Use & evaluation of software packages
24. Knowledge of the business	**17.** Computer operations, JCL, data capture
27. Marketing skills	**19.** Prototyping techniques
28. Quality management concepts	**23.** CASE techniques
29. Project evaluation & justification	**25.** Personal computer systems
30. Negotiating skills	**26.** Computer controls & auditing
34. General management skills	**31.** Use & evaluation of hardware
35. Keeping abreast with new technology	**32.** Documentation writing skills
	33. User training & support

8.1 The Means of the Total Sample

The focus here is on the section in the questionnaire filled out by the total population, that is section B, Part I of the instrument. Two Likert scales were provided for each of the thirty-five KSAs. Respondents were required to use the first scale to rate the importance of the KSA in their job when they first entered their current job designation (even though it may include re-employment in different organisations). The second scale was used to indicate the importance of the KSA at the present time in the job. Hence over the total sample each time difference between the two scales varied according to an individual's career - anything from one to thirty years.

For each KSA the difference between the group mean across the whole sample (n = 433) of the two scales will indicate change in the importance of that KSA. Of course, because Likert scales contain no relative ratio of strength between the intervals on the scale, no weighting can be assigned to the actual position on the scale of the two group means that determine their mean difference.

Figure 8-1: Total Sample Group Means of KSAs Classified into B(usiness) & T(echnology)

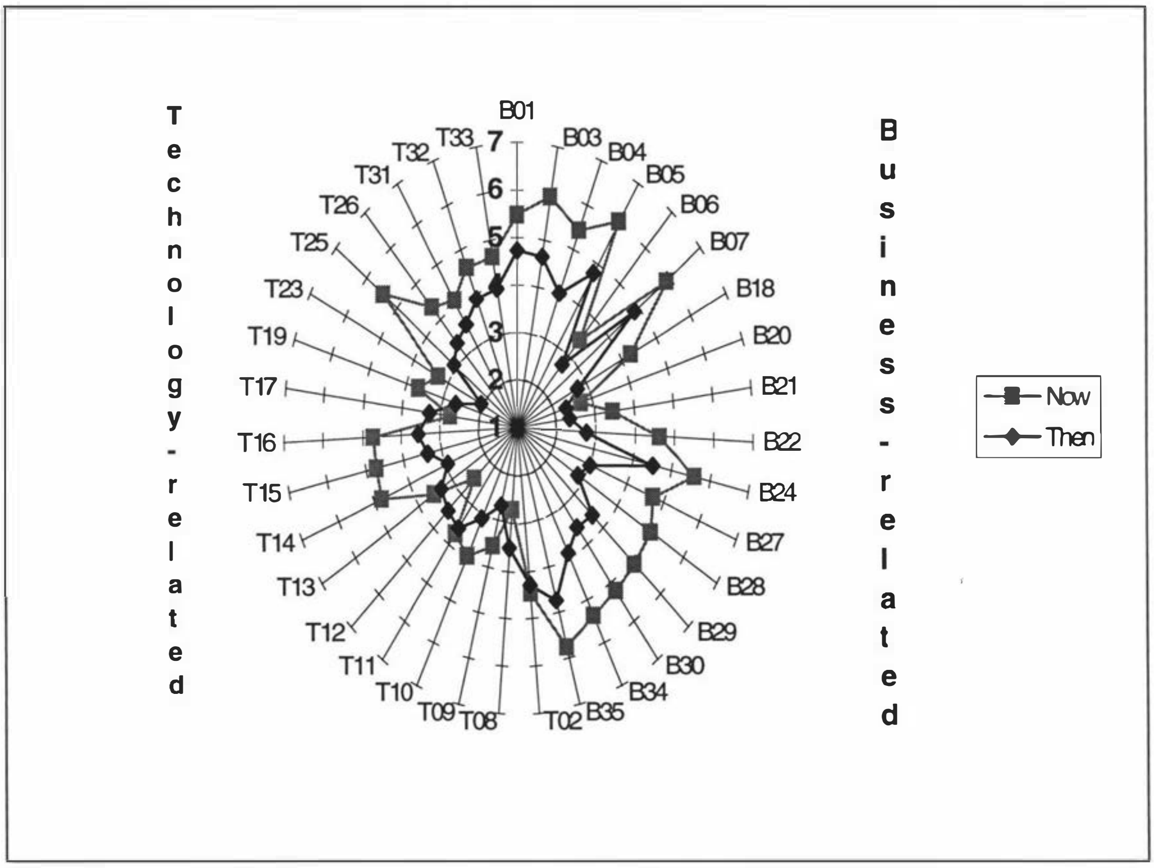


Figure 8-1 provides a pictorial overview of the change that has taken place according to the perception of the respondents. The seven points of the Likert Scale show as rings on the radar chart. Each spoke contains the two group means for the two points in time. Each KSA retains its own number (as on the questionnaire and in Table 8-1) but each includes a prefix of either T or B to indicate its classification as either technology- or business-related. The 'Then' coordinates tend to be clustered around the centre of the chart at the lower scores. The business-related items on the right-hand side have all witnessed movement up each scale, while on the left-hand side the technology-related KSAs have moved less and three have moved down the scale (i.e. **8. 3rd generation programming, 12. Mainframe systems, 17. Computer operations, JCL, data capture**).

The distinct message from this top-down view seems to point to substantial change overall. In terms of the traditional dual ladder the model of two somewhat opposing categories of skills is supported - the half that comprises business-related skills is more skewed towards increased importance in this category. On a more specific plane, the only skills to exhibit a decrease in importance are technology-related (T08, T12 and T17). It is also worthy of note that this does not imply that fewer technology-related skills are perceived to be required for IS personnel in New Zealand. On the contrary, the total 'mass' for both categories seems to have swelled, indicating that a greater intensity of all but three KSA is seen as required in the workplace.

8.2 Tests of Significance

How significant, though, are those differences between the means for each item? To assess the statistical significance, paired *t*-tests were calculated on the pooled sample variance, comparing ratings on both Likert scales. The means (which were the basic data for Figure 8-1 above) and *t*-values by KSA, are shown in Table 8-2.

The *t*-tests are employed here not to assess the likelihood that the two sets of Likert scale responses come from the same population - in this case they were the same - but rather to detect statistical significance in the importance of the skill items perceived by the respondents. In order to avoid a Type 1 error a statistical significance alpha level of 0.05 was applied. But the possibility of error due to the large number of items (35) has to be considered. If alpha were set to a level of 0.001, the likelihood of declaring or making a Type 1 error is 0.035 of 1 item. As can be seen in Table 8-2 the value of alpha for most items is 0.001, which more than compensates for the possibility of error. On this basis the comparative importance over time of **11.Operating Systems, 2.Systems Analysis & Design techniques** and **13.Mini-computer systems** is regarded as not significant enough for further discussion here.

To add further confidence to the results 'two-tailed' paired *t*-tests were used, allowing for the possibility that observations could fall within both tails of the distribution curve. This also ensures a more robust outcome and recognises a non-directional hypothesis - change in the perceived importance of a skill could be either positive or negative. Hence the use of a negative sign before some t-values in Table 8-2 is strictly not relevant. It is retained to indicate a directional tendency of movement in the importance ratings for a particular KSA.

In Table 8-2 the 10 highest mean scores and *t*-values from all respondents are highlighted in **bold**. The *t*-values are sorted in descending order so as to highlight the ten skill items most likely to have undergone the most change in importance in the minds of the respondents. A significant positive *t*-value suggests that the KSA has increased in importance over time for the whole sample. Conversely, a significant negative *t*-value tends to indicate that the KSA has decreased in importance. The sorted rankings, however, cannot be statistically justified. All one can say is that those top ten *t*-values have undergone more change in importance than, say, the bottom ten. Furthermore, it must be remembered that because an item exhibits a low *t*-value it does not follow that it is inherently unimportant; rather the implication is that it has not displayed as much *change* in importance. As an example, it can be seen that KSA **2.Systems Analysis & Design techniques** (which, by its very nature, is the core skill item for systems analysts) has a 'Start' mean of 4.29 in the top ten and has retained a 'Now' mean of 4.48; nevertheless, in terms of the degree of change seen by the respondents, the results are statistically indeterminate.

The following reporting of the results for the whole inventory is based on the dual classification of skill items in Table 8-1 and on an interpretation of the relative size of the *t*-values (keeping in mind the statistical constraints mentioned above).

Table 8-2: For All Respondents - Mean Scores and Changes in the Importance of KSAs

KSA	*Knowledge, skill or ability*	*Start*	*Now*	*t-value*	
28	Quality management concepts	2.82	5.01	**27.63**	***
25	Personal computer systems	3.08	**5.45**	**24.04**	***
14	Telecomms & networking concepts	2.93	4.82	**21.61**	***
30	Negotiating skills	3.56	**5.21**	**21.31**	***
22	Strategic Info. Systems Planning	2.76	4.61	**20.32**	***
18	Understanding legal issues	2.73	4.27	**20.29**	***
27	Marketing skills	3.01	4.72	**19.81**	***
29	Project evaluation & justification	3.62	5.11	**19.54**	***
34	General management skills	3.91	**5.37**	**18.81**	***
3	Verbal & presentation skills	**4.63**	**5.92**	**18.19**	***
5	People skills	**4.79**	**6.03**	17.30	***
4	Project management skills	**4.01**	**5.44**	16.69	***
15	Computer security & disaster recovery	3.37	4.73	16.11	***
7	Written communication skills	**4.85**	**5.88**	15.85	***
21	Decision support systems	2.36	3.45	15.24	***
24	Knowledge of the business area	**4.52**	**5.60**	14.88	***
23	CASE techniques	2.06	3.29	14.58	***
35	Keeping abreast with new technology	**4.73**	**5.74**	13.54	***
26	Computer controls & auditing	3.34	4.34	13.37	***
16	Use & evaluation of software packages	3.55	4.72	13.35	***
19	Prototyping techniques	2.64	3.67	13.16	***
6	Health & safety	2.75	3.43	11.77	***
1	Information gathering techniques	**4.73**	**5.47**	10.00	***
32	Documentation writing skills	**3.91**	4.60	9.01	***
10	DBMS & database design	3.11	3.96	8.79	***
9	4th generation programming	2.66	3.54	8.59	***
33	User training & support	**3.96**	4.63	7.75	***
31	Use & evaluation of hardware	3.52	4.12	6.95	***
20	Statistical & simulation techniques	2.30	2.70	6.25	***
13	Mini-computer systems	3.33	3.54	2.19	*
2	Systems Analysis & Design techniques	**4.29**	4.48	1.98	*
11	Operating Systems	3.57	3.72	1.83	
17	Computer Operations, JCL, data capture	3.26	2.73	–6.35	***
8	3rd generation programming	3.52	2.71	–9.09	***
12	Mainframe systems	3.48	2.54	–10.45	***

* $\alpha = 0.05$; *** $\alpha = 0.001$. The ten highest means and most significant t-values are in **bold**.

Those skills regarded as significantly less important are: **8. 3rd generation programming**, knowledge of **12.Mainframe systems**, and **17.Computer operations, JCL, data capture** (one younger respondent queried the mnemonic!). These three items are the only with negative t-values, and they all fall into the technology domain. On the other hand, and it should be of no surprise, knowledge of **14.Telecomms & networking concepts** and familiarity with **25.Personal computer systems** feature as much more important requirements today. Also in the group of KSAs with the highest t-values are **22.Strategic Information Systems Planning** and, **29.Project evaluation & justification** both of which have been classified as business-related. The popularity of these two can possibly be explained by the high proportion of consultants who would be advising clients in these areas. For similar reasons **4.Project management skills** has assumed greater prominence.

Also in the business domain, a KSA that is perceived to have gained significantly in importance is that of **34.General management skills**, reinforced by **3.Verbal & presentation skills, 5. People skills** and **30. Negotiating skills.** The remainder in the top group of increased importance over time could be thought of as more specific managerial skills: **18.Understanding legal issues, 27.Marketing skills,** and **28.Quality management concepts**.

The next group of KSAs are in the area of software development tools and techniques. The perception about development tools seems to be that **10.DBMS & database design** and **9. 4th generation programming** have been increasing in importance at a much slower rate than their more automated successors: **19.Prototyping techniques** and **23.CASE techniques.**

Increasing awareness of the importance of **15.Computer security & disaster recovery** and **26.Computer controls & auditing** is confirmed by these results. Although classed as technology-related they can have impact throughout an organisation and so should be of concern to management.

In the business domain **20.Statistical & simulation techniques** features as much lower in increasing importance than **21.Decision support systems**, even though the latter relies heavily on business statistics. This result tends to confirm the wary attitude of many practitioners to the application of statistics to explain organisational phenomena. This emphasis on the need to apply technology in an organisational context is reflected in the increasing importance placed on **24.Knowledge of the business** and **35.Keeping abreast with new technology**.

Again in the technology-related area, in comparison with the more user-oriented **16.Use & evaluation of software packages, 31.Use & evaluation of hardware** is seen as increasing at a much slower rate of importance, at approximately the same level as **33.User training & support**. With reference to the latter, the result seems to confirm the tendency of many organisations to slash training budgets in times of retrenchment. Finally, the increasing maturity of the IS profession is reflected in the relative importance given to

32.Documentation writing skills as an essential part of systems development and maintenance.

On the whole, the *t*-values seems to corroborate the general picture of the radar chart that greater importance is being placed on skills in *both* the business-related and technology-related areas, but with less of an increase in importance in the technology-related domain, with the exception of expertise in telecommunications and personal computers.

8.3 Ranking the Means

So far the *t*-tests have explored each skill item 'between groups' - the two groups being two points in time, but the resultant *t*-values cannot be individually ranked in relation to one another. In addition the relative strength of a *t*-value says nothing about the position of the two group means on the Likert scales. Two identical *t*-values would not differentiate between two identical mean differences, if one pair of group means were on the lower and the other on the upper end of the scale. On the other hand, the numeric value of the means themselves carry a sense of weighting.

To extract more information about the relative importance of KSAs in Table 8-2 the sample means per variable were re-visited. The research aim was to attempt to substantiate whether there are significant differences between the means in relation to one another. If a statistically significant difference can be identified between any pair of ranked means, then the value of the higher mean can be declared as superior to all lower ranked means. Numeric significance and weighting can then be attributed to all means on the scales.

To this end an analysis of 'within group' means was carried out on the highest 10 means using a repeated measures design. First the top highest group means of 'Start' were identified and ranked before being submitted for processing in SPSSX. The 'reliability' procedure was used to perform a single-factor repeated measures design of analysis of variance on each pair of means in descending order of rank. Likewise the 10 highest means in the 'Now' scale were subjected to the same procedure. The summary results are displayed in Tables 8-3 and 8-4.

First it should be noted that in both tables the majority of KSAs are business-related. In Table 8-3 which contains the 10 highest group mean scores for skill items perceived important at the commencement of IS careers there are three technology-related items: **Systems Analysis & Design techniques** and the two items with the lowest mean (i.e. **User training & support** and **Documentation writing skills**). Subsequently in Table 8-4 which reflects current perceptions, they are all replaced by only one technology-related KSA: expertise with personal computers.

Table 8-3: Repeated Measures ANOVA of Top 10 Start Means

Knowledge, skill or ability	*Start*	*Cronbach α*	*F*	*P*
Written communication skills	4.8677	0.7088	1.1359	0.2871
People skills	4.7912	0.5601	0.1887	0.6642
Information gathering techniques	4.7541	0.3824	0.0495	0.8241
Keeping abreast with new technology	4.7332	0.4801	1.2458	0.2650
Verbal & presentation skills	4.6334	0.4945	1.8772	0.1714
Knowledge of the business area	4.5035	0.2971	3.6646	0.0562
Systems Analysis & Design techniques	4.2947	0.4490	8.0121	0.0049
Project management skills	4.0093	0.3194	0.5584	0.4553
User training & support	3.9304	0.6376	0.0000	1.0000
Documentation writing skills	3.9304			

Table 8-4: Repeated Measures ANOVA of Top 10 Now Means

Knowledge, skill or ability	*Now*	*Cronbach α*	*F*	*P*
People skills	6.0279	0.7406	4.8069	0.0289
Verbal & presentation skills	5.9233	0.7459	0.6119	0.4345
Written communication skills	5.8860	0.4106	4.4246	0.0360
Keeping abreast with new technology	5.7488	0.3059	3.3374	0.0684
Knowledge of the business area	5.6070	0.2734	2.2742	0.1323
Information gathering techniques	5.4814	0.2578	0.0922	0.7615
Personal computer systems	5.4558	0.3243	0.0481	0.8265
Project management skills	5.4372	0.5587	0.7893	0.3748
General management skills	5.3698	0.7580	6.4719	0.0113
Negotiating skills	5.2093			

The only results to be regarded as significant are those where one can be 95% confident that there is discernible difference between a group mean score and the one below it in the table, that is where $p < 0.05$. The only one to meet the p criterion in Table 8-3 is the technology-related **Systems Analysis & Design techniques**. Its mean score can be declared significantly higher than the three KSAs below, two of which are the only other technology-related items in the table. By inference the seven highest items can all be regarded as ranked higher than the lowest three. But none of the first six skill items (all business-related) can be confidently (although very close at $p = 0.0562$) regarded as more important in rank than **Systems Analysis & Design techniques**. This finding confirms the importance of the latter in the earlier eras of DP and MIS when it was seen as the primary liaison activity providing an interface between the programming domain and the end-user or business domain. Of concern is why it does not feature in the top ten 'Now' means, and whether there are implications for the future of the career position of 'systems analyst'. As was pointed out in Table 8-2 this KSA has not shown any discernible movement in importance since its heyday.

By contrast there is more than one significant result in Table 8-4. At the bottom **General management skills** ranks significantly superior to the one below; but ranked significantly above it with five others is **Written communication skills**. Still ranked significantly higher is the top of the list, **People skills**. By inference **Verbal & presentation skills** is at least as important as **Written communication skills,** but there is no disputing that **People skills** is above all other skills. The message seems to be that IS professionals see their colleagues needing a range of business-related skills the most important of which involve managing people and communicating verbally and orally with others in the organisation.

8.4 The Task Descriptors

The one remaining piece of evidence that affects the whole sample is that of the task descriptors supplied by respondents in section A of the questionnaire. They were asked to identify 'major tasks in your current job code', and this section of the questionnaire precedes the more detailed Likert scales with the 35 KSAs. There is space on the questionnaire for four keyword or phrases describing tasks in *descending order of importance*. As the 35 KSAs are over the page, the intention of the design was that the respondents would have described the four tasks before having seen the KSA names.

As previously described in section 7.2 these 'task descriptors' were manually codified and classified on input. In the research design they fulfilled the purpose of adding further data about job content in terms of skills requirements. Not only have they contributed to the definition of 15 (as 'collapsed' sub-categories in Table 7-2) of the 35 KSAs, but further content analysis at this overview stage may help clarify the results already presented in this chapter.

The research approach adopted here is a technique within content analysis that Weber terms 'content category counts' (Weber, 1985:41), whereby words or phrases that have been classified into categories are counted. As he points out

> ...counting is based on the assumption that higher relative counts (proportions, percentages, or ranks) reflect higher concern with the category. (Weber, 1985:56)

Unlike computer-generated word frequency lists and concordances which can be error-prone to the problems of contextual ambiguity, category counting in this study is more manageable. The precise nature of the task descriptors and their hand-coded classification increase the strength of semantic validity.

Following the technique described above, the first part of the analysis process entailed the counting of all task descriptors classified by 72 codes (see Table 7-1) which were then reduced to the original 35 KSAs (see Table 7-2). These frequency counts for each KSA are shown in Table 8-5 and appear in the 'raw score' column.

The next part of the procedure was to take into account the priority ranking implicit in the order of the descriptors as recorded on the four lines made available in Question 9, section A of the questionnaires. The weighting scheme can be likened to a 4-point Likert scale: 4 points for an entry on the topmost line, 3 for the next and so on down to a 1 for the fourth entry. Based on this scheme the relevant weighting multiplier (1,2,3 or 4) was applied to all raw scores to arrive at the column headed 'Ranked score' in Table 8-5.

Table 8-5: Content Category Count: Business-related and Technology-related Task Descriptors

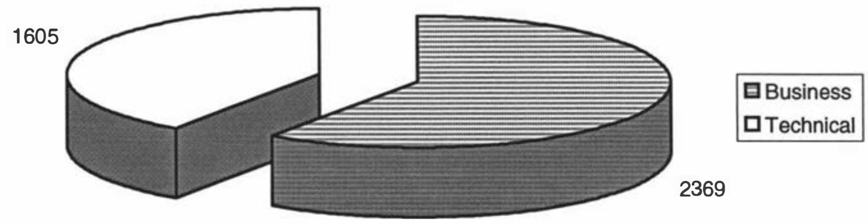
Business-related	**Score Raw**	**Score Ranked**	**Technology-related**	**Score Raw**	**Score Ranked**
1. Information gathering techniques	2	8	**2.** Systems Analysis & Design techniques	190	571
3. Verbal & presentation skills	4	9	**8.** 3rd generation programming	0	0
4. Project management skills	133	360	**9.** 4th generation programming	145	365
5. People skills	145	373	**10.** DBMS & database design	23	65
6. Health & safety	0	0	**11.** Operating Systems	2	7
7. Written communication skills	27	56	**12.** Mainframe systems	2	7
18. Understanding legal issues	1	3	**13.** Mini-computer systems	0	0
20. Statistical & simulation techniques	3	11	**14.** Telecomms & networking concepts	17	46
21. Decision support systems	1	3	**15.** Computer security & disaster recovery	6	18
22. Strategic Info. Systems Planning	131	402	**16.** Use & evaluation of software packages	7	21
24. Knowledge of the business area	86	210	**17.** Computer operations, JCL, data capture	7	17
27. Marketing skills	86	217	**19.** Prototyping techniques	0	0
28. Quality management concepts	72	173	**23.** CASE techniques	3	9
29. Project evaluation & justification	50	127	**25.** Personal computer systems	6	16
30. Negotiating skills	7	17	**26.** Computer controls & auditing	33	82
34. General management skills	131	379	**31.** Use & evaluation of hardware	1	3
35. Keeping abreast with new technology	9	21	**32.** Documentation writing skills	7	13
			33. User training & support	157	365
	===	===		===	===
	888	**2369**		**606**	**1605**
%	59.44	59.61		40.56	40.39

As can be seen from the summative percentages in the table, the allowance made for the priority ranking of the task descriptors had no appreciable effect on the overall percentage difference between the business-related and technology-related categories. This is partly explained by the fact that the responses are focused into a few popular KSAs. On the technology-related side the words and phrases seem to reflect the actual workplace daily activities: **2. Systems Analysis & Design techniques** (with the highest scores) **9. 4th generation programming** and **33. User training & support** (with the next highest raw scores). In a similar pragmatic fashion, on the business-related side **5. People skills** (the scores of which are similar to those of 4GL programming), **4. Project management skills, 22. Strategic Info. Systems Planning** and **34. General management skills** predominate - the latter two scoring high ranked scores. Closely following in importance are 'knowledge of the business area' and marketing skills.

Somewhat surprisingly, given the frequent complaint from recruitment agencies and employers, there is little overt mention of communication skills *per se*. It may be that the task descriptors are portraying an aspect of workplace reality which does not always surface in the more formal part of the questionnaire.

In the end, however, the total counts of both raw and ranked scores show that business-related words and phrases out-numbered the technology-related by approximately 50%, as pictorially represented by the piechart in Figure 8-2 which shows the ranked descriptors (i.e. the keywords weighted by their line position on the questionnaire).

Figure 8-2: Total Number of Ranked Task Descriptors



The above procedure of conducting content and frequency analyses of keywords (task descriptors) expressed by respondents to describe the essential skills in their current jobs is designed to test whether free form textual evidence may corroborate the more precise questions relating to identified skill items. It needs to be remembered that this procedure covers written enunciations of the skills seen to be utilised in the respondents' *current* positions, and so warrants comparison with the 'Now' column of means in Table 8-2.

Table 8-6 is an attempt to explore such a comparison. It is based on the top 10 KSAs extracted from Table 8-5 which have the highest ranked scores, arrived at by counting and categorising task descriptors. Their *nth* position in terms of their ranking is displayed in descending order within either the business-related or technology-related group. For each of these KSAs the corresponding *nth* ranking of the 'Now' mean from Table 8-2 is listed alongside in the first column.

Table 8-6: Current Job KSAs: Comparing the Rankings of Means and Task Descriptor Ranked Scores

Business-related	*Rank #*		**Technology-related**	*Rank #*	
	Now Mean	**Ranked Score**		**Now Mean**	**Ranked Score**
22. Strategic Info. Systems Planning	18	2	**2.** Systems Analysis & Design techniques	20	1
34. General management skills	9	3	**9.** 4th generation programming	27	5=
5. People skills	1	4	**33.** User training & support	17	5=
4. Project management skills	8	6			
27. Marketing skills	15	7			
24. Knowledge of the business area	5	8			
28. Quality management concepts	12	9			
29. Project evaluation & justification	11	10			

An initial inspection reveals what seems to be a discordance between the respondents' textual and their Likert scale accounts of two of the job skills. According to this evidence respondents are much more likely to write that their current jobs involve strategic IS planning on the business side and systems analysis and design techniques in the more technical arena. The same two KSAs' means on the Likert scale ranked in the mid-range of 18th and 20th. A closer inspection, however, shows that of the 8 business-related KSAs that ranked highly in the textual account 6 also are ranked within the top 12 'Now' means. A general observation has to be that the sample is once again reinforcing the need for more business-related skills in their current workplaces

The results in this chapter have clearly demonstrated that the skills inventory for IS personnel in New Zealand is perceived by IS practitioners to have undergone significant change. IS skills in *both* categories of technical and business are perceived to have increased in importance. Moreover it seems clear that while the profession still sees a need for no fewer technical skills, it rates the importance of organisational/business skills as exceeding former requirements. The overall impression created by the results so far is a skewness towards more increase in the value placed on business-related skills relative to those that are technology-related.

This chapter has answered in the affirmative the first of the three research questions posed at the end of Chapter 2, namely:

- are organisational/managerial skills becoming more important for IS professionals in their jobs?

It has also explored in some detail the third research question:

- what are the particular skills required for an IS professional in New Zealand?

This chapter has considered the sample of respondents as a whole, and has retained a holistic view. The next chapter moves from the general to the more specific viewpoint of managers in the IS profession. They represent a large proportion of the sample. They have elected to be members of the profession and so probably started their careers in the technical sphere before making the transition to managerial positions that require a different emphasis in the skills inventory. Their perceptions concerning the contents of that inventory will be explored next.

9. The Manager's Viewpoint

The previous chapter discussed initial findings based on a review of the overall data. This chapter contains further analysis concentrating on experience levels and distinctions between IS job categories, especially between managerial and technological job designations. The earlier review of the literature made reference to instances of a 'clash of cultures' or a duality of *modi operandi* between the more technically-oriented IS professionals and the non-technical users who are their internal clients (Young, 1982:67; Turner & Baroudi, 1986:3; Corbin, 1991). The literature has also stressed that the IS professionals on the so-called managerial ladder require more business-related skills than those on the technical ladder. So when a person makes the shift from technical roles to a management position does the cultural duality on a macro-organisational level exhibit itself in a new persona? In other words, do skills that are thought of as important to incumbents on the technical ladder change in importance when perceived by the managers of those incumbents?

In this chapter the managerial view will be explored in comparison with the respondents who are not actively managing personnel. The research methods used will be *t*-tests of significance to conduct univariate analyses, while inter-group comparisons will be made using the Scheffé test.

9.1 Managers' Assessment of the Importance of Skill Items

The first issue is one of definition: how is a 'manager' to be identified? As already pointed out in the chapter that dealt with research design, it could not be assumed that because a respondent chose one of the managerial job codes, then he or she is in fact managing IS personnel. The researcher suspected that in the New Zealand environment of the 1990s there could be a number of sole proprietors and consultants with managerial titles, such as 'director'. In addition it is possible for someone with a title such as 'consultant' to be managing personnel and yet not claim a so-called managerial title. It was also important that the research instrument identified practising managers in charge of personnel who were specifically in the IS profession. It was for these definitional reasons that section B, Part II of the questionnaire was designed as a separate section. To be deemed a 'manager' for this part of the questionnaire one had to be managing at least two people working in the traditional IS job categories of systems analysis and programming. This conservative approach to the definition of the term 'manager' proved to be well justified. Table 7-3 reveals that 215 people opted for the first three managerial job designations (which do not include consultants), while only 145 (and this figure could also include persons from other 'non-managerial' designations) self selected under the more stringent definition.

In terms of format and layout Part II of the survey instrument is a replica of Part I. The same 35 KSAs are measured on two time-related Likert scales, the first point in time being when the respondent first became a manager of IS personnel, the second is the current point in time of filling out the questionnaire (June/July 1993). In Table 9-1 the group means for the former points in time (varying according to the respondents' length of time as managers) appear in the 'Start' column, and the group means for the current point in time are displayed in the 'Now' column.

Two-tailed paired *t*-tests were conducted on the two sets of pooled means. As in Table 8-2 (which reports the results of Part I for the whole population) a significant positive *t*-value suggests that in the opinion of the respondents the KSA has increased in importance, while a significant negative *t*-value tends to indicate that the KSA has decreased in importance.

The results in Tables 8-2, 9-1 and 9-2 have all been sorted in descending order by *t*-value in order to give some structure to the discussion. While it is statistically valid to comment in general terms about the relative size of the *t*-values, it is not valid to make specific judgements concerning their specific rankings. The same words of caution apply to all other tables in this section where group means have been sorted in order to aid in the discussion of the importance of the corresponding KSAs. It was decided not to conduct further statistical tests to substantiate the individual rankings of the means, because as was shown in the previous chapter where repeated measures ANOVA techniques were used, few of the rankings were statistically differentiated from one another within groups due to the close range of the mean values.

Table 9-1: For Self-selecting Practising Managers (n = 145) - Mean Scores and Changes in the Importance of KSAs

KSA	*Knowledge, skill or ability*	*Start*	*Now*	*t-value*	
28	Quality management concepts	2.99	**5.10**	**17.08**	***
25	Personal computer systems	3.00	**5.42**	**14.15**	***
14	Telecomms & networking concepts	3.24	4.96	**12.89**	***
5	People skills	4.10	**5.35**	**12.47**	***
3	Verbal & presentation skills	**4.29**	**5.49**	**11.26**	***
30	Negotiating skills	3.12	4.43	**11.10**	***
24	Knowledge of the business area	**4.26**	**5.46**	**10.92**	***
21	Decision support systems	2.47	3.71	**10.84**	***
27	Marketing skills	2.74	4.10	**10.78**	***
29	Project evaluation & justification	3.50	4.75	**10.59**	***
7	Written communication skills	**4.47**	**5.40**	10.49	***
22	Strategic Info. Systems Planning	2.68	4.13	10.38	***
19	Prototyping techniques	2.94	4.40	10.24	***
4	Project management skills	4.12	**5.31**	9.90	***
23	CASE techniques	2.39	3.94	9.77	***
34	General management skills	3.28	4.32	9.53	***
35	Keeping abreast with new technology	**4.25**	**5.34**	9.50	***
18	Understanding legal issues	2.52	3.48	9.34	***
16	Use & evaluation of software packages	3.34	4.55	9.30	***
15	Computer security & disaster recovery	3.61	4.60	8.52	***
1	Information gathering techniques	**4.67**	**5.47**	8.49	***
26	Computer controls & auditing	3.63	4.48	8.29	***
32	Documentation writing skills	**4.24**	5.06	8.01	***
9	4th generation (4GL) programming	3.22	4.62	7.34	***
6	Health & safety	2.70	3.40	6.85	***
10	DBMS & database design	3.76	4.80	6.82	***
33	User training & support	**4.23**	5.03	6.77	***
20	Statistical & simulation techniques	2.51	2.98	4.70	***
31	Use & evaluation of hardware	3.42	3.87	3.63	***
2	Systems Analysis & Design techniques	**4.91**	**5.31**	3.30	***
13	Mini-computer systems	3.56	3.93	2.14	*
11	Operating Systems	3.91	4.07	1.33	
17	Computer Operations, JCL, data capture	3.72	3.08	–4.42	***
8	3rd generation programming	**4.37**	3.42	–5.73	***
12	Mainframe systems	3.80	2.67	–6.84	***

* $\alpha = 0.05$; *** $\alpha = 0.001$. The ten highest means or most significant t-values are in **bold**.

Before embarking on a discussion of the results in comparison with the total sample in Part I, a logical extension of the research procedure was to carry out the same significance tests on the responses of Part I that *excluded* those who had filled out Part II. This latter group could be regarded as the genuine 'non-managers' given the more rigorous definition already applied. These results are presented in Table 9-2.

Table 9-2: For non-managing respondents (n = 288) - Mean Scores and Changes in the Importance of KSAs

KSA	Knowledge, skill or ability	Start	Now	t-value	
28	Quality management concepts	2.71	4.80	**21.91**	***
25	Personal computer systems	3.13	**5.47**	**19.35**	***
14	Telecomms & networking concepts	2.82	4.78	**17.89**	***
30	Negotiating skills	3.31	**4.96**	**17.64**	***
18	Understanding legal issues	2.57	4.07	**16.41**	***
29	Project evaluation & justification	3.38	4.87	**16.10**	***
27	Marketing skills	2.83	4.52	**15.84**	***
22	Strategic Info. Systems Planning	2.59	4.34	**15.48**	***
3	Verbal & presentation skills	**4.49**	**5.81**	**15.24**	***
34	General management skills	3.74	**5.12**	**15.16**	***
5	People skills	**4.75**	**5.96**	13.96	***
15	Computer security & disaster recovery	3.26	4.67	13.29	***
7	Written communication skills	**4.74**	**5.78**	13.16	***
4	Project management skills	**3.77**	**5.16**	12.85	***
24	Knowledge of the business area	**4.40**	**5.47**	11.97	***
21	Decision support systems	2.24	3.26	11.55	***
26	Computer controls & auditing	3.17	4.22	11.41	***
16	Use & evaluation of software packages	3.55	4.78	11.32	***
23	CASE techniques	1.97	3.12	11.31	***
35	Keeping abreast with new technology	**4.73**	**5.73**	10.74	***
19	Prototyping techniques	2.61	3.57	10.48	***
6	Health & safety	2.75	3.32	8.51	***
10	DBMS & database design	2.97	3.90	8.29	***
32	Documentation writing skills	**3.90**	4.67	8.18	***
1	Information gathering techniques	**4.67**	**5.42**	8.14	***
9	4th generation (4GL) programming	2.56	3.46	7.23	***
33	User training & support	**3.94**	4.66	6.63	***
20	Statistical & simulation techniques	2.23	2.66	5.50	***
31	Use & evaluation of hardware	3.45	4.05	5.45	***
2	Systems Analysis & Design techniques	**4.14**	4.49	3.23	***
11	Operating Systems	3.57	3.81	2.33	*
13	Mini-computer systems	3.33	3.47	1.12	
17	Computer Operations, JCL, data capture	3.19	2.79	−3.93	***
8	3rd generation (3GL) programming	3.54	2.80	−6.80	***
12	Mainframe systems	3.36	2.60	−6.86	***

* $\alpha = 0.05$; *** $\alpha = 0.001$. The ten highest means or most significant t-values are in **bold**.

At this point, the following comparisons made with the total sample needs to be justified, otherwise it could appear recursive to compare the sub-population of 'managers' with its own total population. It must be remembered that there is a difference in perspective for both groups. In the case of the questions submitted to the total sample, the respondents (including, of course, the managers) were commenting on their *own* skill requirements; in the case of the managerial group, they were assessing the importance of skills of their employees. It is argued, then, that due to the very different perspectives managers can be constructively compared with both non-managers and the total sample. The basic question and the variables under scrutiny are the same, although the perspectives of the respondents are different.

Discussion of the results commences with the lowest *t*-values. At the alpha level of 0.001 all three sets of tests declare significant negative *t*-values for the skill items, **Computer Operations, JCL, data capture, 3rd generation programming** and **Mainframe systems,** meaning that they are seen to have decreased in importance over time. All three populations are not so sure about **Mini-computer systems** and **Operating Systems** - as both fail to register discernible change at $\alpha < 0.01$.

At the bottom of the positive *t*-values is the KSA **Systems Analysis & Design techniques**. Whereas it shows as having undergone significant increase in importance to managers and non-managers, its significance level drops when the whole population is polled. This is to be expected as the managers would have been down-rating this KSA in relation to their *own* job (as requested in Part I of the questionnaire), whereas in Part II they are commenting on the skills requirements that should still be of value to current IS systems analysts and programmers.

As a general observation, the non-manager sample seems to have responded in much the same way as the total population - perhaps to be expected, as it accounts for 66.51 percent of all respondents, and also given the fact that these two groups are responding from the same perspective - that of assessing their own skill requirements. As can be seen in the left and centre columns in Table 9-3, a KSA may move within a range of one to three rank positions at most, and this is the case for all other KSAs for these two groups.

Also apparent in Table 9-3 is the concurrence between two groups and the total sample who all agree that quality and the technology-related expertise in the areas of micro-computers and telecommunications have all witnessed the most dramatic amount of positive change in importance. Ironically these latter two KSAs, **Personal computer systems** and **Telecomms & networking concepts**, are the *only* technology-related skill items in the top group.

Table 9-3: Top 10 *t*-values of KSAs in Tables 8-2, 9-1 and 9-2, ranked and compared

KSA	*Knowledge, skill or ability*	*All* $n=433$	*Non-managers* $n=288$	*Managers* $n=145$
28	Quality management concepts	1	1	1
25	Personal computer systems	2	2	2
14	Telecomms & networking concepts	3	3	3
30	Negotiating skills	4	4	6
5	People skills			4
22	Strategic Info. Systems Planning	5	8	
18	Understanding legal issues	6	5	
27	Marketing skills	7	7	9
21	Decision support systems			8
29	Project evaluation & justification	8	6	10
3	Verbal & presentation skills	10	9	5
34	General management skills	9	10	

On the other hand, the results seem to indicate that the managers hold a different view from the other two groups. In the opinion of managers the more tangible **People skills** and user-oriented **Decision support systems** are now more important than they once were. In Table 9-3 they supplant three skills that might be regarded as more general and longer term business-related skills. In fact, as the results in Table 9-1 show, **Strategic Information Systems Planning** fell to 12th position, **Understanding legal issues** fell to 18th position and **General management skills** dropped to 16th place in the rankings. The only other KSA to move substantially but which is not in the top 10 is **15. Computer security & disaster recovery**. From the viewpoint of managers(Table 9-1) it fell to 20th position, six or seven rungs lower in comparison with the rankings made by the total (Table 8-2) and non-manager (Table 9-2) samples. Although this is a technology-related KSA as defined in this thesis, it seems to be behaving like the three longer term business-related KSAs mentioned above.

These results suggest that in the view of managers communication skills have become increasingly more important in the workplace for practising systems analysts and programmers. By contrast for IS personnel in general, the non-managerial perspective is that longer term business-related skills have undergone more positive change in importance. Both groups concur on the increasing demand for change in the areas of quality, micro-computers and telecommunications.

The discussion now moves from the *degree* of change over a period of time (identified by *t*-values) to the samples' priorities in terms of skill items at the time they commenced their current job in comparison with their priorities now. This discussion is centred on an analysis of the highest ranked group means for the two points in time. To this end, for all three samples Tables 9-4 and 9-5 display the top ten group means scores for the 'Start' and 'Now' points in time. The researcher's intention here is not to imply a direct comparison between the samples but rather to explore a possible differing viewpoint or perspective on what are the same KSAs. As a consequence it must be remembered that for the self-selecting 'managers' they are commenting on their IS employees' skills, not their own (they commented on their own skills priorities as respondents in the 'All' sample).

For the same managers **People skills** does not even feature in the highest 10 group means when they consider the relative importance of skills when they were first managers (see Table 9-4). In its place they choose programming skills - a perception that matches the tenor of earlier eras of computing. In keeping with this historic sense all groups include in the top ten skills for earlier IS careers the need for **Systems Analysis & Design techniques,** reinforced with communication skills. In the more technical area **Documentation writing skills** and **User training & support** are seen by all respondents as important.

Table 9-4: Top 10 Start Means Ranked

KSA	*Knowledge, skill or ability*	*All*	*Non-managers*	*Managers*
5	People skills	2	1	
7	Written communication skills	1	2	3
35	Keeping abreast with new technology	3	3	7
8	3rd generation programming			4
1	Information gathering techniques	4	4	2
3	Verbal & presentation skills	5	5	5
24	Knowledge of the business area	6	6	6
2	Systems Analysis & Design techniques	7	7	1
33	User training & support	9	8	9
4	Project management skills	8	10	10
32	Documentation writing skills	10	9	8

When the respondents focus on the current skills need (see Table 9-5), there seems to be a definite shift towards the more business-related KSAs as perceived by all three groups. KSAs that have disappeared from the top ten group means over time are all technology-related: **3rd generation programming, User training & support,** and **Documentation writing skills.**

Table 9-5: Top 10 Now Means Ranked

KSA	*Knowledge, skill or ability*	*All*	*Non-managers*	*Managers*
5	People skills	1	1	6
3	Verbal & presentation skills	2	2	1
7	Written communication skills	3	3	5
35	Keeping abreast with new technology	4	4	7
24	Knowledge of the business area	5	5	3
1	Information gathering techniques	6	7	2
25	Personal computer systems	7	6	4
2	Systems Analysis & Design techniques			8
4	Project management skills	8	8	9
28	Quality management concepts			10
34	General management skills	9	9	
30	Negotiating skills	10	10	

The managers, however, seem to have a differing set of priorities. In contrast to the other two groups of respondents, they still value systems analysis skills and quality management (which showed up as the highest *t*-value across all three groups in Table 9-3) above the less specific general management and negotiating skills. On the technical front for all three groups, PC knowledge is in the top ten group means, but telecommunications does not appear - perhaps the former is seen as more relevant due to its more ubiquitous nature.

In this discussion in which three sets of the 10 highest ranked group means are compared the intention has not been to suggest relative significance between the actual ranking positions. The aim is not to make definitive statements about particular KSAs, but rather to evoke the following general trends:

1. A trend that is being re-iterated as a recurring theme is the growing importance of business-related skills. In each group of KSAs, those that rise to the top of each

ranking under consideration invariably contains a higher proportion of relevant managerial or organisational skills.

2. The results suggest that managers of systems analysts and programmers present a differing viewpoint from the generic population of IS professionals. From the point of view of these managers, systems analysts and programmers require more communication and technical skills in preference to longer term business-related skills.

The reason, however, for less differentiation between the 'non-manager' group and the total sample may be due to sample size. The results seem somewhat inconclusive, and *t*-tests do not cater for inter-group comparisons. In addition, the self-selecting managers were requested to comment on skills specific to the more technically-oriented IS employees. Are there other differences that relate to the profession as a whole? Consequently Scheffé tests were seen as an appropriate research method to extend the inter-group analysis to further explore possible differences in attitude between managers and non-managers in the IS profession in New Zealand.

9.2 Inter-group comparisons by Job Category and Experience Level

Longitudinal research samples in the literature have been small and have looked at broad trends over approximately 10 years (Cheney *et al.*, 1990). As the sample in this study is comparatively large and covers a period of up to 30 years, the author took the opportunity to explore the possible influences of experience levels and job categories as a means of elucidating the research into managerial perceptions about the KSA indicators.

For this analysis the same 35 KSAs are still the items of interest in terms of the importance placed on particular skills over the period of the respondents' employment. The sample is the total population who filled out the section B, Part I of the questionnaire (see Figure 6-3). First of all, for each response the difference between the 'When you first started' and the 'At the present time' scores was calculated.

Then two separate analyses were conducted, based on the data being split two different ways. For the first analysis, the sample was divided into three groups (as in Table 7-4) depending on years of experience in the current job category (i.e. not necessarily for their whole career in IS). Based on the author's knowledge of employment trends it was decided to pass over those with less than three years' experience, on the grounds that either the timespan does not allow for sufficient discrimination in the minds of the respondents or because they could be regarded as 'inexperienced'. The three time periods selected were 3 to 5, 6 to 10, and 11 to 30 years. The reasons for trichotomising (de Vaus, 1991:280) the data into differing time periods were twofold. The first reason was to survey in five-year spans, although the first group loses the 'inexperienced' and the last smaller group had to include all the others. The second reason was to keep the group size as large as possible and of equal size if possible.

For the second analysis, the data was split into four broad categories of job description (refer to Table 7-3): executive management, middle management (which includes line and project management), consultants, and 'Programmers Analysts etc.' (which in Table 7-3 represents all the others on the technical ladder).

The unit of analysis is still the KSA whose importance has been rated by respondents. For each group a mean difference score was calculated. Then the Scheffé test, which is regarded as conservative, was used to determine statistical significance, at an alpha level of 0.05, of the difference between the mean scores.

The first analysis highlighted any differences in the importance of KSAs in each job category depending upon the various levels of experience. The second analysed any differences in the importance of KSAs in each level of experience depending upon the various job categories.

In the first inter-group comparison (Table 9-6) knowledge of **Personal computer systems** appears as significant in all job categories. On reflection, it is of little surprise that the least experienced in all job categories rate the degree of change for PC skills as of much less importance than their most experienced counterparts. It is probable that the former accept the world of PCs, while the latter have grown through most of the micro-computer revolution of the 1980s.

Table 9-6: Differences in Perceived Importance of KSA: Mean difference scores, Job Category within Years of Experience

Knowledge, skill or ability	Years of Experience 1 (3-5)	2 (6-10)	3 (11-30)	F	p	Scheffé Difference
I. Executive Management						
Personal computer systems	1.59	2.52	3.27	3.96	0.0234	1 versus 3
II. Middle Management						
Personal computer systems	1.76	2.97	3.70	10.08	0.0001	1 versus 2 1 versus 3
Use & evaluation of software packages	0.61	1.39	1.74	3.79	0.0256	1 versus 3
III. Consultants						
3rd generation programming	-1.00	-0.33	-2.05	5.16	0.0074	3 versus 2
CASE techniques	0.74	1.87	2.28	5.19	0.0072	1 versus 2 1 versus 3
Personal computer systems	1.67	2.91	3.67	9.61	0.0002	1 versus 2 1 versus 3
IV. Analyst, Programmers etc.						
4th generation programming	0.78	1.70	3.45	9.97	0.0001	1 versus 3 2 versus 3
CASE techniques	0.48	1.13	2.32	7.03	0.0015	1 versus 3 2 versus 3
Computer Operations, JCL, data capture	1.09	-0.16	-1.18	10.40	0.0001	3 versus 1 2 versus 1
DBMS & database design	1.27	1.19	2.77	4.89	0.0099	2 versus 3
Mainframe systems	0.39	-0.73	-1.76	7.86	0.0007	3 versus 1
Personal computer systems	1.58	2.73	3.55	5.34	0.0065	1 versus 3
Prototyping techniques	1.21	1.07	2.18	4.20	0.0181	2 versus 3

A similar picture emerges for middle management in terms of **Use & evaluation of software packages** - the difference between least and most experienced is statistically significant. If we accept its relative importance from the prior t-tests in comparison with **Use & evaluation of hardware** (where the former's t-value was approximately twofold higher), it could be that the most experienced have lived through the disillusionment of high software development overruns and too much fascination with hardware.

The issue of software development languages and tools appears as significant in the categories of consultant and in the fourth, more technically-oriented group. The most experienced consultants are distinctly more positive about the decreasing importance of

3GLs than the 6 to 10 year group. Conversely, both these groups have witnessed more change in the importance of CASE tools than the least experienced consultants. In a similar vein, the most experienced in the Programmers/Analysts group attest to more importance to both CASE and 4GLs over time than either of the lesser experienced cohorts, while in the case of both **DBMS & database design** and **Prototyping techniques** they are significantly more positive about the two KSAs' importance than the middle group. The same most experienced group have seen more of a declining importance of **Mainframe systems** and **Computer Operations, JCL, data capture** in comparison with the least experienced.

To summarise, an inter-group comparison on level of experience shows that the longer IS personnel have worked in a particular job category the more they detect significant shifts in skill requirements. Although *no* significant trends show up in respect to business-related KSAs, there is a perceived swing away from older technology-related skills (such as 3GL, mainframe systems and computer operations) towards the more 'leading-edge' (PCs, 4GL, database and prototyping). The least experienced are less polarised on issues. These trends apply across all job categories.

In the second inter-group comparison which is on job category (Table 9-7), it is interesting to note that, unlike the previous set of tests, significant results appear for not only technology-related KSAs. Four skill items re-appear, namely, **Mainframe systems**, **Computer Operations, JCL, data capture**, **4th generation programming**, and **DBMS & database**. The first two relate to those in the least experienced group, with the technologists rating both skills significantly higher than do the executive management and middle management. In the case of the second skill the consultants also do not agree. The technologists are polarised on the other two skills as well - rating 4GL skills as more important than do all other job categories, and DBMS more so than do middle management.

But on the question of the continuing importance of **Operating Systems** the least experienced technologists are on their own; all other personnel with 3 to 5 years experience judge this KSA to be of diminishing importance.

Table 9-7: Differences in Perceived Importance of KSA: Mean difference scores, Years of Experience within Job Category

Knowledge, skill or ability	Job Category 1 Exec Mgmt	2 Middle Mgmt	3 Consul-tants	4 Progs Analyst etc.	F	p	Scheffé Difference
I. 3 - 5 Years Experience							
Computer controls & auditing (T)	0.08	1.20	0.74	1.63	5.99	0.0007	1 versus 2
							1 versus 4
Computer Operations, JCL, data capture (T)	-0.67	-0.50	-0.36	1.09	7.57	0.0001	1 versus 4
							2 versus 4
							3 versus 4
Computer security & disaster recovery (T)	0.44	1.49	1.49	1.92	3.99	0.0092	1 versus 4
Documentation writing skills (T)	0.07	0.88	0.69	1.50	3.39	0.0201	1 versus 4
Keeping abreast with new technology (B)	0.41	1.12	0.95	2.00	4.53	0.0047	1 versus 4
Mainframe systems (T)	-0.96	-0.76	-0.77	0.39	3.66	0.0142	1 versus 4
							2 versus 4
Operating Systems (T)	-0.63	-0.23	-0.06	1.33	7.56	0.0001	1 versus 4
							3 versus 4
							2 versus 4
Project management skills (B)	0.78	1.69	1.97	2.00	3.69	0.0136	1 versus 3
Systems Analysis & Design techniques (T)	-0.30	-0.20	0.24	1.67	7.03	0.0002	1 versus 4
							2 versus 4
							3 versus 4
Use & evaluation of hardware (T)	0.19	0.73	0.87	1.58	3.43	0.0190	1 versus 4
II. 6 - 10 Years Experience							
Documentation writing skills (T)	0.08	0.31	0.96	1.25	3.86	0.0108	1 versus 4
Information gathering techniques (B)	0.00	0.50	1.32	1.25	5.90	0.0008	1 versus 4
							1 versus 3
Project management skills (B)	0.44	1.17	1.98	1.79	4.16	0.0074	1 versus 3
Quality management concepts (B)	2.08	1.97	2.81	1.70	3.82	0.0113	4 versus 3
Strategic Info. Systems Planning (B)	1.72	2.00	2.53	1.27	3.41	0.0193	4 versus 3
Systems Analysis & Design techniques (T)	0.04	-0.61	0.39	0.68	3.25	0.0237	2 versus 4
Understanding legal issues (B)	2.12	1.42	2.15	1.16	3.71	0.0130	4 versus 3
Verbal & presentation skills (B)	0.72	1.17	1.83	1.07	3.42	0.0190	1 versus 3
III. 11 - 30 Years Experience							
4th generation programming (T)	0.86	1.26	0.50	3.45	8.73	0.0000	3 versus 4
							1 versus 4
							2 versus 4
DBMS & database design (T)	1.00	0.87	1.16	2.77	3.92	0.0115	2 versus 4
Project management skills (B)	0.50	1.04	1.74	2.09	4.55	0.0054	1 versus 4
Strategic Info. Systems Planning (B)	0.91	2.48	2.74	2.14	3.91	0.0116	1 versus 3
Systems Analysis & Design techniques (T)	-0.41	0.32	-0.89	0.86	3.54	0.0183	3 versus 4

T = technology-related; B = business-related

Systems Analysis & Design techniques is significant in all experience levels, but again the technically-oriented respondents are more positive about its importance as a skill in their jobs, when compared with: the most and least experienced consultants, all but the most experienced middle management, and the least experienced executives. This result is supported by the fact that **Information gathering techniques,** seen as a skill necessary for analysts in a more general sense, has undergone no change in importance for executive management in the 6 to 10 year experience bracket, while consultants join the technologists in support of its business-related importance.

Project management skills, too, as a business-related skill is significant in all experience levels. In comparison with their executive management counterparts, consultants with 3 to 10 years' experience, and the most experienced technologists indicate its increasing importance.

The dichotomy between executive management and the more technically-oriented job category is further highlighted by all remaining significant results in the least experienced group. It is not surprising that **Use & evaluation of hardware** and **Documentation writing skills** is still important to technologists, but what is interesting is the lack of importance given by executive management to the business-related skill of **Keeping abreast with new technology** and the more general technology-related **Computer security & disaster recovery** and **Computer controls & auditing** - skills associated with risk management and business continuity planning. At least middle management are at one with the technologists on the need for continuing emphasis on controls and auditing.

In the case of the technology-related **Documentation writing skills**, technologists with 6 - 10 years of experience rate it as significantly more important in their jobs than for executive management with the same amount of experience.

Within the same group, those with 6 to 10 years' experience, the consultants stand out as a distinct job category which stresses the importance of business and organisational skills. In comparison with the executive management category mention has already been made of the consultants' higher regard for **Information gathering techniques** and **Project management skills**. Similarly **Verbal & presentation skills** are also ranked as significantly more important by consultants compared to the executives. Perhaps the latter have always rated such communication skills highly, and so see no need for change.

Again consultants distinguish themselves in comparison with the technologists when they recognise the increasing importance of another group of business-related KSAs. **Strategic**

Information Systems Planning is seen as growing in importance by all but the least experienced consultants. For consultants in the 6 to 10 years' experience group **Understanding legal issues,** and **Quality management concepts** have been increasing in importance.

To summarise, an inter-group comparison on job category shows that there is general polarisation between those in the more technically-oriented IS jobs and all other three managerial job categories. This polarisation is more pronounced the less experienced the two groups are, and tends to involve the more specialist areas of technology. The emergent job category of consultant demands a range of business-related skills that are different from those regarded as important by executive managers.

Worthy of note is that of the total 34 differences between the means declared significant by the Scheffé test 13 (or 38.2%) involve executive management disagreeing with the programmer/analyst group. Whereas the former ascribe more importance to business and organisational job skills ahead of the more technical, the opposite view is held by the latter. This result tends to substantiate the commonly held view that there is a very marked divergence of opinion between executives and the more technically oriented members of their organisations. The degree of importance that each group might attach to a skill item can be diametrically opposite.

This chapter has been exploring the perception of the importance of skill items in an IS professional's job from the dual perspectives of manager and non-manager. An analysis of the survey data using a variety of statistical techniques has clearly demonstrated that the more technology-oriented members of the profession hold a different set of priorities when they assess the importance of skill items in their jobs.

The first part of the chapter has offered an affirmative answer to the second research question posed in Chapter 2, namely:

- have IS managers perceived a shift in emphasis with regard to skills for their IS staff?

The managers' perception is that their IS staff originally required more traditional systems analysis skills in preference to people skills. But over time, in their opinion, there has been a shift to a greater need for communication skills and certain technical skills ahead of longer term business-related skills.

The next chapter accepts the fact that 35 KSAs are a large number of items to analyse. So far the business versus technology duality has been a convenient classification schema for the categorisation of the 35 KSAs. If they were reduced in number a more sophisticated interpretation of the results may be possible. This topic of data reduction is addressed in the following chapter.

10. Data Reduction

The research process so far has focused on an analysis of data from a broad perspective. In this chapter there is a move to a higher plane for two reasons. The first is that because of the large number of skill items it would be helpful to the analysis if the 35-items scales could be amalgamated into a smaller set of scales of related items. If items could be logically grouped by common characteristics, then more meaningful understanding of their relevance to the workplace may result. The second reason for conducting data reduction is to address research issues of validity and reliability. These issues are discussed in greater detail below.

10.1 Validity and Reliability

In the statistical literature a number of types of validity and the need to test for reliability of the data are regarded as important to data analysis. Statistical testing for content validity, construct validity and reliability ensure instrument validity.

Content validity - the representativeness of the measures (Straub, 1989) - has already been addressed (in Chapter 5) by subjecting the survey questionnaire to pilot testing by IS/IT literate mid-career students. The pilot testing suggested that the skill items (KSAs) were clearly worded and representative.

Construct validity - the meaningfulness of the measures - addresses the question of whether the measures are true constructs describing the event or are merely artifacts of the methodology (Straub, 1989). It was assessed by the exploratory statistical technique of principal component analysis (PCA):

> In principal component analysis and in factor analysis....we concentrate on relationships *within* a single set of variables. Both of these techniques - although authors differ in whether they consider principal component analysis to be a type of factor analysis or a distinct technique - can be used to reduce the *dimensionality* of the set of variables....with as little loss of information as possible. If this effort is successful, then the new variables (components, factors) can be considered as

providing a description of the "structure" of the original set of variables. (Harris, 1975:23).

Hence the PCA technique, if successful, not only serves to validate the meaningfulness of 'structure' of the 35-item scales but also to reduce the number of items into a smaller set of new composite variables. The major goal of PCA is to identify as few components as possible to account for the most variance in the original set of variables.

Reliability - the stability of the measures (Straub, 1989) - was assessed by Cronbach's alpha. Cronbach's alpha was used to assess the inter-item reliability of the final multi-item scales (see Table 10-1). As a 'reliability coefficient' score should be at least 0.7 to be considered acceptable (de Vaus, 1991:256), individual unreliable items (marked with a '+' in Table 10-1) were dropped in order to raise the overall reliability of the final scales. If an item's removal, due to its low inter-item reliability score, meant that alpha increased then it was deleted from the scales.

10.2 Psychometric Coherence

A number of authors (Cyr & Atkinson, 1986; Dziuban & Shirkey, 1974; Gorsuch, 1983) have argued that for results from exploratory factor analysis to be 'interpretable' there is a psychometric requirement to demonstrate systematic covariation among the variables under consideration. Two statistics should be examined. The first is the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy which indicates whether the associations between the variables in the correlation matrix can be accounted for by a smaller set of factors - a minimum value of 0.5 is required, but on calibrations of the index 'meritorious' is ≥ 0.8 and 'marvelous' is ≥ 0.9 (Dziuban & Shirkey, 1974:359). The second test is the Bartlett test of sphericity (BS) which tests the null hypothesis that no relationships exist between any of the variables. As can be seen in Table 10-1 (which subsumes sub-sections a, b, c and d), because the KMO is greater than 0.5 and the BS is significant for all four sets of data, the results signify that the correlational matrices are appropriate for PCA. In fact all KMO results are in the 'meritorious' category.

10.3 Principal Component Analysis (PCA)

As displayed in Table 10-1 four sets of data were separately submitted for principal component analysis using the varimax procedure in the software package SPSSX. The means of each of the 35 items in a scale were analysed by the software, and a four component solution emerged for all four scales. The four sets of data are the four 35-item scales developed in Part I and II of the questionnaire (for details refer to the four sections of Table 10-1) - that is, the four sets comprise a pair relating to the whole sample and a second pair relating to the self-selecting managers; each pair comprises one for the current responses, the other scale refers to the 'start' responses.

Eigenvalues greater than 1 and scree plots were used in determining the number of components. Initially as many as between seven and nine composite factors (also known as 'dimensions') for the four scales satisfied the criterion of having an eigenvalue of >1. On closer inspection it was found that while the first principal component attracted approximately a third of all the KSAs, many of those with the lowest eigenvalues attracted only one or two of the 35 KSAs. Of interest is the observation that the former KSAs were always business/organisation-related. As the latter were always technology-related, it means that the technological area is more readily reduced to small sub-groupings of associated skill items. But such components comprising few items were regarded as not explaining sufficient variance in the set of 35 individual items, so further inspection resulted in the re-running of PCA on a specified limit of four dimensions for each of the four scales. This resulted in three of the four scales converging in fewer iterations.

For an item to be considered in the composition of a composite variable, it had to have a loading of at least 0.44 on a component (the cutoff point for loadings is .01 significance, which is determined by calculating $2.58/\sqrt{n}$ where n is the number of items in the questionnaire) and had to add to the variable's reliability (as explained above). All items that failed to pass either test are marked in the results (with a ++ or + respectively), but were rejected before all data was *re-submitted* for the final PCA (as recommended by Ferguson & Cox, 1993:91). Hence it must be noted that Table 10-1 displays not only the final stable list of KSAs, but also those rejected throughout the PCA process.

The naming of those four sets of composite factors was also more of an art than a science. The expertise of an IS colleague was enlisted to independently suggest, having been supplied with the groups of KSAs, suitable names for the corresponding composite factors or components. Below is listed for each of the scales the nomenclature suggested by

i) the author (as in Table 10-1) ii) the independent expert:

		Component 1	***Component 2***	***Component 3***	***Component 4***
a)	i)	General management skills	InfoSys environment/ infrastructure	3GL systems	4GL software
	ii)	General skills	Planning skills	Operating skills	Application skills
b)	i)	General management skills	Systems development infrastructure	'Hard' technology	Decision support
	ii)	Basic skills	Computer IS skills	'Hard' technical skills	System Development
c)	i)	Managing InfoSys environment	Business analysis	3GL systems	4GL software
	ii)	Management of IS	Management skills	Implementation of IS	Design skills
d)	i)	Managerial skills	Communication skills	4GL systems development	'Hard' technology
	ii)	Broad-based Management skills	Communication skills	Systems Development	Operations skills

Noteworthy is not only the similarity of the nomenclature proposed by the two academics, but also the semantic continuum from the highest loading managerial component through managing technology down to the technology components. The individual items in Component 1 for both a) and b) are identical but for one: **Project management skills** in place of **Understanding legal issues.** In the case of the first principal components for c) and d) it is understandable that the name and contents of the former (where managers were assessing the importance of KSAs of their technical employees when they *first* became managers) is marginally more technically oriented than the latter.

As a general observation this evidence suggests that there has always been in an IS job an associated grouping of managerial/business skills that can be collectively identified as a single skill entity. In reverse, such an entity can in itself be regarded as complex due to its composition of more individual skill items than a corresponding technically-oriented entity.

At a detailed level, in the two scales used to measure the views of *all* respondents (Table 10-1, sections a and b) the component with the highest eigenvalue is comprised exclusively of 'business-related' KSAs (as defined in Table 8-1), and in the other two where managers are rating the importance of skills for more technical operatives it is not surprising that the three or four technology-related KSAs load much less highly within those principal components. But in general it will be observed that technology-related KSAs (marked with a 'T' in the rightmost column) tend to reside in the lower half of the component pattern matrices. In fact the clustering of KSAs into either business-related and technology-related groups seems to reinforce the traditional dual ladder model.

If an item also loaded highly on another variable it was not rejected. In such a case of 'cross loading' it is interpreted as indicating the multi-dimensionality of that item as it is related to more than one component (Ferguson & Cox, 1993:91). It is taken as an instance of the complexity of skill items which may not readily be categorised into clearly delineated groupings. If a loading of > 0.44 is retained as the cutoff point for secondary components, then inspection of individual KSAs in Table 10-1 reveals some meaningful examples of multi-dimensionality. For instance, in section d that relates to current IS skills requirements as assessed by managers, **Negotiating skills**, **Project management skills**, **Verbal & presentation skills** and **Quality management concepts** load highly on both components of 'managerial' and 'communication' skills. It makes sense that **Computer security & disaster recovery** which should of concern to managers and technologists, load onto both ends of the continuum - but to justify that **Use & evaluation of hardware** is in the same category is more problematic.

Table 10-1: Component Pattern Matrix, including α reliability analysis, for Items Measuring:

a) Skills inventory perceived important by All respondents at the Start in their current job designations

KSA item	*Component 1* General management skills	*Component 2* InfoSys environment/ infrastructure	*Component 3* 3GL systems	*Component 4* 4GL software	
Verbal & presentation skills	**.77283**	.15218	-.14980	.06106	
People skills	**.73467**	.19116	-.12330	-.01721	
Project management skills	**.70394**	.21249	.03446	.10328	
Written communication skills	**.69004**	.19644	-.06656	.11023	
Negotiating skills	**.66128**	.47336	-.12192	.05180	
General management skills	**.64187**	.43496	-.01337	-.07801	
Information gathering techniques	**.63664**	-.08083	.14535	.07336	
Project evaluation & justification	**.58871**	.45405	.09103	.09221	
Knowledge of the business area	**.57743**	.21992	.09365	.04734	
Marketing skills	**.50857**	.41616	-.15955	.05655	
Quality management concepts	.43454	.32292	.05122	.20506	
~~[Keeping abreast with new technology++~~	~~.41229~~	~~.30347~~	~~.16126~~	~~.07632~~	
Strategic Info. Systems Planning	.31657	**.68174**	-.16741	.21324	
Decision support systems	.16010	**.63859**	-.05749	.43088	
Computer security & disaster recovery	.21073	**.59250**	.42734	.00680	T
Understanding legal issues	.38477	**.57776**	-.07657	.07372	
Telecomms & networking concepts	.10384	**.55736**	.21577	.17979	T
Use & evaluation of hardware	.28661	**.52843**	.40282	-.01367	T
Computer controls & auditing	.26320	**.52835**	.39737	-.06488	T
Use & evaluation of software packages	.25016	**.50666**	.09584	.23401	T
~~[Mini-computer systems++~~	~~-.04954~~	~~.39673~~	~~.37225~~	~~.19214~~	T
~~[Health & safety++~~	~~.24595~~	~~.25074~~	~~.04746~~	~~.03723~~	
Computer Operations, JCL, data	-.18032	.09738	**.71942**	-.02535	T
Operating Systems	-.15448	.18404	**.64191**	.13504	T
3rd generation programming	-.29284	-.22811	**.57124**	.27572	T
User training & support	.34261	.08619	**.55674**	.05725	T
Mainframe systems	-.21565	.03475	**.52660**	.12366	T
Documentation writing skills	.34795	.08829	**.49934**	.14745	T
Systems Analysis & Design techniques	.33455	-.24347	**.48899**	.36433	T
Prototyping techniques	.05591	.25160	.07332	**.74271**	T
4th generation programming	.09819	-.08498	.17408	**.68060**	T
DBMS & database design	.12700	.01948	.34505	**.66946**	T
CASE techniques	.11626	.28350	-.12744	**.66220**	T
Statistical & simulation techniques	-.07286	.29816	.17445	**.56239**	
~~[Personal computer systems+~~	~~.17902~~	~~.33905~~	~~-.26999~~	~~.40822~~	T

Kaiser-Meyer-Olkin measure of sampling adequacy = .88982 No. of iterations: 12
Bartlett test of sphericity = 5729.3043, significance = .00000

Eigenvalue	8.48219	3.81924	1.99323	1.67979
% of variance	27.4	12.3	6.4	5.4
Cumulative % of variance	27.4	39.7	46.1	51.5
Mean	4.046	3.063	3.711	2.557
Standard deviation	1.167	1.094	1.149	1.150
Reliability coefficient	.8950	.8292	.7264	.7537

+ deleted on the reliability coefficient analysis
++ eliminated during PCA loading < 0.44

T= technology-related
→ = cross loading

b) Skills inventory perceived important Now by All respondents in their current jobs

KSA item	*Component 1* General management skills	*Component 2* Systems development infrastructure	*Component 3* 'Hard' technology	*Component 4* Decision support	
Verbal & presentation skills	**.78475**	.03484	-.07378	.05095	
Negotiating skills	**.76252**	-.14791	.09664	.12228	
General management skills	**.75051**	-.20590	.12100	.11524	
Written communication skills	**.74925**	.01500	.00015	.00007	
Marketing skills	**.73444**	-.05873	-.06591	.11834	
People skills	**.71450**	-.06802	.02444	.01798	
Understanding legal issues	**.60521**	-.13903	.25693	.26718	
Knowledge of the business area	**.54064**	.04560	.11095	.15452	
Quality management concepts	**.50180**	.11457	.07507	.37535	
Project evaluation & justification	**.48301**	-.00811	.20468	.40741	
~~[Keeping abreast with new technology+~~	~~.43707~~	~~.37373~~	~~.22019~~	~~-.05078~~	
~~[Information gathering techniques++~~	~~.33423~~	~~.33044~~	~~-.01646~~	~~.05871~~	
~~[Mainframe systems++~~	~~-.31554~~	~~.00122~~	~~.26166~~	~~.26362~~	T
DBMS & database design	-.14764	**.75130**	.14719	.22425	T
Systems Analysis & Design techniques	-.09798	**.74230**	.08165	.13995	T
4th generation programming	-.11265	**.74123**	.08734	.15978	T
3rd generation programming	-.30352	**.61429**	.21667	-.11451	T
Prototyping techniques	.04085	**.57662**	~~-.05018~~	.53952	T
User training & support	.05787	**.57593**	.36054	-.10526	T
Documentation writing skills	.22424	**.54805**	.31624	-.09425	T
~~[Personal computer systems+~~	~~.33156~~	~~.48385~~	~~.31004~~	~~-.07115~~	T
~~[Use & evaluation of software packages++~~	~~.30294~~	~~.33998~~	~~.31273~~	~~.11733~~	T
Computer security & disaster recovery	.16926	.00612	**.73948**	.17210	T
Telecomms & networking concepts	.14461	.07135	**.64969**	.09899	T
Use & evaluation of hardware	.14509	.14760	**.63934**	.11738	T
Computer Operations, JCL, data	-.18945	.26323	**.60783**	-.07659	T
Computer controls & auditing	.25533	.12961	**.60213**	.30918	T
Operating Systems	-.20248	.39244	**.56573**	-.17735	T
Mini-computer systems	-.01181	.14753	**.50741**	.13308	T
~~[Health & safety+~~	~~.18377~~	~~-.06700~~	~~.44265~~	~~.07293~~	
Decision support systems	.23804	-.02974	.21183	**.73393**	
CASE techniques	.08101	.33205	-.16081	**.67782**	T
Strategic Info. Systems Planning	.33600	-.20591	.15650	**.65675**	
Statistical & simulation techniques	.08936	.14745	.23878	**.56874**	
~~[Project management skills++~~	~~.34961~~	~~.13083~~	~~.14317~~	~~.42615~~	

Kaiser-Meyer-Olkin measure of sampling adequacy = .87662 No. of iterations: 7
Bartlett test of sphericity = 4802.8784, significance = .00000

Eigenvalue	6.32701	4.98374	2.00402	1.50702
% of variance	22.6	17.8	7.2	5.4
Cumulative % of variance	22.6	40.4	47.6	52.9
Mean	5.312	3.923	3.977	3.501
Standard deviation	0.979	1.282	1.108	1.310
Reliability coefficient	.8757	.8237	.7804	.7134

+ deleted on the reliability coefficient analysis
++ eliminated during PCA loading < 0.44

T= technology-related
→ = cross loading

c) Managers' perception of skills inventory important for IS staff when they first became managers

KSA item	*Component 1* Managing InfoSys environment	*Component 2* Business analysis	*Component 3* 3GL systems	*Component 4* 4GL software	
Understanding legal issues	**.78545**	.07128	-.10826	.11736	
Decision support systems	**.77224**	.01179	.04907	.32967	
Strategic Info. Systems Planning	**.71848**	.14543	-.01034	.32162	
Project evaluation & justification	**.59772** ←	.50598	.13487	-.02072	
Marketing skills	**.58788**	.41256	-.20585	.29815	
Negotiating skills	**.58634** ←	.52711	-.20292	.11560	
Use & evaluation of hardware	**.58115**	.14659	.29924	-.01750	T
General management skills	**.56833**	.42635	-.20623	.09155	
Health & safety	**.56612**	.23349	.12972	-.13956	
Computer security & disaster recovery	**.53926**	.24272	.34337	-.00570	T
Use & evaluation of software packages	**.53339**	.30334	.05648	.24020	T
Quality management concepts	**.52143**	.28510	.04089	.06458	
Computer controls & auditing	**.51941**	.35852	.36963	-.02220	T
~~[Statistical & simulation techniques+~~	~~-.11638~~	~~.47252~~	~~.16293~~	~~.45883~~	
Verbal & presentation skills	.25069	**.81148**	-.03522	-.02507	
Written communication skills	.31773	**.77242**	-.00127	-.05140	
People skills	.35670	**.76356**	-.12956	-.03623	
Project management skills	.24964	**.74546**	-.01702	.09219	
Information gathering techniques	.09591	**.73416**	.19164	.04828	
Knowledge of the business area	.30998	**.62024**	-.01834	.02442	
Systems Analysis & Design techniques	-.15430	**-.57822**	.31263	.40433	T
Documentation writing skills	.17619	**.52488**	.29293	.17418	T
Keeping abreast with new technology	.44901 →	**.50248**	.17697	.11633	
User training & support	.04056	**-.49607**	.19845	.21172	T
Computer Operations, JCL, data	.26382	.05323	**.77035**	-.05223	T
Mainframe systems	.05777	-.01755	**.75608**	.09171	T
3rd generation programming	-.21374	-.08159	**.74699**	.08541	T
Operating Systems	.08481	.20575	**.62387**	.03175	T
~~[Mini-computer systems+~~	~~.04615~~	~~.11489~~	~~.44326~~	~~.15262~~	T
~~[Telecomms & networking concepts++~~	~~.17414~~	~~.38519~~	~~.39993~~	~~.39055~~	T
Prototyping techniques	.27339	.03683	-.08797	**.78201**	T
CASE techniques	.32018	-.00291	-.11400	**.77980**	T
4th generation programming	.01665	.09035	.11621	**.76781**	T
DBMS & database design	-.00151	.18059	.37447	**.67823**	T
~~[Personal computer systems+~~	~~.21454~~	~~.38360~~	~~-.38857~~	~~.45167~~	T

Kaiser-Meyer-Olkin measure of sampling adequacy = .86168 No. of iterations: 8
Bartlett test of sphericity =2543.8674, significance = .00000

Eigenvalue	10.03707	3.08804	2.67731	2.05754
% of variance	32.4	10.0	8.6	6.6
Cumulative % of variance	32.4	42.4	51.0	57.6
Mean	3.046	4.352	3.943	3.113
Standard deviation	1.050	1.049	1.441	1.375
Reliability coefficient	.9012	.8930	.7487	.7985

+ deleted on the reliability coefficient analysis
++ eliminated during PCA loading < 0.44

T= technology-related
→ = cross loading

d) Managers' perception of skills inventory important for their current IS staff

KSA item	*Component 1* Managerial skills	*Component 2* Communication skills	*Component 3* 4GL systems development	*Component 4* 'Hard' technology	
Understanding legal issues	**.78761**	.09082	-.06957	.07624	
Strategic Info. Systems Planning	**.75225**	.14968	-.04516	.05342	
Marketing skills	**.72482**	.31664	.07717	-.09332	
Project evaluation & justification	**.69126**	.42006	-.03676	.10946	
Negotiating skills	**.64725**	.52510	-.00149	.00740	
Project management skills	**.64189**	.48333	.11142	-.07305	
General management skills	**.62395**	.20509	-.08808	.10625	
Decision support systems	**.60466**	.09837	.25482	.16752	
Use & evaluation of hardware	**.56346**	~~-.03419~~	~~.10058~~	.46090	T
Keeping abreast with new technology	**.54391**	.25250	.13556	.27296	
Personal computer systems	**.49347**	.25194	.15462	.10951	T
Use & evaluation of software packages	**.47663**	.20491	.28332	.15711	T
Health & safety	**.46511**	.20361	-.12076	.41495	
[~~3rd generation programming+~~	~~.48811~~	~~-.16221~~	~~.29311~~	~~.22937~~	T
[~~Statistical & simulation techniques++~~	~~.41846~~	~~-.15499~~	~~.32156~~	~~.17175~~	
Written communication skills	.32404	**.75513**	.10397	.07383	
Information gathering techniques	.05234	**.69097**	.04387	.09706	
People skills	.42045	**.68112**	-.06189	-.02962	
Verbal & presentation skills	.45018	**.67118**	.10802	-.00109	
Knowledge of the business area	.29736	**.65709**	.11176	.13814	
Quality management concepts	.44629	**.45682**	-.04625	.26387	
[~~Documentation writing skills+~~	~~.05390~~	~~.58641~~	~~.27956~~	~~.17325~~	T
DBMS & database design	-.08030	-.03514	**.80086**	.14724	T
4th generation programming	.04131	-.09132	**.78078**	.15913	T
Prototyping techniques	.34795	.04483	**.69918**	-.12892	T
CASE techniques	.33635	-.06945	**.65860**	-.10589	T
Systems Analysis & Design techniques	-.15568	.26273	**.61755**	.08610	T
User training & support	-.10038	.27967	**.56088**	.21356	T
Computer Operations, JCL data	.10808	-.04049	.01181	**.72262**	T
Operating Systems	-.04766	.04550	-.01323	**.68529**	T
Mini-computer systems	-.05185	.00935	.20125	**.61850**	T
Telecomms & networking concepts	.34710	.10102	.24217	**.54821**	T
Computer security & disaster recovery	.46575	~~.26789~~	~~-.00436~~	**.54624**	T
Computer controls & auditing	.33978	.30891	.11505	**.50461**	T
[~~Mainframe systems+~~	~~.10763~~	~~-.01733~~	~~.02036~~	~~.42083~~	T

Kaiser-Meyer-Olkin measure of sampling adequacy = .84562 No. of iterations: 13
Bartlett test of sphericity = 2620.6749, significance = .00000

Eigenvalue	9.75017	3.21426	2.32403	1.62963
% of variance	31.5	10.4	7.5	5.3
Cumulative % of variance	31.5	41.8	49.3	54.6
Mean	4.355	5.367	4.686	4.170
Standard deviation	1.121	.961	1.154	1.050
Reliability coefficient	.9069	.8516	.7956	.7510

\+ deleted on the reliability coefficient analysis
++ eliminated during PCA loading < 0.44

T= technology-related
→ = cross loading

So in section d a total of 6 of the 35 KSAs loaded significantly onto two of the four components. This could be further evidence that the traditional separation of skills into two distinct 'ladders' is too simplistic - many skills required in the IS profession overlap. But the picture emerging from the other three sections in Table 10-1 is more uni-dimensional. A more persuasive analysis of the results is that managers are somewhat ambivalent as to the distinctiveness of skills required of their *current* staff, whereas, as section c in Table 10-1 shows, they are more definitive in hindsight.

It might be argued that a further submission of the data to a higher order PCA to two components may reveal the underlying reality of the traditional dichotomy of managerial versus technological. But a closer inspection of the four-component principal component analyses suggests that to do so would result in a certain loss of distinction in terms of the theme of change (which is central to this thesis). According to the perception of management, communications skills has moved from being part of 'business analysis' with **Systems Analysis & Design techniques** to become clearly separate from both systems analysis and managerial skills; and **Systems Analysis & Design techniques** is now part of '4GL', while a hard-core technical skill set remains as a successor of 3GL.

Also of interest are similar, although different, changes detected in the principal component analyses of the total sample. Here it seems that a 'systems development infrastructure' skill set combines the previous 3GL and 4GL sets with the gap being filled by a small 'decision support' component. The results suggest a redefining of 'bundles' of skills with subtle but important shifts in definition.

10.4 The Means of the Components

Whereas the reduced number of components derived from PCA are listed in descending order according to eigenvalue, the implied priority does not relate to their importance in relation to each other as perceived by the sample respondents. The scores (on the 7-point scale) of the sample means of these new components (each subsuming a number of the original 35 KSAs) provide a measure of importance. These four sets of means are shown at the bottom of sections a, b, c and d, Table 10-1.

In addition, in order to test whether the relative differences between each is statistically significant repeated measures analysis of variance procedures were conducted on each pair of means in descending order of score. The results are reported in Table 10-2. Here it will be noticed that some of the means vary slightly from their counterparts in Table 10-1. This is due to taking into account null responses in the data.

In the main, each mean value is significantly larger in comparison with that below it and by implication all others of lesser value. For the total sample 'general management skills' have always been and are still the most important, followed by '3GL' at the start of their careers and followed by 'hard technology' now. In the case of the latter, however, it is no more important in current jobs than systems development skills. Although '4GL' rates as the least important at the start of careers, it will be recalled that now it is part of 'systems development infrastructure' which is significantly more important than 'decision support'.

For managers the results are trichotomous. They perceive that when they were first managers 'business analysis' was a decidedly more important skill set for their IS employees than '3GL' skills. Yet these two were more valued than the others. Likewise in current positions they see communications skills of supreme importance above '4GL systems development', and these two supersede the other two, one of which is managerial skills.

The interesting finding as a result of both an analysis of components and their means is that in the view of managers communication skills for the more technically-oriented IS professions are distinct from managerial skills which have now been relegated to the least important with 'hard' technology. Not in dispute for all cases is the superior regard for the business-related components.

Table 10-2: Repeated Measures ANOVA of Skill Components Ranked by Means:

a) as perceived by All respondents at the Start of their current job designation

Skill Component	*Mean*	*Cronbach α*	*F*	*P*
General management skills	4.030			
		0.029	18.806	0.0000
3GL systems	3.683			
		0.379	82.819	0.0000
InfoSys environment/ infrastructure	3.061			
		0.586	77.529	0.0000
4GL software	2.533			
Total Mean	13.307			

b) as perceived by All respondents Now in their current jobs

Skill Component	*Mean*	*Cronbach α*	*F*	*P*
General management skills	5.311			
		0.297	419.032	0.0000
'Hard' technology	3.965			
		0.638	0.608	0.4359
Systems development infrastructure	3.918			
		0.364	28.189	0.0000
Decision support	3.499			
Total Mean	16.693			

c) as perceived by managers as being important for their IS/IT staff when they were first became managers

Skill Component	*Mean*	*Cronbach α*	*F*	*P*
Business analysis	4.312			
		0.292	7.748	0.0061
3GL systems	3.933			
		0.286	27.769	0.0000
4GL software	3.125			
		0.499	0.472	0.4930
Managing InfoSys environment	3.043			
Total Mean	14.413			

d) as perceived by managers as being important for their current IS/IT staff

Skill Component	*Mean*	*Cronbach α*	*F*	*P*
Communication skills	5.361			
		0.290	33.875	0.0000
4GL systems development	4.691			
		0.346	8.4883	0.0042
Managerial skills	4.339			
		0.639	3.6165	0.0593
'Hard' technology	4.160			
Total Mean	18.551			

It is also worth noting, as a general observation that the two sets of means that relate to current job skills have higher total means than those for the earlier points in time. Expressed as a percentage the total sample rated their current skills as 25% higher in importance than when they first started their careers. The managers are more demanding of their IS employers, rating current skills as 28% higher than when they first became managers. The conclusion is that most of this additional emphasis over time has been on business-related skills, but there is no evidence to suggest that this implies any *less* emphasis on technical skills over the same period.

10.5 Task Descriptors Re-visited

Now that the data has been reduced to psychometrically cohesive scales, the next stage is to cross-reference the frequency counts of task descriptors (as discussed in Chapter 8) grouped by the KSAs that are contained within each of the new composite items. Due to the structure of the questionnaire, it is worthy of note that respondents wrote down in a prioritised list these keywords describing the tasks in their job *before* they turned over the page to respond to the Likert scales. The question is whether the results of content analysis of these words describing the principal tasks in their *current* jobs help to validate the results from statistical analysis of the importance ratings ascribed to the set of 28 KSAs (i.e. 35 less 7 rejected as in Table 10-1, section b) that relate to current jobs.

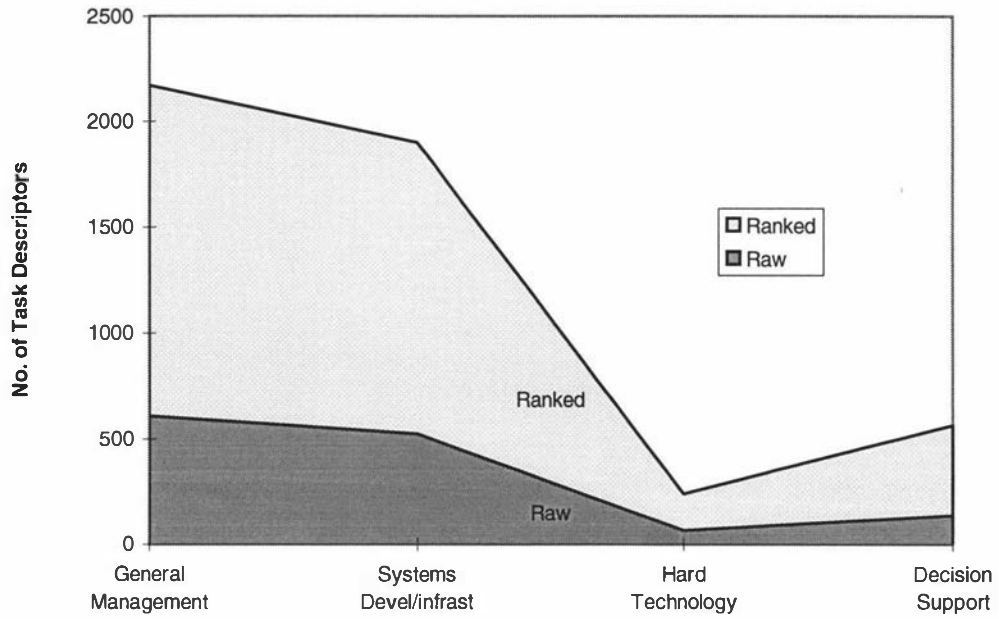
It will be recalled in Table 8-5 that for each KSA two sets of frequency or content category counts were calculated: the first being a count of actual occurrences of the words or phrases i.e. the 'raw scores', and the second a 'ranked score' whereby each occurrence was weighted by a simple multiplier (1, 2, 3 or 4) depending on the line position of the word or phrase. Four lines were provided on the questionnaire, and respondents were made aware that they were to enter one keyword or phrase per line in descending order of importance in relation to their current job. All entries or 'task descriptors' were codified by the researcher as described in section 7.2. Hence for analysis purposes a task descriptor on the first line was assigned the highest multiplier of 4 to arrive at a ranked score. One on the last line received the lowest multiplier of 1, in other words remained the same as its raw score.

Based on the stable reliable KSAs identified by principal component analysis which collapsed them into the four components in Table 10-1 section b, four sets of composite raw and ranked frequency counts were calculated.

As can be seen in Figure 10-1, the respondents' words definitely support the general superiority of the two components with the highest eigenvalues, even with the same order of priority. As regards the means, if one interprets that 'systems development infrastructure' is no less significant than 'hard technology', then it can be argued that the task descriptor analysis still corroborates the general findings. On the other hand, pure technology-related skills are definitely under-represented by task descriptors, contrary to the expectations in both the CPA and analysis of the component means. For some reason the total sample chose not to provide textual reinforcement of the importance of the more technical side of their job tasks.

Notwithstanding such an omission, it still seems that in general, content analysis of the task descriptors tends to validate the data reduction procedure of PCA. It also reflects the strength of the means if the case of hard technology is regarded as a textual aberration on the part of the sample.

Figure 10-1: Task Descriptors categorised by Components for All Respondents' Current Jobs



This chapter commenced by testing for the reliability of the data and for the validity of the research instrument. Although a small number of KSAs had to be rejected as part of principal component analysis and reliability testing, the overall validity of the survey instrument was confirmed.

This chapter's findings continue to underscore a consistent set of answers to the primary research questions. Exploratory principal component analysis of the retrospective and current perceptions of the surveyed IS professionals highlighted not only the value of business-related skills throughout the subjects' careers but also a perceived increase in importance of those skills over time. As an indication of current skills requirements, a similar message was conveyed by a content analysis of keywords and phrases describing the subjects' current job tasks. In this case, in addition to the emphasis on business- and organisation-related skills, of approximately equal importance is the language of systems development which is after all the stuff of the workplace for IS professionals.

11. Conclusions

After assessing the evidence from previous research constructs and academic writers a conceptual model of how a skills inventory for information systems personnel might be visualised (Figure 2-6) was posited as a basis for this research. The model accepts the bipolar nature of business-related and technology-related skill items (later defined *à la* Cheney as KSAs) but it also contains more sophistication. As explained historically through three eras of DP, MIS and SIS a core of skills continue to exist, but it is suggested that over time there has been a shift in emphasis. Implicit in the model are two assumptions: that a core of competencies remain central to the IS professional, but that the shift has tended towards the more business-related skill items within that core inventory. It also recognises the probability that on the technical side relevant skills are more likely to become more specialised in response to more sophisticated user demand.

The design of the research instrument was based on these premises and after its execution and application the model remains a useful conceptual framework to explain the findings. Alongside the model three research questions were posed. But the findings relating to these questions will be presented at the end of this chapter. First, the research process will be summarised, including comments on its limitations, followed by suggestions for future research.

The research instrument chosen as the most appropriate for this piece of research was that of a questionnaire. Its design was based on work carried out by Cheney and the primary unit of analysis arose out of his 1987 set of 20 skill items dubbed 'knowledge, skill or ability (KSA)'. A further 15 KSAs were added after careful consideration: four were initially justified from an extensive review of the literature, then supplemented by a further 11 after a pilot test with mature IS students as the sample.

In order to explore the topic of the relative importance of skills in the context of change, data that related to an extensive time period needed to be captured. This requirement led to the 'retrospective panel' design of the questionnaire whereby the total sample of IS professionals and a sub-set of self-selecting managers rated the importance of the 35

KSAs on Likert scales, both at the beginning of the their careers and in their current jobs. At this stage initial scales had been constructed to accept data.

To help validate the choice of KSAs and the analysis of the data relating to *current* skills, a preceding section was introduced to capture textual data in the form of keywords describing the respondent's tasks in the current job. Subsequent interpretive and semantic content analysis of the keywords tended to reinforce the validity of the statistical analysis of the data collected on the remainder of the questionnaire.

As a result of successful negotiations with the New Zealand Computer Society the survey instrument was mailed out to its members. The sample size of 443 represents a statistically adequate size. A demographic analysis of the data revealed an aging membership with a predictably high proportion of managerial members.

The initial data analysis centred on both 'between' and 'within group' tests of significance on all data collected on the Likert scales. To help explain the results the researcher found it meaningful to follow in the footsteps of most other researchers by consciously defining and distinguishing between so-called 'business-related' and 'technology-related' KSAs. Further distinctions were made between the self-selecting managers and non-managers, between job categories and levels of experience. The general picture that arose from these statistical analyses is one of bipolar tension not only between the two categories of KSAs but also between the management and non-management views of their respective roles in the workplace.

The next part of the process was to develop the four scales. The method selected for scale development was principal component analysis (PCA). The aim was to arrive at sets of stable KSAs which themselves would contribute to smaller sets of composite items or components. During the PCA process KSAs were checked for unidimensionality and reliability. The results proved to be interpretable and stable. A final 'within group' analysis of the ranking of the means of the composite items revealed further evidence of change over time. It seems that whereas the total sample perceive that general management skills have always been important and are increasingly so, there have also occurred subtle changes in the technology-related skills over the same period. For managers the shift in emphasis has been more definitively from systems analysis and 3GL related skills to more communication and managerial skills ahead of the more technology related skill items.

The one major limitation in this thesis is access to a representative sample. It is very difficult for a researcher to have control over the composition of a sample. Because most research to-date had been based on quite small samples of more technically-oriented information systems subjects, when the researcher initially investigated the profile of the members of the New Zealand Computer Society he was gratified to detect a large proportion of managerial candidates. In addition it was potentially a large sample with a trichotomous structure that approximated to an organisational structure: executive management, middle management and technical operatives.

In retrospect, it is debatable whether such a sample is representative of the 'information systems profession' in New Zealand. Not only is an appellation such as 'information systems' and the concept of 'profession' open to interpretation, but there is the perennial problem of definition that besets all researchers in such a rapidly evolving environment. This thesis is no exception.

As there had been no previous longitudinal samples available in New Zealand, the research instrument was designed for a retrospective panel. The limitations of this approach are discussed within the thesis. The author was also aware that under the provisions of the Privacy Act (1993), although a longitudinal study might have been preferable to the retrospective panel design of the questionnaire, approval to gain access to membership lists for any on-going research will be very difficult.

Nevertheless, despite the limitations of the sample composition, there is still merit in pursuing further research with the New Zealand Computer Society or other bodies that represent the computer industry and its personnel, such as the Telecommunications Users Association of New Zealand (TUANZ) which is currently prominent as it reflects the industry's shift towards embracing convergent technologies and telephony.

The skills for IS personnel will continue to evolve, as this thesis has demonstrated, to keep abreast of new developments in the industry. Although certain core skills have been identified by this research they can still undergo subtle metamorphic re-alignment in rapidly changing commercial, industrial and social environments. Consequently, academic researchers will need to continually re-visit and update the topic of the IS skills inventory.

The researcher recommends that the identical research instrument and analytical methods be re-applied to a future sample of NZCS members (say in 1998, being the next 5-year 'snap-shot'). Either the same skill set could be retained or the instrument's mechanism for eliciting additional KSAs could be utilised.

As stated at the commencement of this chapter, this thesis posited three questions to be answered as outcomes of exploratory research into the job skills inventory for information systems personnel in New Zealand. The intention was that the questions would take into account a context of changing requirements in New Zealand over at least a decade. A summary of the major findings in the light of the three research questions are presented below.

1. **Are organisational/managerial skills becoming more important for IS professionals in their jobs?**

   The evidence from this survey of members of the New Zealand Computer Society in 1993 certainly indicates an affirmative response to this question.

   The questionnaire's 35 skill items fell into two categories of approximately equal number: 16 'business-related' and 17 'technology-related' KSAs (Table 8-1). In this thesis 'organisational', 'managerial' and 'business-related' are all regarded as synonyms. An overall pictorial representation (Figure 8-1) of perceived importance of the items over the period that all respondents have been in the IS industry shows a very definite increase for the former category. When the data was submitted to two-tailed paired *t*-tests this picture was reinforced by the strength of the *t*-values. Understandably knowledge of telecommunications and personal computers have undergone substantial increase in importance, but cumulatively it has been the business-related skills that have been ascendant.

As perceived by the total sample, the organisational/managerial skills have *always* been more important than the technology-related. This is the finding after analyses of the means ranked in descending order by KSA (Tables 8-3 and 8-4).

This initial inspection of the data was followed by more rigorous statistical data reduction and reliability testing to arrive at fewer more complex skill 'components'. The findings still confirm the increasing importance of the organisational and managerial skill components.

2. Have IS managers perceived a shift in the relative importance of particular skills required of their IS staff?

It is the viewpoint of the manager that is the strength of this sample of IS practitioners. Initially its profile could have been viewed as being skewed towards the non-technical or managerial in a ratio of 2:1, but due to a mechanism in the research design whereby the respondents had to satisfy a basic criterion to qualify as an active 'manager' the proportion dropped to 145/433 or 33.48%. This sample of self-selecting managers continued to concur with the total sample on the need for more emphasis on business-related skills, but with an additional focus. After analyses of the original 35 items, which were then reduced to sets of four principal components it was found that the managers were pinpointing communication skills above other skills sets.

In their opinion change had taken place. They recalled that when they were first in a managerial position their IS staff then required more traditional systems analysis skills in preference to people skills. But over time, according to the IS managers, there has been a shift to a greater need for communication skills and certain technical skills ahead of longer term business-related skills.

3. **What are the particular skills required for an IS professional in New Zealand?**

To help validate the results from the Likert scales that referred to current skills requirements, the design of the research instrument included textual responses in the form of keywords to describe a respondent's present job tasks. Content and frequency analysis of the task descriptors supported the general thrust of the findings already established. The message for New Zealand information systems personnel is that employers are demanding no fewer technical skills, but that there is a definite call for more business-related skills, especially concentrating on communication skills. This means that whereas the core of the skills inventory may have not changed appreciably, nevertheless the expectation is that the current environment welcomes expertise in telecommunications and personal computer technology, supported by much more demonstration of organisation/managerial skills in the workplace.

Two important results concerning the nature of requisite skills arose from principal component analysis (PCA) of the data. The first finding undermines the simplicity of the dual ladder concept of two distinct sets of skills. It is indicative from the degree of 'cross-loading' of the components that the skill items are multi-dimensional; in other words, that many skills contain elements that are useful to differing job designations.

The other finding refines the shift within the technology-related skill items. The PCA of the total sample suggests that over time there has been more importance placed on long term IS infrastructural skills. On the other hand, analysis of the management sub-sample was not so conclusive; but if we take into account the inter-group Scheffé tests that hint at a continuing rift between managers and the more technically oriented IS personnel on longer term issues, we might assume that managers may have not recognised such a shift.

These findings carry implications for the education and training of New Zealand computer professionals. This is a crucial time in the evolution of the New Zealand computer industry as it has yet to set up an industry training organisation (ITO), and computing majors are already featuring in many of the new polytechnic degrees. This thesis provides evidence that computing practitioners themselves are calling for more business-related skills in addition to technology skills in the areas of telecommunications, personal computers and infrastructure. Furthermore, the continuing requirement is people skills, especially in the area of communications. Educational authorities still tend to divorce 'technology' from its applications; and this can be reflected in funding decisions. Ultimately the application can only be effected by personnel - hence the importance of people skills as the enabling 'technology'.

In conclusion, as this thesis is essentially about information systems personnel, it is befitting to make two comments on the cultural dynamics that are detectable. Within the sample there is the sense of an emerging group of 'consultants' who may not have satisfied the criterion of practising 'manager'. Secondly, Snow's clash of cultures seems to be alive in the inter-group comparison between executive management and the programmer/analyst groups. It is hoped that as the IS profession matures and becomes more cohesive it will be in response to the Delphic oracle's pronouncement which was the inspiration for this research.

References

Anthony, R.N. (1965). *Planning and control systems: A framework for analysis.* Boston, Massachusetts: Harvard University Press.

Arnold, M. (1957). *Culture and anarchy*. Cambridge University Press. First published in 1869.

Arvey, R.D. & Hoyle, J.C. (1974). A Guttman approach to the development of behaviorally based rating scales for systems analysts and programmer/analysts. *Journal of Applied Psychology*, *59* (1), 61-68.

Ashenhurst, R. (Ed.) (1972). Curriculum recommendations for graduate professional programs in information systems. *Communications of the ACM*. *15* (5), 364-398.

Athey, T.H. and Wagner, G.E. (1979). Separate but real, business DP is different than 'computer science'. *Data Management*, *17* (8) 36 ff.

Awad, E.M. (1977). Prediction of satisfaction of systems analysts, programmers. *Data Management*, *15* (1), 12-18.

Baker, F.T. (1972). Chief programmer team management of programming. *IBM Systems Journal*, *11* (1), 56-73.

Benbasat, I. & Taylor, R.N. (1978). The impact of cognitive styles on information sytem design. *MIS Quarterly*, *2* (2), 43-54.

Benbasat, I., Dexter, A.S., & Mantha, R.W. (1980). Impact of organizational maturity on information system skill needs. *MIS Quarterly*, *4* (1), 21-34.

Benbasat, I., & Nault, B.R. (1990). An evaluation of empirical research in managerial support systems. *Decision Support Systems, 6,* 203-226.

Berelson, B. (1952). *Content analysis in communication research.* New York: Hafner.

Blake, B. & Price, D. (1969). The men in the machine. *Data Processing* (London), *11* (5), 482-488.

Blank, M.M. & Barratt, D. (1988). Finding and selecting systems analysts and designers. *Journal of Systems Management*, *39* (3), 8-11.

Borland, R.H. (1971). Shopping around for computer personnel? *Data Processing in NZ*, *4* (3), 7 ff.

Boswell C.R. & Melhuish P.J. (1978a). Data processing personnel & their careers - a profile. *Sixth NZ Computer Conference*, *I,* 20-53.

Boswell C.R. & Melhuish P.J. (1978b). Teaching of computing in New Zealand - The dream and the reality. *Sixth NZ Computer Conference, I*, 54-82.

Braverman, H. (1974). *Labor and monopoly capital: The degradation of work in the twentieth century*. New York: Monthly Review Press.

Bunn, G., Bartlett, C. & McLean, D. (1989). *Strategic planning for information systems*. Central Computer and Telecommunications Agency: Wiley.

Broadbent, M., Hansell, P.L., & Dampney, C.N.G. (1992). Managing information systems in Australia and New Zealand: Requirements for the 1990s. *The Australian Computer Journal*, *24* (1), 1-11.

Campbell, D.V.A. (1970). Systems design - can it be left to the experts? *Data Processing* (London), *12* (5), 402-404.

Canning, R (ed.) (1976). Professionalism: Coming or not? *EDP Analyzer*, *14* (3), 1-11.

Carlyle, R.E. (1989). Careers in crisis. *Datamation*, *35* (16), 12-16.

Cheney, P.H., & Lyons, N.R. (1980). Information systems skill requirements: A survey. *MIS Quarterly*, *4* (1), 35-43.

Cheney, P.H. (1984). Effects of individual characteristics, organizational factors and task characteristics on computer programmer productivity and job satsfaction. *Information & Management*, *7*, 209-214.

Cheney, P.H., Hale, D.P. & Kasper, G.M. (1990). Knowledge, skills and abilities of information systems professionals: past, present, and future. *Information & Management*, *19,* 237-247.

Converse, J.M. & Presser, S. (1986). *Survey questions: Handcrafting the standardised questionnaire.* Sage.

Corbin D.S. (1991). From nerd to normal in 10 easy steps: A guide for IS pros. *Journal of Systems* Management, *42* (6), 32-34.

Couger, J.D. (Ed.) (1973). Curriculum recommendations for undergraduate programs in information systems. *Communications of the ACM*, *16* (12), 727-749.

Couger, J.D. & Zawacki, R.A. (1978). What motivates DP professionals? *Datamation*, *24*, (9), 116-123.

Couger, J.D. (1984). Blue skies ahead. *Datamation*, *30* (21), 106-110.

Couger, J.D., Burns J., Dengate, G., Farn, C.K., Ma, L., Motiwalla, J., Tompkins, H.K. & Weber, R. (1992). A study of motivation of Asia-Pacific programmer/analysts vs. those in the United States. *Asia-Pacific Journal of Information Management*, *1* (1), 3-17.

Couger, J.D. and Monin, D.J. (1994). Comparing motivation of New Zealand computer personnel versus those of the United States. *New Zealand Journal of Computing, 5* (2), 39-48.

Crawford, J. (1980). Business DP curriculum: Next step's employee skill definitions. *Data Management*, *18* (2), 34-37.

Crepeau, R.G., Crook, C.W., Goslar, M.D., & McMurtrey, M.E. (1992). Career anchors of information systems personnel. *Journal of Management Information Systems 9*, (2), 145-160.

Crockett, H.D., Hall, G.R. & Jeffries, C.J. (1993). Preferred information systems skills: Are undergraduate IS programs serving their markets? *Interface*, *15* (2), 9-13.

Crocombe, G.T., Enright, M.J. & Porter, M.E. (1991). *Upgrading New Zealand's competitive advantage.* Auckland: OUP.

Crossman, T.D. (1986). Roots of the job turbulence in information systems(IS) development. *Computer Personnel*, *10* (3), 12-15.

Cyr, J. & Atkinson, L. (1986). Selection of the appropriate number of factors: A case of questionable dimensions. *Psychological Reports, 58*, 251-256.

Daniels, A. (1968). Systems analysis training. *Data Processing*, *10* (1), 22-23.

Data Processing. (1971). Professionalism - the realities. *Data Processing* (London), *13* (2), 81.

Data Processing in NZ. (1969). Courses in computer science at Victoria University of Wellington. *Data Processing in NZ*, *2* (1), 19.

Data Trend. (1972, September). Professional standards set too low. *Data Trend* (Australia), 6-7.

Davenport, T.H. (1993). *Process innovation: Reengineering work through information technology*. Harvard Business School.

de Vaus, D.A. (1991). *Surveys in social research.*(3rd ed.) London: Allen & Unwin.

Dengate, G., Couger, J.D. & Weber, R. (1990). Motivational characteristics of Australian information systems personnel. *The Australian Computer Journal, 22* (3), 77-88.

Department of Labour. (1986). *Data processing industry: March 1986.* Key skills trends studies series. Wellington: Department of Labour.

Ditri, A.E., Shaw, J.C. & Atkins, W. (1971). *Managing the EDP function.* New York: McGraw-Hill.

Doke, E.R. (1986). Productive programmers must be nurtured, fed with technology. *Data Management*, *24* (7), 14-17.

Dziuban, C. & Shirkey, E. (1974). When is a correlation matrix appropriate for factor analysis? Some decision rules. *Psychological Bulletin*, *81*, 358-361.

Earl, M.J. (1989). *Management strategies for information technology.* Hemel Hempstead: Prentice-Hall.

Earl, M.J. & Skyrme, D.J. (1992). Hybrid managers - what do we know about them? *Journal of Information Systems*, *2* (3), 169-187.

Ferguson, E. & Cox, T. (1993). Exploratory factor analysis: A user's guide. *International Journal of Selection and Assessment*, *1* (2), 84-94.

Festinger, L. (1957). *A theory of cognitive dissonance*. Evanston Ill: Row, Peterson.

Fougere K.T. (1991). The future role of the systems analyst as a change agent. *Journal of Systems Management*, *42* (11), 6-9.

Francis, R. (1989). Climbing the PC ladder. *Datamation*, *35* (9), 77-78.

Gane, C. & Sarson, T. (1977). *Structured systems analysis.* Improved Systems Technology Inc.

Garden, A. (1988). Behavioural and organisational factors involved in the turnover of high tech professionals. *Computer Personnel*, *11* (4), 6-9.

George, F.H. (1970). Some new trends on the software front. *Data Processing* (London), *12* (6), 464-465.

Ginsberg, M.J. & Baroudi, J.J. (1988). MIS careers - A theoretical perspective. *Communications of the ACM*, *31* (5), 586-594.

Glaser, B.G. & Strauss, A.L. (1967). *The discovery of grounded theory: strategies for qualitative research.* Chicago, IL: Aldine.

Gorsuch, R. (1983). *Factor Analysis.* London: Lawrence Erlbaum Associates.

Gory, G.A. & Scott Morton, M.S. (1971). A framework for management information systems. *Sloan Management Review, 13* (1), 51-70.

Green, G.I. (1989). Perceived importance of systems analysts' job skills, roles, and non-salary incentives. *MIS Quarterly*, *13* (2), 115-133.

Grodman, L. (1977). Making of an EDP professional. *Data Management*, *15* (1), 26-30.

Hackman, J. & Oldham G. (1975). Development of the job diagnostic survey. *Journal of Applied Psychology*, *60*, 159-170.

Hammer, M. (1990). Reengineering work: don't automate, obliterate. *Harvard Business Review* (July-August), 104-112.

Hammer, M. & Champy, J. (1993). *Reengineering the corporation: A manifesto for business revolution.* London: Nicholas Brealey.

Harrington, H.J. (1991). *Business process improvement: The breakthrough strategy for total quality, productivity, and competitiveness.* New York: McGraw-Hill.

Harris, R.J. (1975). *A primer of multivariate statistics.* New York: Academic Press.

Hartog, C. (1985). Of commerce and academe. *Datamation, 31* (17), 68 ff.

Hooley, G.J. and Franko, G.D. (1990). *The making of New Zealand managers: management education, training and development for the 21st century.* Dunedin: University of Otago.

Hudson, H. R. (Committee Chair) (1992). *Report of the discipline review of computing studies and information sciences education.* Canberra: Australian Government Publishing Service.

IBM Corporation. (1978). *Business systems planning: information systems planning guide, GE20-0527-2* White Plains, N.Y.: IBM Corporation.

Idema, T.H. (1978). Systems career path development. *Journal of Systems Management*, *29* (4), 30-35.

Igbaria, M. & Guimaraes, T. (1993). Antecedents and consequences of job satisfaction among information center employees. *Journal of Management Information Systems*, *9* (4), 145-174.

Ivancevich, J.M., Napier, H.A. & Wetherbe, J.C. (1985). An empirical study of occupational stress, attitudes and health among information systems personnel. *Information & Management, 9*, 77-85.

Jackson, I.F. (1983). *Computers in New Zealand.* Vocational Training Council & University of Otago.

Jackson, I.F. (1987). *DP management study*. Wellington, NZ: Information Technology Training Council.

Jones, Mary C. & Arnett K.P. (1993). Current practices in management information systems. *Information & Management*, *24,* 61-69.

Kaid, L.L. & Wadsworth, A.J. Content Analysis. in Emmert, P., & Barker, L.L. (1989). *Measurement of communication behavior*. New York: Longman, pp. 197-217.

Kaiser, K.M. (1983). DP career paths. *Datamation*, *29* (12), 178ff.

Kaiser, K.M. (1985). The relationship of cognitive style to the derivation of information requirements. *Computer Personnel, 10* (2), 2-12.

Keen, P.G.W. (1988a). *Competing in time: using telecommunications for competitive advantage.* USA: Ballinger.

Keen, P.G.W. (1988b). Rebuilding the human resources of information systems. Ch. 15 in: *Information Management: The Strategic Dimension*, Earl, M.J. (ed.) Oxford: Oxford University Press.

Keen, P.G.W. (1991). *Shaping the future: Business design through information technology.* Boston: Harvard Business School Press.

Knuth, D.E. (1968). *The art of computer programming.* Reading, Mass., Addison-Wesley.

Knuth, D.E. (1992). Computer programming as an art 1974. *«Literate programming».* USA: Center for the Study of Language and Information, 1-16.

Kraft, P. (1977). *Programmers and managers: the routinization of computer programmers in the USA.* New York: Springer-Verlag.

Krippendorff, K. (1980). *Content analysis: An introduction to its methodology.* Beverly Hills, CA: Sage.

Kuhn, T.S. (1970). *The structure of scientific revolutions.* Chicago: University of Chicago.

LaBelle, C.D, Shaw, K & Hellenack, L.J. (1980). Solving the turnover problem. *Datamation, 26* (2), 144ff.

Leitheiser, R.L. (1992). MIS skills for the 1990s: A survey of MIS managers' perceptions. *Journal of Management Information Systems, 9* (1), 69-91.

Licker, P.S. (1983). Skills, attitudes, and credentials for business data processing. *Computer Personnel, 9* (3), 2-5.

Licker, P.S. (1985). Importing theory "z" to the software shop: cultural technology transfer. *Computer Personnel, 10* (1), 8-14.

Martin, J. (1985). Computer science education today: A dialogue; and DP and academia: The communication gap. *Communications of the ACM, 28* (3), 251-262.

Martin, J.J. (1977). Panel: Certification and licensing. *Data Management, 15* (1), 31-35.

Marton, A. (1986). The scamble for computer talent. *Institutional Investor, 18* (4), 211-216.

Mawhinney, C.H. & Lederer, A.L. (1988). Validation of a Jungian instrument for MIS research. *Computer Personnel, 11* (3), 2-9.

Mayer, D.B. & Stalnaker, A.W. (1968). Selection and evaluation of computer personnel - history of SIGCPR. *Proceedings of the 6th Annual Conference Computer Personnel Research Group, 6*, 657-670.

McFarlan, F.W. (1984). Information technology changes the way you compete. *Harvard Business Review* (May-June).

Metzger, P.W. (1987). *Managing programming people: A personal view.* Englewood Cliffs NJ: Prentice-Hall,

Nash, S.H. & Redwine, S.T. (1988). People and organizations in software production: a review of the literature. *Computer Personnel, 11* (3), 10-23.

Nelson, R.R. (1991). Educational needs as perceived by IS and end-user personnel: A survey of knowledge and skill requirements. *MIS Quarterly, 15* (4), 503-521.

Nolan, R.L. (1973a). Managing the computer resource: A stage hypothesis. *Communications of the ACM, 16* (7), 379.

Nolan, R.L. (1973b). Plight of the EDP manager. *Harvard Business Review, 51* (3), 143-152.

Nolan, R.L. (1979). Managing the crisis in data processing. *Harvard Business Review, 57* (2), 115-126.

Nunamaker, J.F., Couger, J.D. & Davis, J.B. (Eds.) (1982). Information systems curriculum recommendations for the 80s: Undergraduate and graduate programs. *Communications of the ACM, 25* (11), 781-805.

Perry, W.E. (1991) *Quality Assurance of Information Systems: Methods, Tools, and Techniques.* QED.

Peters, F. (1971). SEP a case for self-employed programmers. *Data Processing* (London), *13* (6), 430-433.

Porter, M.E. (1980). *Competitive strategy.* New York: The Free Press.

Price Waterhouse (1993). *Technology forecast version 4.0.* Menlo Park, Cal.:Price Waterhouse World Firm Technology Centre.

Primozic, K.I., Primozic, E.A. & Leben, J. (1991). *Strategic choices: Supremacy, survival, or sayonara.* New York: McGraw-Hill.

Robson, W. (1994). *Strategic Management and Information Systems: an integrated approach.* London: Pitman.

Robinson, F. (1968). The role of the systems analyst. *Data Processing, 10* (5), 228-233.

Rockart, J.F. & Treacy, M.E. (1982). The CEO goes on-line. *Harvard Business Review, 60* (1), 84-88.

Rouse, R. & Hartog, C. (1988a). The new MIS professional - Part 1. *Journal of Systems Management, 39* (5), 6-10.

Rouse, R. & Hartog, C. (1988b). The new MIS professional - Part 2. *Journal of Systems Management*, *39* (6), 19-21.

Schneiderman, B. (1980). *Software psychology: human factors in computer and information systems.* Cambridge, MA: Winthrop.

Scott Morton, M.S. (ed.) (1991). *Corporation of the 1990s: Information technology and organizational transformation.* New York: Oxford University Press.

Setaro, F.J. (1990). Where should the information systems function go in the 1990s? *Developing the world class information systems organization.* Wellesley Massachusetts: QED Information Sciences. *3*, 1-13.

Simpson, C.L. and Bettinger, C.O. (1982). Are computer science degrees necessary in business DP? *Journal of Systems Management*, *33* (4), 29-33.

Snow, C.P. (1959). *The two cultures and scientific revolution.* Cambridge University Press.

Smith, D.C. (1989). The personality of the systems analyst: An investigation. *Computer Personnel*, *12* (2), 12-14.

Sprague, R.H. (1980). A framework for the development of decision support systems. *MIS Quarterly*, *4* (4), 1-26.

Sprague, R.H. & McNurlin, B.C. (1993). *Information systems management in practice.* Englewoods Cliffs, N.J.: Prentice-Hall.

Straub, D.W. (1989). Validating instruments in MIS research. *MIS Quarterly*, *13* (2), 147-170.

Stewart, R. (1971). Do you know what you want? Computer specialists need to be taught how to understand management problems and the reasons for management attitudes. *Data Processing* (London), *13* (3), 174-176.

Strassmann, P.A. (1990). *The business value of computers.* New Canaan, Conn.: The Information Economics Press.

Stymest, R.C. (1966). In *Data processing in management.* Toronto: The Canadian Institute of Chartered Accountants, 5-9.

Sullivan, C.H. (1985). Systems planning in the information age. *Sloan Management Review*, *26* (2), 3-12.

Szanja, B. and Scamell, R.W. (1993). The effects of information system user expectations on their performance and perceptions. *MIS Quarterly*, *17* (4), 493-516.

Tapscott, D. & Caston, A. (1993). *Paradigm shift: the new promise of information technology*. New York: McGraw-Hill.

Todd, P.A., McKeen, J.D. & Gallupe, R.B. (1992). The evolution of IS positions: A content analysis of IS job advertisements from 1970 to 1990. University of Auckland Working Paper #50.

Todd, P.A., McKeen, J.D. & Gallupe, R.B. (1995). The evolution of IS positions: A content analysis of IS job advertisements from 1970 to 1990. *MIS Quarterly*, 19 (1), 1-27.

Toledo, R.A. & Unger, E.A. (1985). Another look at motivating data processing professionals. *Computer Personnel*, *10* (1), 1-7.

Trauth, E.M., Farwell, D.W. & Lee, D. (1993). The IS expectation gap: Industry expectations versus academic preparation. *MIS Quarterly*, *17* (3), 293-307.

Turner, I.G. (1968). EDP courses at Auckland Technical Institute. *Data Processing in NZ*, *1* (5), 19-20.

Turner, J. A. & Baroudi, J.J. (1986). The management of information systems occupations: A research agenda. *Computer Personnel*, *10* (4), 2-11.

Vitalari, N.P. (1985). Knowledge as a basis for expertise in systems analysis: an empirical study. *MIS Quarterly*, *9* (3), 221-241.

Wallis, A. (1993, August 23). Consultants caught in tax trap. *New Zealand InfoTech Weekly*, (110), 1.

Walton, R.E. (1989). *Up and running: integrating information technology and the organization*. Boston: Harvard Business School.

Ward, J., Griffiths, P. & Whitmore, P. (1990). *Strategic planning for information systems*. Chichester: Wiley.

Watson, H.J., Young, D., Miranda, S., Robichaux, B., & Seerley R. (1990). Requisite skills for new MIS hires. *Data Base*, (Spring), 20-26.

Watson, H.J., Rainer, R.K. & Koh, C.E. (1991) Executive information systems: A framework for development and a survey of current practices. *MIS Quarterly*, *15* (2), 13-30.

Weber, R.P. (1985). *Basic Content Analysis*. Beverly Hills, CA: Sage.

Weinberg, G.M. (1971). *The psychology of computer programming.* New York: Van Nostrand Reinhold.

Whittet, L.T.M. (1976). Data processing courses - A survey of industry requirements. *Proceedings of the Australian Colleges of Advanced Education Computing Conference, 1976.*

Williams, W.R. (ed.) (1985). *Looking back to tomorrow: A survey of the impact of the first twenty-five years of the use of electronic computers in New Zealand together with some thoughts for the future.* Wellington: New Zealand Computer Society.

Wiseman, C. (1985). *Strategy and computers: Information systems as competitive weapons.* Homewood, IL: Dow Jones-Irwin.

Young, R.T. (1982). New training, work analysis methods needed to manage office of the future. *Industrial Engineering, 14* (7), 66-68.

Yourdon, E. & Constantine, L.O. (1975). *Structured design.* Yourdon Inc.

Zawacki, R.A., Scott, D.K. & Zawacki, P.A. (1988). How college students choose IS careers. *Datamation, 34* (18), 40-46.

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power.* New York: Basic Books.

Appendix I: The Questionnaire

A STUDY TO DETERMINE JOB & SKILLS CHARACTERISTICS OF INFORMATION SYSTEMS PROFESSIONALS (including managers & consultants) IN NEW ZEALAND

June 1993

INSTRUCTIONS

There are no right or wrong answers; we are simply interested in your opinion. Please answer each question as honestly and frankly as possible.

We apologise for the similarity of many questions. This is necessary to produce statistical validity of the questionnaire.

All responses to the questionnaire will be kept completely confidential. Only summary, aggregate information will be reported.

First impressions are often accurate - don't dwell too long on your answer. You will be asked to respond in one of three ways: circle a number on a scale, write your answer in the brackets or write your comments on the line provided. Below is an example of each.

These are Sample Questions ONLY:

A. To what extent does your job require you to work with mechanical equipment?

1 ________ 2 ________ 3 ________ 4 ________ 5 ________ 6 ________ 7

Very little: the job requires almost no contact with mechanical equipment of any kind	Moderately	Very much; the job requires almost constant work with mechanical equipment.

Please **circle** the number which is the most accurate description of your job. If, for example, your job requires you to work with mechanical equipment a good deal of the time - but also requires some paperwork - you might indicate the number six, as was done in the example above.

B. How many years of Management experience have you had? [ ]

Please provide your answer in the brackets

C. Your sex?

Male 1
Female 2

Please circle the appropriate option.

D. Any items that you feel we have omitted - please list here......

____

Please write your comments on the lines provided.

Thank you for your help!

A. Background Data

In this section we are interested in recording information as to your background, job position and the tasks in your job.

1. How many years of Management experience have you had? [ ]

2. Your sex?

Male	1
Female	2

3. What is your highest level of education? 4. Your age? [ ]

School Certificate	2
Seventh Form secondary school	3
university undergraduate diploma	4
bachelor's degree	5
master's degree	6
PhD	7

5. How many years have you worked in the computer field (to the nearest year)? [ ]

6. How many dependents do you have? [ ]

7. What is Your Current Job Code?

CIRCLE ONE (Choose one where at least 75% of your time is spent)

Director/Executive	01	Programmer	10
Middle Management	02	Systems Programmer	11
First Line Supervisor and Project Manager	03	Data Base Designer	12
Consultant	04	Data Communications Specialist	13
Clerical	05	Data Communications Operator	14
Secretary	06	Computer Operator	15
DP Trainer	07	Data Control (Output Distributor)	16
Systems Analyst	08	Operations Scheduler	17
Programmer/Analyst or Analyst/Programmer	09	Data Entry	18

8. How many years have you worked in the Job Code indicated above? [ ]
(**Note** here that you may have changed employment *without necessarily changing the job code*).

9. What are the major tasks in your current job?
*If you were to identify the major tasks in your current job code, please list below in **descending order of importance** up to four(4) tasks that you consider best describe what you do (use keywords or phrases):*

Task 1. ____________________

Task 2. ____________________

Task 3. ____________________

Task 4. ____________________

B. Part I Your Job Skills

In this section you are being asked to make *two responses.*

First, we want you to think back over the time you have been in your job code (even though you may have changed employment) and indicate on the scales below how important each skill item was **when you first started**.

Secondly, we would like you to go through the same process, but this time indicate on the scales below how important the skill items are in your job **at the present time**.

1____2____3____4____5____6____7

Not important — Quite important — Extremely important

	When you first started	At the present time
1. Information gathering techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
2. Systems Analysis & Design techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
3. Verbal & presentation skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
4. Project management skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
5. People skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
6. Health & safety	1__2__3__4__5__6__7	1__2__3__4__5__6__7
7. Written communication skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
8. 3rd generation programming	1__2__3__4__5__6__7	1__2__3__4__5__6__7
9. 4th generation programming	1__2__3__4__5__6__7	1__2__3__4__5__6__7
10. DBMS & database design	1__2__3__4__5__6__7	1__2__3__4__5__6__7
11. Operating Systems	1__2__3__4__5__6__7	1__2__3__4__5__6__7
12. Mainframe systems	1__2__3__4__5__6__7	1__2__3__4__5__6__7
13. Mini-computer systems	1__2__3__4__5__6__7	1__2__3__4__5__6__7
14. Telecomms & networking concepts	1__2__3__4__5__6__7	1__2__3__4__5__6__7
15. Computer security & disaster recovery	1__2__3__4__5__6__7	1__2__3__4__5__6__7
16. Use & evaluation of software packages	1__2__3__4__5__6__7	1__2__3__4__5__6__7
17. Computer Operations, JCL, data capture	1__2__3__4__5__6__7	1__2__3__4__5__6__7
18. Understanding legal issues	1__2__3__4__5__6__7	1__2__3__4__5__6__7
19. Prototyping techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
20. Statistical & simulation techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
21. Decision support systems	1__2__3__4__5__6__7	1__2__3__4__5__6__7
22. Strategic Info. Systems Planning	1__2__3__4__5__6__7	1__2__3__4__5__6__7
23. CASE techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
24. Knowledge of the business area (eg accounting, manufacturing)	1__2__3__4__5__6__7	1__2__3__4__5__6__7
25. Personal computer systems	1__2__3__4__5__6__7	1__2__3__4__5__6__7
26. Computer controls & auditing	1__2__3__4__5__6__7	1__2__3__4__5__6__7
27. Marketing skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7

28. Quality management concepts	1__2__3__4__5__6__7	1__2__3__4__5__6__7
29. Project evaluation & justification	1__2__3__4__5__6__7	1__2__3__4__5__6__7
30. Negotiating skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
31. Use & evaluation of hardware	1__2__3__4__5__6__7	1__2__3__4__5__6__7
32. Documentation writing skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
33. User training & support	1__2__3__4__5__6__7	1__2__3__4__5__6__7
34. General management skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
35. Keeping abreast with new technology	1__2__3__4__5__6__7	1__2__3__4__5__6__7

Any items that you feel we have omitted - please list here......

36.	1__2__3__4__5__6__7	1__2__3__4__5__6__7
37.	1__2__3__4__5__6__7	1__2__3__4__5__6__7
38.	1__2__3__4__5__6__7	1__2__3__4__5__6__7

STOP!

If you are not a manager nor a consultant please finish.
Otherwise, please continue below.

B. Part II Job Skills from the point of view of Managers or Consultants

Answer this Part if you are a Manager or Consultant who has reporting to you at least two personnel with one of the following job titles:

Systems Analyst	*Programmer/Analyst*
Programmer	*Analyst/Programmer*

> This section is like Part I above. It asks you to make two responses.
>
> First, we would like you to think back to the time when you first became a manager. Consider the job skills of **information systems staff** for whom you were responsible. Please indicate the importance of each skill as **required by you then.**
>
> Secondly, we would like you to indicate the importance of these skill items as required by you from those working for you **now**.

1____2____3____4____5____6____7

Not important — Quite important — Extremely important

	As required by you then	**As required by you now**
1. Information gathering techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
2. Systems Analysis & Design techniques	1__2__3__4__5__6__7	1__2__3__4__5__6__7
3. Verbal & presentation skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7
4. Project management skills	1__2__3__4__5__6__7	1__2__3__4__5__6__7

	As required by you then	As required by you now
5. People skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
6. Health & safety	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
7. Written communication skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
8. 3rd generation programming	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
9. 4th generation programming	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
10. DBMS & database design	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
11. Operating Systems	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
12. Mainframe systems	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
13. Mini-computer systems	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
14. Telecomms & networking concepts	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
15. Computer security & disaster recovery	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
16. Use & evaluation of software packages	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
17. Computer Operations, JCL, data capture	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
18. Understanding legal issues	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
19. Prototyping techniques	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
20. Statistical & simulation techniques	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
21. Decision support systems	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
22. Strategic Info. Systems Planning	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
23. CASE techniques	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
24. Knowledge of the business area (eg accounting, manufacturing)	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
25. Personal computer systems	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
26. Computer controls & auditing	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
27. Marketing skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
28. Quality management concepts	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
29. Project evaluation & justification	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
30. Negotiating skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
31. Use & evaluation of hardware	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
32. Documentation writing skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
33. User training & support	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
34. General management skills	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
35. Keeping abreast with new technology	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7

Any items that you feel we have omitted - please list here......

36.	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
37.	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7
38.	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7	1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7

The End. Thank you.

Please mail using the Return Paid envelope.