TOWARDS IDENTIFYING THE SKILLS REQUIRED FOR THE CHANGING ROLE OF THE SYSTEMS ANALYST

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ABSTRACT

Information Systems (I.S.) departments are continually challenged to identify methods of exploiting advances in computer-related technology. The rapid evolution and spread of computing power and the propagation of new methods of application systems development, have created a job turbulence in the I.S. industry. Efforts to resolve this turbulence have resulted in significant investments in both hardware and software, in the creation of new organizational structures and the emergence of new job responsibilities within I.S. departments. Traditional skills and job titles show signs of becoming obsolete.

To identify the skills required by the systems analyst of the future, two conceptual models were constructed. The first model was built from empirical data accumulated from the answers to open-ended questions from 32 experts, and mailed questionnaire replies from 159 practising systems analysts. This model linked the expected application systems development methods with the systems analyst job responsibilities within these development methods, and the skills required to perform these responsibilities effectively. The second model, based on a literature survey, linked the associations which future systems analysts are expected to have with their environments, with the roles they will play within these associations, and the skills they will require to be effective in these roles.

The skills identified in these two models were combined into generic groups which suggested a new dispensation of job categories. The job title 'systems analyst' was found, at best, to identify a function (or role) rather than an individual and, more probably, to be

inappropriate for the future application systems developer.

Identifying these skills and job categories is seen as a necessary step in determining appropriate recruiting, educational, training and career-path planning for those who will be employed in the computer-based application systems development industry. The conclusions of this research have practical implications for both academics and practitioners.

DECLARATION

I declare that this thesis is my own, unaided work. It is being submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this, or any other university.

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6TH DAY OF SEPTEMBER 1990

PREFACE

If the I.S. industry is to make the best use of its human resources, it must have a clear picture of the skills needed for future application systems development. This is particularly so in South Africa, where the shortage of appropriate skills is exacerbated by the 'brain-drain'. The purpose of the present study was to attempt to identify the skills profile of the systems analyst of the future and, therefore, help directly with what can become a serious problem.

While it is recognized that the turbulence in the application software development industry is affecting other job categories (e.g. the programmer and the I.S. manager), this study concentrated specifically on the systems analyst. There were two reasons for this. Although the systems analyst is regarded as central to the future success of application development, there is evidence that the definition of the term is inadequate and unclear. It was decided, therefore, to concentrate specifically on the changing role of the systems analyst, and to set the following specific research objectives:

- to provide a clear definition of the systems analyst;
- to identify the skills profile of the systems analyst of the future;
- to compare and contrast the opinions concerning future systems analysts' skills identified through empirical research and a literature survey.

The exposure which the researcher has had to building systems in the I.S. industry, to the designing of business information systems curricula and lecturing in the academic environment, proved to be valuable background experience for the study.

The initial ideas for the research were identified when preparing the keynote address (entitled 'The Future of the Software Development Department') for the South African Computer Users of Burroughs Equipment (SACUBE) Conference in May 1984. As a direct result of the research, two papers have been published. The material used in the introduction of the thesis was published in ACM Special Interest Group Computer Personnel Research (SIGCPR) Quarterly Publication in December 1986 in a paper entitled 'Reasons for Turbulence in Systems Analysts' Job Responsibilities' (Crossman, 1986). The results of the empirical research were presented at an IFIP/Computer Society of South Africa International Conference on Information Systems in April 1987. The paper appeared in the conference proceedings which was published by North-Holland in 1988 (Crossman, 1988). In addition, a comparison of the opinions of the academic and practitioner experts was presented at the South African Computer Lecturers Association (SACLA) Conference in June 1987 in a paper entitled 'A Comparison of Academic and Practitioner Perceptions of the Changing Role of the Systems Analyst: An Empirical Study'. This paper was published in Quaestiones Informaticae in December 1987 (Crossman, 1987).

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CHAPTER ONE

INTRODUCTION

> 'At this time, it is clear that the data processing industry is in a state of transition that is unlike any other previously undergone .... The implication of much of the literature is that we are on the verge of a revolution in computing that will make much of the work currently done by computer professionals unnecessary .... All this has led to some uncertainty as to the type of skills that will be required of computer professionals .... ' (Cheney and Lyons, 1980, p.35)

Chapter One introduces the research in the context of this prediction of transition and change within the information systems (I.S.) industry. In order to ground the objectives of the research, the study initially establishes two things:

- a meaning is given of the term 'turbulence' (the word used in the thesis to describe this transition and change);
- a link is established between turbulence as it affects organizations in general and the turbulence identified in the I.S. industry.

The rest of the chapter is then divided into four sections :

- the research objectives as stated;
- the research approach is described;
- the value of the research is established;
- an outline of the structure and content of the thesis is given.

1.1 MEANING OF THE TERM 'TURBULENCE'

Rather than attempt to provide an unambiguous definition of the term 'turbulence', it is suggested that the meaning of the word be derived from two sources. Firstly, following a study on the effects of organizational decline and turbulence, the word 'fluctuation' is presented as a synonym for 'turbulence' (Cameron, Kim and Whetten, 1987, p. 223).

The second source is found later in the same article where the authors state that in a turbulent environment :

> '.... changes come from anywhere without notice, and produce consequences unanticipated by those initiating the changes and those experiencing their consequences ....' (Cameron et al., 1987, p.225).

These sources provide a lead which suggests that one of the ways of giving meaning to the term 'turbulence' is to identify the degree of movement in an organization which is in a fluctuating state. There is another quotation which supports this view:

> 'Business organizations are facing a change more extensive, more far-reaching in its implications, and more fundamental in its transforming quality than anything since the 'modern' industrial system took shape .... These changes come from several sources: the labor force, patterns of world trade, technology, and political sensibilities .... the changes are profound .... and they are occurring together .... organizations will need to learn to operate in a wholly new mode.' (Kanter, 1983, pp.37 and 38).

Turbulence exists, therefore when changes faced by an organization are nontrivial, rapid, discontinuous and difficult to predict. It is with these connotations that the word is used in this study.

1.2 TURBULENCE IN ORGANIZATIONS

Immodest claims about the influence of organizational turbulence were made in the previous section. In this section these ideas are expanded to include typical indicators of turbulence in organizations, the impact of this organizational turbulence, and some of the ways organizations can react to cope with the turbulence.

1.2.1 EVIDENCE OF TURBULENCE IN ORGANIZATIONS

It is claimed that there are a number of groups of indicators which can be identified when an organization is in a state of turbulence. One of these groups centres on the characteristics of management activity within the organization (e.g. management groping for solutions (Dalton et al., 1970, p.222); the defence of previous positions (Kotter et al., 1979, p.380); the defence of status and areas of control (Feldberg, 1975, p.135); no long-term planning (Cameron et al., 1987, p.227)). A second group of indicators is associated with organizational problems and include issues such as role overload, ambiguity and conflict of responsibilities (Mitchell and Larson, 1987, p.198); politics and power struggles (Kotter et al., 1979, p.380), and repeated restructuring (Feldberg, 1975, p.134). There is a third group of indicators suggested in the literature. This group directly concerns the company's employees. In a turbulent environment it can be expected that staff morale will be low (Dalton et al., 1970, p.217), there will be an atmosphere of misunderstanding and distrust, with widely differing assessments of the situation (Kotter et al., 1979, p.380), and people will feel insecure, afraid and unwilling to change (Feldberg, 1975, pp.134-136).

1.2.2 IMPACT OF TURBULENCE ON ORGANIZATIONS

Turbulence is a major challenge facing modern organizations (Cameron et al., 1987, p.225) and its impact is notable.

> 'When so great a wave of change crashes into society, traditional managment, values, cultures, organizational procedures and organizational forms become obsolete'. (Sankar, 1988, p.10).

Because a number of aspects of the organization that once fitted the situation and worked well, are no longer appropriate (Kotter et al., 1979 p.379), many organizations are being challenged to change in order to survive (Sprague and McNurlin, 1986, p.475).

The change and uncertainty forced on organizations by this turbulence causes stress among its employees. (Mitchell and Larson, 1987, p.196).

1.2.3 ORGANIZATIONAL REACTION TO TURBULENCE

It can be argued that all organisms and systems continually strive to maintain a state of equilibrium by attempting to counter forces which cause turbulence (Feldberg, 1975, p.137). Possibly this is why it is found that managers - rather than workers - are likely to react to the condition of organizational turbulence (Cameron et al., 1987, p.234). Typical management reaction to turbulence includes changing organizational structures (Sprague and McNurlin, 1986, p.475), and realigning power, status and resources within the organization (Liker et al., 1987, p.30). This is why it is often stated that those organizations which are not able to adapt, face a bleak future (e.g. the theme of Kanter, 1983).

1.3 TURBULENCE IN THE I.S. INDUSTRY

In spite of the recognized advances in the I.S. industry (Davis and Olson, 1984, p.4), it is possible to identify evidence of turbulence within this sector. In this section evidence is provided to support the contention that the I.S. environment is in a considerable state of flux (Benjamin, 1982, p.11). Direct parallels are drawn between turbulence in organizations in general, and the fluctuations within the I.S. discipline.

1.3.1 EVIDENCE OF TURBULENCE IN THE I.S. INDUSTRY

Not only is there the suggestion that turbulence in the I.S. industry can be expected (Straub and Wetherbe, 1989, p.1328), but there is evidence within the discipline of some issues typically associated with organizational turbulence.

ROLE CONFLICT

In a previous section (section 1.2.1) it was established that role conflict is found in situations of organizational turbulence. The following claims have been made concerning uncertainty and conflict in the roles in the I.S. industry which help to substantiate the claim that there is turbulence in the industry:

- the type of skills required in the industry are questioned (Cheney and Lyons, 1980, p.35; Dixon and John, 1989, p.248);
- the need for new skills not previously demanded is identified (Rockart and Short, 1989, p.15; Friedman and Cornford, 1989, p.5);
- it is claimed that new skills and new titles are needed within the industry (Lauer and Stettler, 1987, p.8);
- conflicting ideas about staff loyalty have been identified (Ginzberg and Baroudi, 1988, p.587);
- conflicting ideas for career planning within I.S. are suggested (Ginzberg and Baroudi, 1988, p.587);
- it is recognized that it is not easy to ascertain new skill requirements for the industry (Adler, 1986, p.9).

MULTIPLICITY OF SYSTEM BUILDING APPROACHES AND METHODOLOGIES

In a situation of organizational turbulence it is common to find a groping for solutions to the problems being faced. There is evidence that there is considerable groping to find the most appropriate method to build computer-based systems. Again this helps to support the suggestion that the industry is in a state of turmoil. For example :

- a rethink about traditional approaches to systems development is suggested (Aukerman et al., 1989, p.30);
- unclear opinions have been found about what tools and techniques to include in systems analyst education and training (Aukerman et al., 1989, p.30);
- a confusing array of approaches to systems development have been identified (Wood-Harper and Fitzgerald, 1982, p.12 (31 separate methodologies have been identified (Teichroew, 1987));
- an array of approaches are suggested just to determine system requirements (Shemer, 1987, p.607);
- it is claimed that multidisciplinary and multidimensional approaches to systems development are needed (Verrijn-Stuart, 1987, p.103);
- the situation is such that which building method to use is a significant issue facing I.S. managers (Canning, 1984b, p.3).

MANAGEMENT UNCERTAINTY

Management uncertainty (a further suggestion of a turbulent situation) is also identified in the following areas:

- I.S. chief executives are found to be managing more than a single I.S. function (Dixon and John, 1989, p.251);
- a rethink of current managerial approaches is suggested (Adler, 1986, p.20);
- no clear answer was found on who should be the senior I.S. executive (Dixon and John, 1989, p.253).

NEW PARADIGM

Because of the changes being faced by the I.S. industry, it is suggested that those training as system developers redress an over-emphasis on technical issues by having part of their studies based on toally new disciplines. It is suggested that there is a mapping between the behavioural sciences' paradigm and the software engineering activity (Beynon-Davies, 1990, p.21).

DIFFERING ASSESSMENT OF THE SITUATION

The diverse points of view about the current situation in the application development industry can be illustrated by the following disagreements (all of which suggest a state of turmoil in the industry):

- there is no consensus on the definition of 'systems analyst' (Shemer, 1987, p.509 - a fact confirmed by this study (see sections 1.5 and 2.1.1.4));
- it is claimed that the often conflicting literature within the discipline has produced very little insight which provides direction to practitioners (Rockart and Short, 1989, p.7);
- one study on the future of computer systems development suggested that in the future the industry could face one of a number of scenarios - none of which is expected to dominate in all installations (Friedman and Cornford, 1989, pp.330 - 333).

Unless the turbulence is understood and managed, the application of technology in the business environment could be weakened or may even be misplaced.

(NOTE: Understanding the reasons for this turbulence is regarded as one of the steps towards being able to manage within the turbulence. An attempt is made in section 2.1.2.3 to identify why the application development industry is in a state of turmoil.)

1.3.2 IMPACT OF THE TURBULENCE IN THE I.S. INDUSTRY

The nature of the change which lies at the root of the turbulence in the I.S. industry is such that opinions on its predicted continuing impact on I.S. departments also cover multiple points of view. Two groupings of opinions are identified in this section.

1.3.2.1 THE EXTENT OF THE IMPACT UNCERTAIN

Some writers (e.g. Benjamin, 1982, p.11; Cheney and Lyons, 1980, p.35) have predicted that the turbulence within the I.S. industry is likely to be a characteristic of its future. Should this be so, the reason for uncertainty regarding the full impact of the changing technology on I.S. departments (found, for example, in Ostle, 1985, p.534), can be understood.

1.3.2.2 IMPACT ON JOBS AND SKILLS

Other writers have more definite opinions. James Martin is one. He claimed that the changes influencing I.S. departments are such that excessive familiarity with COBOL and conventional program development methods will be a disadvantage in the future. He made the point that: 'A different way of thinking is needed.' (Martin, 1982, p.333.)

1.3.3 I.S. INDUSTRY'S REACTION TO TURBULENCE

In an effort to minimise the impact of the turbulence and maintain (or re-introduce) some form of equilibrium and stability in their work environment, I.S. departments are being forced to :

- restructure their work-force (Martin, 1982, p.16; Foster and Flynn, 1984, p.229);
- introduce new job categories (Barr and Kochen, 1986, p.28; Whiteside, 1985, p.72; Canning, 1985a, p.7);
- introduce a new range of job skills for systems developers (Bush and Schkade, 1986, p.24; Barr and Kochen, 1986, p.174; Canning, 1984b, p.4; Davis D L, 1983, p.16).

This research has been conducted against a back-drop of these changes.

1.4 TURBULENCE AND THIS RESEARCH

While the turmoil in the I.S. industry is likely to force changes in a wide range of job categories, this research concentrated on the impact of the turbulence on the job of the systems analyst. There are four reasons for this:

(i) The systems analyst is regarded by some as a key figure in the future of applications systems development (Gilchrist, Dagli and Shenkin, 1983; Thierauf, 1986, p.4; Jackson, 1986, p.248; Cushing and Romney, 1987, p.438);

(ii) Predictions suggest that the demand for systems analysts in this pivotal role will grow in the future, possibly even exponentially (Thierauf, 1986, p.4; NPI, 1983, p.213, Gilchrist et al., 1983, p.100; Ostle, 1985, p.533);

(iii) There is evidence of concern about the failure of systems analysis to be consistently effective:

> 'Despite the present widespread use of systems analysts .... and the forecasts that indicate even greater demands will exist in the future, a substantial concern is growing about systems analysts' abilities and their ultimate performance' (Vitalari and Dickson, 1983, p.948).

This concern is exacerbated by the suggestion that, in the future, there could be a total change in the systems analyst's job (Martin, 1982, p.332).

(iv) It is no longer clear what the term 'systems analyst' means. The actual activities of the systems analyst (see section 2.1.1.4) tend to vary to the extent that it is difficult to provide a precise definition of the term (Pope, 1979, p.21; Grindlay, 1981, p.15; Meissner, 1986, p.6). Two examples illustrate this:

(a) Capron defined a systems analyst as 'a person who understands computer technology and the systems life cycle and who develops new systems' (Capron, 1986, p.510).

(b) Gore and Stubbe defined the systems analyst as 'an individual who performs systems analysis during any, or all, of the life cycle phases of a business information system. A life-cycle manager'. (Gore and Stubbe, 1983, p.535).

In fact, the term has evolved beyond its original meaning (Chen, 1985, p.38), so a literal definition of systems analysis is probably inappropriate. The situation is confused further by the use of other job titles (e.g. systems designer, analyst, analyst-programmer) for some of the systems analyst's activities (Newman and Rosenberg, 1985, p.394). Perhaps Croisdale was right when he wrote, more than a decade ago, that the job title tends to be so loosely used that it has come to mean all things to all people (Croisdale, 1975, p.35).

As a result of all this, it is not clear who should be recruited as systems analysts, nor is there certainty concerning the appropriate background, education, training or experience to ensure people can become effective in this position. Unless these issues are resolved, however, the spectacular advances in technology may not be harnessed by the business sector. Those organizations which can predict these requirements, will be placed at a potentially competitive advantage.

1.5 OBJECTIVES OF THIS RESEARCH

This research was undertaken to provide practitioners and academics with some guidance in this turbulent computer-based application development environment. In general terms, this research was an attempt to identify the skills required for the changing role of the systems analyst. Comparisons were made between the opinions of groups who participated in the empirical research (and between the opinions representing the South African computer industry as a whole and the opinions documented in the literature). This was done to help identify where and why consensus was not possible on constructing a skills profile of the future systems analyst.

Specifically this research had the following objectives:

(i) To provide a clear definition of SYSTEMS ANALYST.

(ii) To identify the skills profile for the systems analyst of the FUTURE.

(iii) To compare and contrast opinions concerning the skills required by the systems analyst of the future held by groups of participants in the empirical survey.

(iv) To compare and contrast opinions concerning the skills required by the systems analyst of the future identified in the literature with those held by the participants in the empirical survey.

1.6 THE RESEARCH APPROACH

To meet the stated objectives of the research the following six steps were taken:

(i) A clear definition of SY3TEMS ANALYST was given (see section 2.1.1.4).

(ii) The factors which appear to be the roots of the turbulence in the application development environment were identified (see section 2.1.2.3).

(iii) Empirical data was collected using a mailed questionnaire to determine the opinions of the South African computer industry on what skills will be required by the systems analyst of the future. These data were used to build the first of the conceptual models used in the research. Because the questionnaire respondents were asked to identify the skills they regarded as important to the future systems analysts in the context of the systems analysts' future job responsibilities, this model was called the job responsibilities/skills model (see section 5.3.2).

(iv) The second conceptual model was built (by deduction) directly from the literature survey. Links were identified in the literature between the roles the systems analyst of the future was expected to fulfill and the skills required to perform effectively within these roles. This model was called the roles/skills model (see section 6.3).

(v) The skills required by the systems analyst of the future were identified by comparing and contrasting the skills identified in these two models. These skills were grouped into clusters based on the occupational categories literature (see section 7.3.2).

(vi) The skills clustering exercise suggested that the responsibilities of the systems analyst could be grouped into a number of new job categories. To ensure that these new job categories were independent of any present, or future systems development life cycle stages, they were identified using a widely used job diagnostic survey instrument (see section 7.5.2.1).

These six steps have been presented graphically in figure 1.2 (This figure has been repeated throughout the thesis to ensure that the description of each step of the research is assessed in context.) An expanded description of these steps is given in chapter 3 in the context of presenting the characteristics of the research.

1.7 VALUE OF THE RESEARCH

If the turbulence in the I.S. industry continues, and if there is a growing need for the systems analyst as the key figure in future application systems development, then identifying the skills profile for the future systems analyst has value in the following areas:

1.7.1 THE SELECTION OF PERSONNEL

The traditional career path to systems analysis is through programming (Capron, 1986 p.42; Thierauf, 1986, p.4). This in itself may have merit, but many companies in South Africa employ programmers on the basis of an aptitude test rating. If the job responsibilities and required skills of the systems analyst of the future are dissimilar from those traditionally expected, the selection process for systems developers may need to change. The industry cannot afford either to employ people who may not be productive systems analysts, or to exclude people who may become useful systems analysts (Dickson and Wetherbe, 1985, p.58).

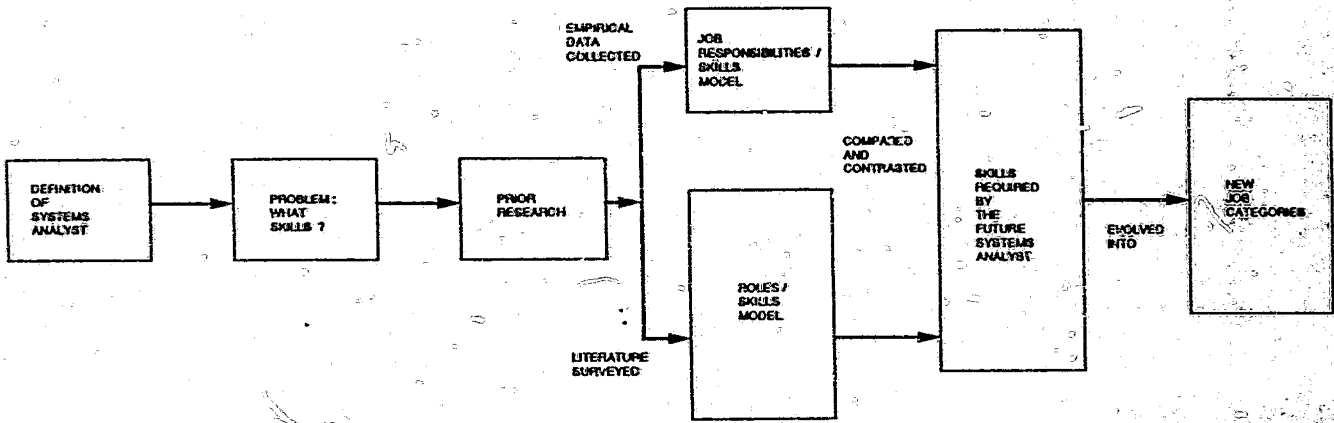

FIGURE 1.1

Research outline

1.7.2 THE DESIGN OF EDUCATION PROGRAMMES

One of the approaches to effective curriculum design is to make education goal orientated (Gagne and Briggs, 1979). Unless the skills required by the systems analyst of the future are identified (i.e. the goals are known), designing relevant tertiary education courses to build an appropriate body of knowledge for the future systems analyst will be difficult, if not impossible (see Harold, 1983, p.102; Byrkett and Uckan, 1985; Greenwood, Deveau and Greenwood, 1986, p.12). To wait in the hope that the turbulence will settle so that the goals of education will be known, will continue to perpetuate the 'five year gap' between education and practice identified by Kryt (1983, p.123).

1.7.3 IDENTIFYING APPROPRIATE EXPERIENCE

There is a lack of consensus on how much experience in the user environment is appropriate for a systems analyst (cf Mann, 1985 and Chen, 1985). It is possible that once the skills of the systems analyst of the future are identified, the I.S. industry will find it necessary to reassess the experiencce appropriate for systems analysts. If the required skills are significantly different from those currently developed for systems analysis, it may be necessary to introduce different career paths for personnel who will become systems analysts in the future (e.g. much more exposure to the user activity, no time at all in the programming discipline).

1.7.4 TOWARDS OVERCOMING SKILLS SHORTAGE

The shortage of skilled systems analysts is regarded as a wide-spread problem (Barr and Koehen, 1984, p.164; Marton, 1984, p.211; Grindlay, 1981, p.15; Thierauf, 1986, pp.3 and 4; Vitalari and Dickson, 1983, p.948). In South Africa a shortage of 24% p.a. was identified by the National Productivity Institute in their report on the manpower and training needs of the South African computer industry (NPI, 1983, p.213). Although actual numbers vary, the situation in South Africa is aggravated by the so-called 'brain-drain' of I.S. staff to other countries. One report stated:

> '.... the brain-drain (of South African computer personnel) is no myth, with at least 25% of computing professionals currently active in the DP industry wanting to leave the country.' (CSA, 1986, p.1.)

These views are supported by another report:

> 'The DP industry this year (1986) is unlikely (to) be any better than it was last year and it is expected that a higher number of skilled personnel would be leaving the country .... over the next nine months several hundred DP people would go .... this has led to there being a 20% shortage of skilled computer people in South Africa.' (Computing SA, 12 Jan 1986, p.2.)

Because the country's total population is small, this presents a serious problem. Any effort to try to overcome these shortages will demand exact knowledge of the skills required by the future systems analyst. There is no room for obsolete skills, or personnel who are incapable of adapting to new environments and developing new skills.

1.8 CONTRIBUTION TO KNOWLEDGE

The research made a contribution to knowledge in three broad areas:

- of meeting the specific objectives set for the research; (why meeting research objectives has been claimed as making a contribution to knowledge will be substantiated in section 1.8.1)
- as a direct result of identifying the skills required by the systems analyst of the future, of identifying a set of generic skills clusters, and possible new job titles which are independent of any systems development life cycle;
- of identifying two groups of hypotheses which were generated from the research.

1.8.1 MEETING OBJECTIVES (see sections 1.5 and 8.2.1.2)

Whether a research programme makes a contribution to knowledge as a direct result of meeting its objectives obviously will depend on the nature of the objectives set for the research. The objectives set for this research (see section1.5) were to identify specific groups of information which, prior to research, had not been published. In general terms, therefore, the meeting of these objectives could be regarded as a contribution to knowledge. Specifically how each objective was met is detailed below.

(i) A clear definition of 'systems analyst' was given, based on the literature (see section 2.1.1.4), and a definition was given of the role of the systems analyst of the future (see section 7.3.2).

(ii) The skills profile of the systems analyst of the future was identified by combining the skills identified in the job responsibilities\skills model with those of the roles\skills model (see section 7.3.1).

(iii) The opinions of the participants in the empirical survey were compared and contrasted in section 5.2. Disagreements were identified between academic and practitioner experts, the experts and the practising systems analysts and groups of practising systems analysts.

Knowledge of these disagreements are of value to each of the participant groups. It provides feedback to the academics to enable them tc evaluate their courses. Managers in the South African computer industry are given an indication of possible problem areas in the education, training and career planning of systems analysts. The system analysts themselves are given a basis from which to plan their own career development.

(iv) The comparison of the skills identified through the empirical research and the literature survey helps to identify any local peculiarities of the systems analysts' discipline. From the results of this research it seemed that the South African perception of the future systems analyst was that of a generalist (rather than the categories of specialization which can be identified in the literature (see sections 7.3.1 and 7.3.2)). In spite of the areas of disagreement, however, the comparison between the models built in chapter five and chapter six gave a clear indication of the changing role of the systems analyst (e.g. in the areas of investigative, management and systems acquisition activities), and the essential skills required for the role of the systems analyst (e.g. skills in business practices, human issues and acting as a change agent).

1.8.2 NEW GENERIC SKILLS CLUSTERS AND JOB TITLES

To avoid linking the skills required for the future systems analyst to any perceived systems development life cycle, they were grouped into clusters based on occupational categories, prior research and a factor analysis of the empirical data (see sections 7.2.1 and 7.2.2). This process identified ten skills clusters of

business acumen
change agent
computational
evaluation
human issues
investigative
performance
project management
savant
systems acquisition.

By using a job diagnostic survey instrument these ten skills clusters were combined into a new dispensation of job categories which make the currently used titles (e.g. programmer, designer, analyst-programmer, systems analyst) obsolete. Two broad job categories (that of the generalist systems developer, and various specialist categories) were identified (see section 7.5.2.1). The job categories which are expected to be found in the commercial application software development industry within these broad categories include

The generalist systems developer

Specialist categories

information architect specialist

database specialist

prototyper specialist

savant specialist

audit specialist.

1.8.3 HYPOTHESES GENERATED

The research was classified as a hypothesis generating field study. These hypotheses identify those areas where, as a result of this study, further research is required. The hypotheses fall into two groups (see sections 8.3 and 8.4).

(i) Hypotheses resulting directly from the research and being associated with issues such as:

- systems analysts and aptitude testing,
- systems analysts' social needs strength,
- systems analysts and small I.S. departments,
- the future of programmers,
- the appropriateness of the title 'systems analyst',

- the impact the suggested job categories will have on systems analysts' performance,
- the link between the fragmentation of the systems analysts' job and the maturing of the I.S. industry.

(ii) Hypotheses which may result from further research, which include topics such as:

- factors which characterize a good systems analyst,
- the link between the maturity of an I.S. department and the skills mix required from the systems developer,
- the impact of culture on the performance of the systems developer.

Providing these hypotheses are regarded as a contribution to knowledge because they identify areas where further order can be introduced into the turbulent application software development environment.

1.9 OUTLINE OF THESIS STRUCTURE

This thesis is divided into eight chapters and appendices. The summary of each chapter is as follows:

Chapter 1: This chapter was designed to provide a broad overview of the study. Evidence was provided of turbulence in the I.S. industry, the research objectives were established in the context of this turbulence and an overview was given of the research approach. The value of the research, and its contribution to knowledge was given.

Chapter 2: The second chapter is still introductory in nature. Background to the research is given through a general review of relevant literature. This review becomes more specific as key terms used in this study are defined. A description and analysis of prior research is used as a platform on which to set the research objectives.

Chapter 3: The characteristics of the study were identified. The main thrust of the chapter was to indicate why this particular approach to the research was taken, and how the research can be classified in terms of the social science paradigm. The research's boundaries, the assumptions made in the context of the research and the limitations of the research are identified. The chapter closes with a description of the use of statistics in this study.

Chapter 4: In this chapter the methods used to collect the empirical data are described. Details are given of the objective, construction and distribution of the questionnaire. The section describing the response to the questionnaire makes references to the appendices where details are provided of all the data collected. The effectiveness of the questionnaire as a measuring instrument is assessed and the limitations of the empirical research are identified.

Chapter 5: The methods used to analyze the empirical data are outlined in this chapter. The job responsibilities/skills model, built from the empirical data is described in detail.

Chapter 6: Each level of the roles/skills model, which is built from a detailed literature survey, is described. These levels have been identified by linking the associations which systems analysts of the future are expected to have with their environment to the roles they will need to play within these associations, and the skills which will be needed to perform effectively within these roles.

Chapter 7: In this chapter the research findings are presented and interpreted. The skills required by the systems analyst of the future are identified in terms of the a new set of generic skills clusters. This new clustering has been interpreted as suggesting a new dispensation of job categories in the I.S. application development industry. The new job categories are described in detail.

Chapter 8: Before areas of further research are identified, the research procedures and findings are summarized and evaluated in terms of the research objectives set in chapter 2.

CHAPTER TWO

RESEARCH FOUNDATIONS

The foundation of the research programme given in this chapter is grouped into two sections:

Section 2.1 - a literature review appropriate to this study;

Section 2.2 - a description and analysis of prior research attempting to identify future systems analysts' skills;

2.1 LITERATURE REVIEW

A large amount of literature was reviewed to enable the foundation of this research programme to be built. Sometimes progress was delayed to allow for a thorough study of a particular issue. To help clarify some of the arguments or to reinforce some of the themes of the research, details of the literature survey have not been confined to this section. At times it seemed more appropriate to place the literature review with the chapter which built on the foundation which the survey established. In essence, the literature has been used in three ways:

- to provide input to the definition of key terms;
- as a background to the research programme;
- to provide specific input to the building of the roles/skills model.

2.1.1. DEFINITION OF KEY TERMS

Three methods were used to ensure that it was unlikely any substantial body of literature relevant to the research was ignored:

- a computerized search for relevant material (published after 1970) was done on the ABI database;
- appropriate business, educational and computing indices for the same time-span, were searched manually;
- the references of related articles in the major computing journals were searched for material not found by the usual indexing methods.

In each case focus was placed specifically on empirical studies, but cognisance was taken of conceptual articles which were firmly based on I.S. literature.

It is noted that the amount of literature identified which concentrated on I.S. personnel issues was generally relatively small, and that which concentrated on future I.S. skill requirements, even smaller.

The four key terms used in this research which needed to be defined clearly were:

- the future
- skills
- model
- systems analyst.

2.1.1.1 THE FUTURE

Throughout the research, the FUTURE was defined as a period from five to eight years hence.

2.1.1.2 SKILL

In the literature there appeared to be an inconsistent usage of the words SKILL and COMPETENCY. The following points are, therefore, made:

(i) SKILL was often used in the context of a MOTOR SKILL (e.g. typing, riding a bicycle, playing tennis), or in a specific category of skills (e.g. mental, social or linguistic skills) (see Bruner, 1973, p.241; Anderson, 1980, p.224; Lovell, 1980, p.74; Knapper and Cropley, 1985, p.76). Obviously in this research, the term could not be confined to such a narrow meaning.

(ii) While a possible synonym for SKILL could be COMPETENCY, this term was sometimes given the connotation of an inherent capability. For example, the term has been defined as:

> '.... an area of knowledge and/or skill which an individual must possess in order to produce outputs for his/her role.' (American Society for Training and Development, Competency Questionnaire, 1982);
>
> '.... special characteristics of people who do the best job.' (Goleman, 1981);
>
> '.... a condition of being capable.' (Collins English Dictionary, 1979).

(iii) To avoid a misunderstanding of the objectives and boundaries of this research, the word COMPETENCY was specifically avoided.

(iv) Because a SKILL was perceived as an acquired and/or learned quality (rather than an intrinsic attribute (see Parisian, 1984 p.12)) the definition used in this research was an adaptation of that given by Allen, 1974. A SKILL, was defined as an ability to perform specialized work with recognized proficiency.

2.1.1.3 MODEL

The conclusions reached in this research were based on the building of two conceptual models (see chapters 5 and 6). The word MODEL is used widely in the literature, for example, in:

human resources management (Peterson and Tracy, 1979, p.107).

statistics (Minium, 1978, p.110).

economics (Johnson, 1984, p.1).

research (Bailey, 1987, p.317).

Because of the nature of these disciplines, there is the probability that the word MODEL in these contexts has the connotation of simulation. This connotation is inappropriate in this research. The approach taken here was an adaptation of the Leavitt model quoted in Davis and Olson (1985, p.354). The word MODEL, therefore, is used to describe a hierarchy of interrelationships between components which, in totality, represent a complex entity (e.g. a profile of the skills required by the systems analyst of the future (see figures 5.37 and 6.2)).

2.1.1.4 SYSTEMS ANALYST

It was noted earlier (see section 1.5) that definitions of SYSTEMS ANALYST tend to be inadequate and unclear. When a working definition of the term to use in this research was attempted, the following additional problems were identified:

(i) The variety and variability of definitions used preclude the possibility of finding a widely accepted definition (see table 2.1 for a list of systems analyst activities which were extracted from documented definitions).

(ii) Some of the activities identified in the literature as SYSTEMS ANALYSTS' responsibilities include functions which could be regarded as outside the scope of analyzing systems - for example:

- building, developing, implementing, maintaining systems (e.g. Cheney and Lyons, 1980, p.38, Capron, 1986, p.510, Pope, 1979, p.22).
- managing systems' development by setting objectives and establishing standards (e.g. Mosard, 1982, p.83, Cronan, 1985, p.23).
- fulfilling an administrative role (e.g. Cronan, 1985, p.23).

The use of the term SYSTEMS ANALYST in this research, therefore, is the systems developer whose activities are confined to:

- analyzing workflows, organizational policies and practices, existing reports and documents of the application under study; (see e.g. Gore and Stubbe 1983, p.535, Cronan, 1985, p.23, Meissner, 1986, p.7).
- documenting existing operations and procedures to evaluate them in order to determine their operational effectiveness (which, in turn, helps to determine if an alternative approach is necessary); (see e.g. Canning, 1981b, p.6, Byrkett and Uckan, 1985, p.45, Roe, 1984, p.38).

TABLE 2.1

List of systems analyst activities compiled from definitions in the literature.

ACTIVITY	EXAMPLE OF SOURCE
Administer storage	Cronan, 1985, p.23
Administer use of information	Cronan, 1985 p.23
Analyze	Gore and Stubbe, 1983, p.535
Analyze distribution/use of reports	Cronan, 1985, p.23
Analyze information needs	Pope, 1979, p.22
Analyze problems	Byrkett and Uckan, 1985, p.45
Analyze systems with problems	Cronan, 1985, p.23
Audit implemented systems	Pope, 1979, p.22
Build systems (to generate required information)	Cheney and Lyons, 1980, p.38
Determine what a system has to do	Roe, 1984, p.38
Determine cost-benefit of system	Pressman, 1982, p.36
Define what must be accomplished	Pressman, 1982, p.36
Define the problem	Mosard, 1982, p.83
Define input, output and files	Cheney and Lyons, 1980, p.38
Define users' needs	Cheney and Lyons, 1980, p.38
Define forms	Cronan, 1985, p.23
Design computer applications	Cushing and Romney, 1987, p.882
Define specifications	Lucas, 1982, p.299
Design new/modified systems	Cronan, 1985, p.23
Design systems	Clarke and Prins, 1986, p.32
Design computer-based systems	Newman and Rosenberg, 1985, p.394
Determine if accomplishment feasible	Pressman, 1982, p.36
Develop new systems	Capron, 1986, p.510
Develop company's information system	Cushing and Romney, 1987, p.882

(CONT)

TABLE 2.1 (CONT)

Develop logical description of system	Davis W S, 1983, p.5
Determine user requirement	Jackson, 1986, p.118
Develop new methods of performing work	Semprevivo, 1982, p.8
Develop alternatives	Mosard, 1982, p.83
Document activities	Cronan, 1985, p.23
Document systems	Pope, 1979, p.22
Establish standards	Cronan, 1985, p.23
Evaluate alternatives	Mosard, 1982, p.83
Evaluate approach	Chen, 1985, p.38
Evaluate systems capacity to meet users needs	Ostle, 1985, p.569
Identify suitable computer projects	Pope, 1979, p.22
Identify needed information	Meissner, 1986, p.7
Identify user needs	Canning, 1981b, p.6
Implement systems	Pope, 1979, p.22
Implement computer-based systems	Newman and Rosenberg, 1985, p.394
Manage life cycle	Gore and Stubbe, 1983, p.535
Maintain systems	Pope, 1979, p.22
Measure/simplify work	Cronan, 1985, p.23
Model alternative solutions	Mosard, 1982, p.83
Plan for implementation	Mosard, 1982, p.83
Secure needed information	Meissner, 1986, p.7
Select between alternatives	Mosard, 1982, p.83
Set objectives	Mosard, 1982, p.83
Specify needs	Pope, 1979, p.22
Specify programs	Cushing and Romney, 1987, p.882
Solve problems	Byrkett and Uckan, 1985, p.45
Supply needed information	Meissner, 1986, p.7
Translate user needs	Davis W S, 1983, p.5

- designing new (or modified) approaches which are technically, economically and operationally feasible; (see e.g. Pressman, 1982, p.36, Cushing and Romney, 1987, p.882, Semprevivo, 1982, p.8).
- preparing the necessary documentation (structure charts, decision tables, program specification, etc.), systems test data, implementation plans (development and conversion) and cost/saving estimates for the new or revised system; (see e.g. Mosard, 1982, p.83, Cronan, 1985, p.23, Lucas, 1982, p.299).
- monitoring the development and implementation process; (see e.g. Gore and Stubbe, 1983, p.535).
- conducting sessions to evaluate the effectiveness of the implemented system and reporting findings to management. (see e.g. Chen, 1985, p.38, Ostle, 1985, p.569).

2.1.2 THE LITERATURE REVIEWED AS A BACKGROUND TO THE RESEARCH PROGRAMME

The review of the literature for this study was focused on three major areas:

- theories documented in the literature which were used as a foundation to this study;
- the evolution of the discipline of systems analysis;
- the root causes of turbulence in the I.S. industry.

2.1.2.1 THEORETICAL BASIS FOR THE RESEARCH

Details of the theories used in this study have been included in the thesis in those places where they are used. In this section these theories are summarized (in the context of the overall research approach) to help establish the foundation on which the study was based.

The research approach (described in section 1.6 and presented diagrammatically in figure 1.1) is presented again in figure 2.1, together with an indication of the context in which the theories were used.

(i) PROBLEM IDENTIFICATION STAGE

The change in the skills required by the systems analyst of the future is the result of the interaction of a number of factors (described in detail in section 2.1.2.3 and presented graphically in figure 2.2). The literature base on which need for this changing skills pattern is built includes:

- the impact on the I.S. industry of the merging islands of technology (McKenney and McFarlan, 1983, p.70);
- the evolution of the relationship between the environment (the work environment in particular) and technology (Lawrence and Lorsch, 1967, p.237);
- the evolution of the systems analyst (Couger, 1973);
- changes in the perceived value and potential use of information (McFarlan, 1983);
- the elements which constitute a viable/adaptive system (Miller, 1978).

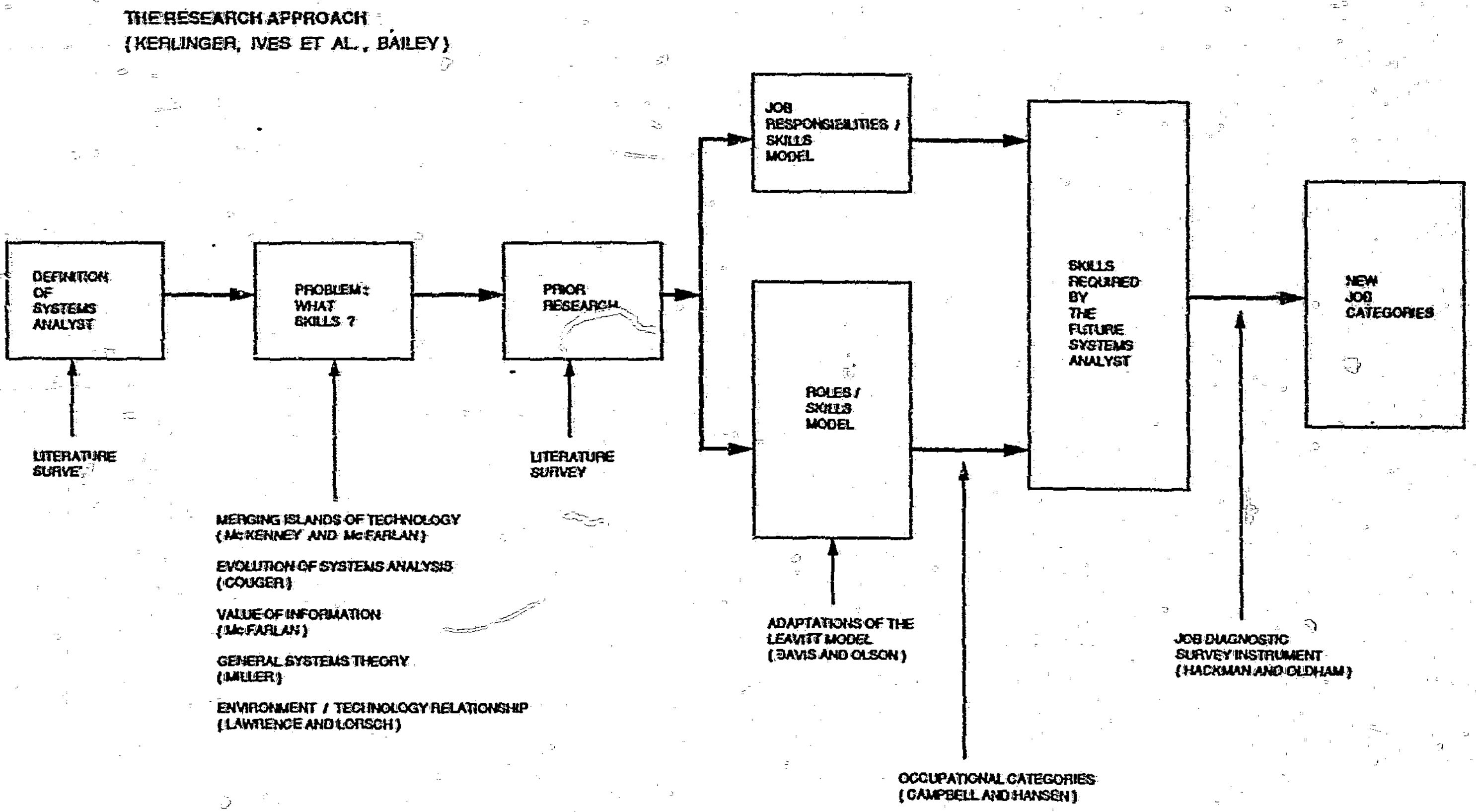

FIGURE 2.1

Theoretical basis of the research

(ii) THE RESEARCH APPROACH

Details of the research approach and the reasons for taking the approach are given in chapter 3. Here it is noted that:

- research procedures to be followed when the researcher has no control over the environment, is documented in Kerlinger 1974, p.379;
- conceptual studies in the I.S. environment in which there are no predicted relationships, but where research is undertaken in one variable group, are described by Ives et al., 1980, p.921;
- characteristics of research which is undertaken following the social science paradigm are given by Bailey, 1982.

(iii) BUILDING THE CONCEPTUAL MODELS

The basic concept used in the building of both the conceptual models in the research was an adaptaticn of the Leavitt model of organizational subsystems, quoted by Davis and Olson, 1984, p.355.

(iv) ESTABLISHING THE SKILLS PROFILE OF THE FUTURE SYSTEMS ANALYST

The categories used to combine the future systems analysts' skills were established from a method of classifying occupational categories used by Campbell and Hansen, 1981, p.29.

(v) NEW JOB CATEGORIES

The procedure followed to combine the skill requirements of the systems analyst of the future into work units (and subsequently new job categories), was based on the use of part of the job diagnostic survey instrument of Hackman and Oldham (Huse, 1980, p.314 and Couger, 1978, p.188).

2.1.2.2 THE EVOLUTION OF SYSTEMS ANALYSIS

As the discipline of systems analysis has evolved, not only has it undergone changes in emphasis and complexity, but attempts have been made to design appropriate syllabi to meet its changing educational needs and establish a knowledge base appropriate to its demands. As a background to identifying the skills required by the systems analyst of the future, in this section a description is given of:

- changes in emphasis in systems analysis;
- methods of curriculum design and development;
- steps taken towards developing an epistemology for systems analysts.

(i) IDENTIFIED CHANGES IN EMPHASIS IN SYSTEMS ANALYSIS

Contemporary systems analysis is defined and described in books such as Capron (1986), Gore and Stubbe (1983) and Ostle (1985). In his detailed description of the evolution of business systems analysis techniques, however, Couger (1973) traced the development of systems analysis from the early 1900's, when the activity was closely associated with industrial engineering and process flow analysis, through the pre-computer era of mechanical data processing to the current situation of a close association between systems analysis and computer-based systems. As this evolution new job categories), was based on the use of part of the job diagnostic survey instrument of Hackman and Oldham (Huse, 1980, p.314 and Couger, 1978, p.188).

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(ii) APPROPRIATE CURRICULUM DESIGN AND DEVELOPMENT

Although the process of curriculum design, as such, is outside the scope of this research, it is noted that one of the approaches to curriculum design is based on the formulation of appropriate objectives for the course (see Gagne and Briggs, 1974, pp.7 and 8; Mager, 1962, p.1). Provided these objectives are stated in measurable terms, they can be used to assess a participant's achievement. To facilitate defining measurable objectives, the design goals are sometimes classified in terms of a taxonomy (e.g. see Bloom, 1956, p.12). Such a taxonomy differentiates between those objectives which focus on recall or recognition of knowledge, and those associated with synthesis and the evolution of concepts. Without having a clear picture of the skills required by the future systems analyst, part of the establishment of appropriate syllabi for systems analysis education will not be possible (see section 8.2.3). An assessment of proposed college curricula (e.g. Nunamaker, 1982; DPMA, 1985), educational taxonomies and the needs of the computer industry, is given by Pollack (1981, pp.20-32).

(iii) EPISTEMOLOGY FOR SYSTEMS ANALYSIS

Another relevant issue, closely related to the concepts of curriculum design, is an apparent emphasis in the industry on the development of systems analysis techniques and methods. These techniques and methods typically gain acceptance then became obsolete, with rapid frequency (see Yourdon, 1986, pp.133 to 136). Vitalari suggested that the software development industry needs a well-formed knowledge base for systems analysts which does not suffer from the volatility of the techniques and methods, which tend to receive so much attention. He claimed:

> '..... the organization and content of the systems analyst's knowledge base plays a central role in the level of analyst expertise in the analysis domain.' (Vitalari, 1985, p.221).

Identifying the skills of the systems analyst of the future, therefore, will only make a partial contribution towards meeting the need which Vitalari identified. It is, however, a further step towards understanding the evolution of the discipline of systems analysis.

2.1.2.3 THE ROOT CAUSES OF TURBULENCE IN THE APPLICATION DEVELOPMENT INDUSTRY

It has already been established (see section 1.3) that the application development industry is in a state of turbulence. The reasons for this turbulence were presented graphically in figure 2.2. The review of the literature became more focused as links were established between the variables in figure 2.2. As part of the background to this study, these variables, and the links between them, are described in this section.

2.1.2.3.1 CHANGES IN TECHNOLOGY

The contention that man is pushing back the frontiers of knowledge is so widely held that it may almost be regarded as axiomatic. Some writers (e.g. Naisbitt, 1982; Drucker, 1981; Toffler, 1980) have suggested that human exploration into the unknown is particularly associated with scientific knowledge and technology.

One of the most dramatic growth areas within this sector is linked to computer technology. Rapid evolution is taking place in the interrelated areas of:

hardware,

software,

data,

communications (see Canning, 1984b, p.5).

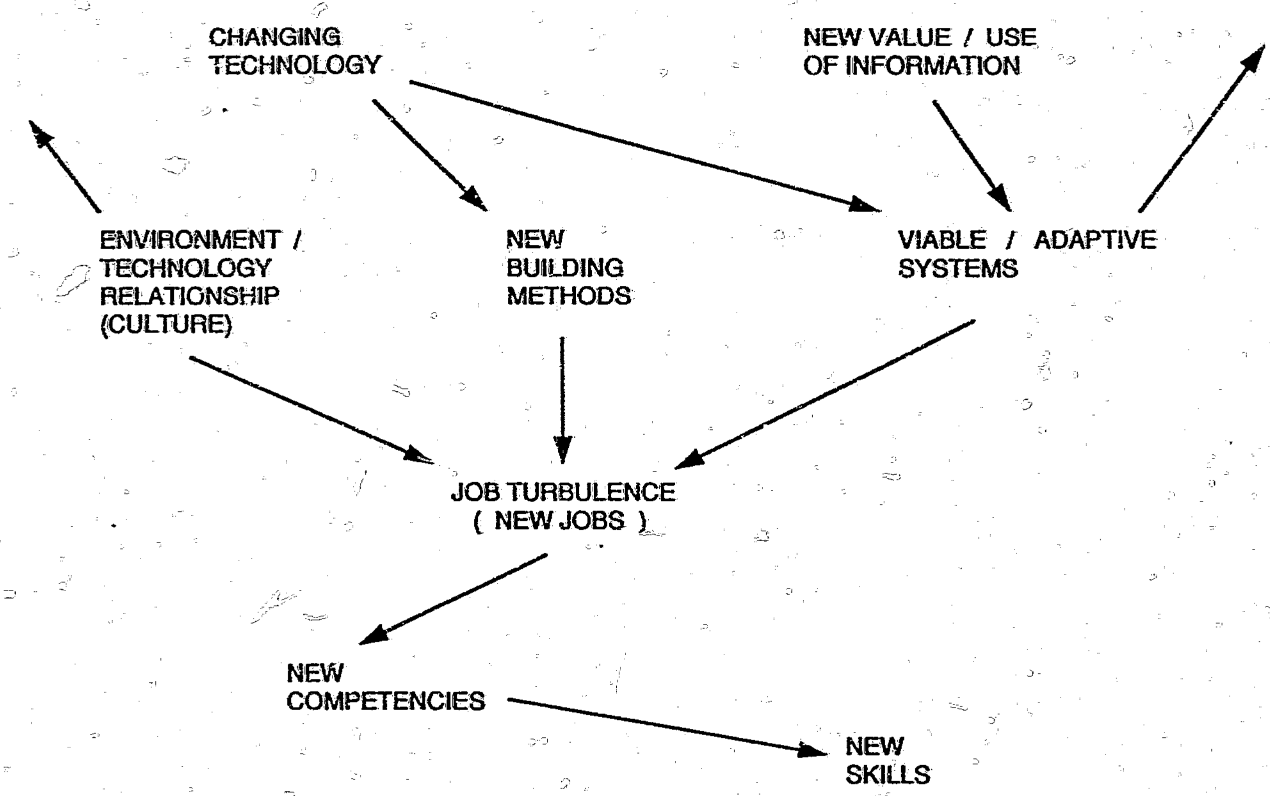

FIGURE 2.2
Reasons for turbulence in the application development industry

(i) HARDWARE

The dramatic increase in the price-performance ratio of computer processing is well known and often quoted (e.g. Gore and Stubbe, 1983, p.14; Martin, 1982, p.227; Ostle, 1985, p.244; Cash, McFarlan and McKenney, 1983, p.70, Page and Hooper, 1987, p.160). This growth is encountered throughout the range of processor sizes, with expansion beyond the current top of the range supercomputers and below the present bottom of the range microcomputers (see figure 2.4).

This evolution is not just taking place in processing power, but also in storage capacity and efficiency (Mitchell, 1987), networks and terminal/work-station development (Benjamin, 1982, p.20).

(ii) SOFTWARE

According to Hessinger (1984) the future will see the co-ordinating and combining of the current pockets of technology into an integrated software architecture (see figure 2.3). Building systems within these architectural constraints will require the exploitation of advances in multiple areas of software technology.

(iii) DATA

In an informal survey conducted by the EDP Analyzer in 1984, the management of data was found to be one of the I.S. managers' concerns (Canning, 1984b, p.9).

No longer is emphasis in this area confined to controlling data in a centralized environment, but rather on managing the access to data through tools like data dictionaries and distributed databases (see figure 2.3, and Navathe and Kerschberg, 1986, p.21).

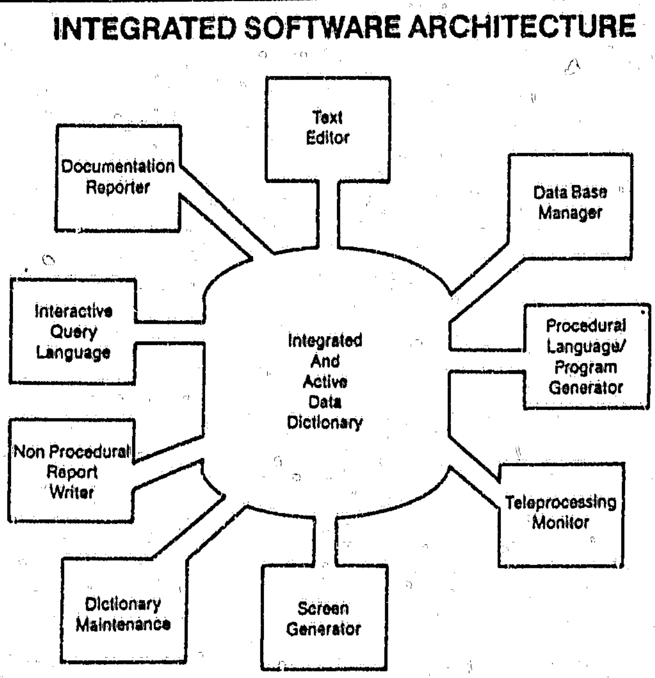

FIGURE 2.3
Integrated software architecture (Hessinger, 1984)

(iv) COMMUNICATIONS

The use of decentralized facilities is made possible through the advances in teleprocessing (one of the islands of technology which are seen to be merging (McKenney and McFarlan, 1982, p.111)).

The advances through a range of architectures provide the possibility of multiple solutions to networking requirements (Exley, 1984, p.12). This view was supported by Teichroew (1987) (see figure 2.4).

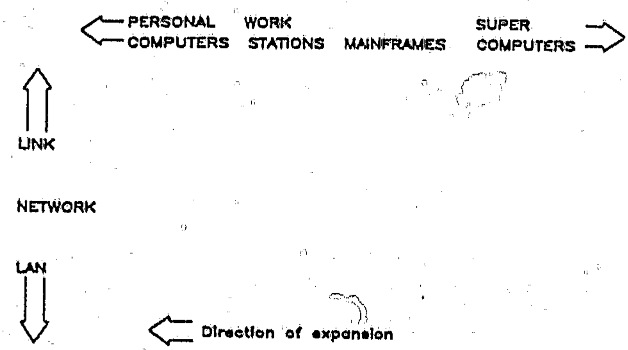

FIGURE 2.4
Computer environment spectrum (Teichroew, 1987)

These changes in technology contribute to the turbulence within the I.S. industry by themselves creating changes in:

- the environment/technology relationship (section 2.1.2.3.2);
- the use and perceived value of information (section 2.1.2.3.3);
- new methods of building computer-based systems (section 2.1.2.3.4).

2.1.2.3.2 CHANGES IN ENVIRONMENT/TECHNOLOGY RELATIONSHIP

Figure 2.5 is an imprecise, schematic diagram (taken from Lawrence and

Lorsch, 1967, p.237) which was used to illustrate the impact of technological change on the work environment. The authors claimed that one of the fundamental reasons for the increased diversity and turbulence of work is that man invents machines to produce most of his survival commodities in order to free himself to invent new forms of 'work'. They suggested that all forms of productivity can be broken down into four sectors:

- all human work,
- man-tool work (which requires man to guide and power simple tools),
- man-machine work (which requires man himself to guide and feed machines),
- all machine work.

With the passing of time there is an accelerated movement of work from the unknown through the sectors suggested above, to the point where machines can be programmed to do this work.

It is not claimed that figure 2.5 proves anything. It is presented as an illustration of the impact which advancing technology has on man's working environment. As new knowledge is gained and new technology is developed, so more work traditionally done by humans will be done by machines (e.g. telephone operating, building motorcars, flying aeroplanes, bank telling). The advances in technology enable this to occur at an ever-increasing rate.

This impact, in the context of computer technology, has been described as follows:

> 'The unparalleled advances in management information technology in the past half decade are bringing wholesale

changes in organizational form and function unanticipated even a few years ago.

'.... new unexpected relationships between .... individual and task are restructuring organizations into forms impossible prior to the advent of the technologies.' (Foster and Fynn, 1984, p.229.)

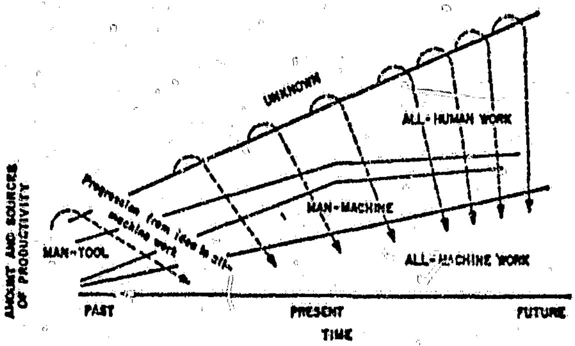

FIGURE 2.5

Sources of productivity (from Lawrence and Lorsch, 1967, p.237)

A similar view was expressed by Benjamin:

'The dramatic improvements in technology cost performance, coupled with rising salary inflation, have produced an Information Systems environment in major organizations that is in a considerable state of flux.' (Benjamin, 1982, p.11.)

2.1.2.3.3 CHANGES IN THE VALUE OF AND NEED FOR INFORMATION

The change in First World countries from an industrial society to an information society is part of a continuum (Naisbitt, 1982, p.1), rather than a sharp dichotomy. His view was supported by Cronin:

'Fewer and fewer people earn their daily bread with the sweat of their brow. Instead we have become a race of symbol manipulators .... (who spend a fortune on) creating, processing, retrieving, validating, evaluating, refining, packaging,marketing and disseminating information.' (Cronin, 1985, p.2.)

While this move away from the industrial society focuses sharply on the value of and need for information, this is a passive standpoint compared with the aggressive dimension introduced with the idea of using information as a competitive weapon (McFarlan, 1983; Stodel, 1985; Yourdon, 1986, p.138; Henderson and Treacy, 1986). Using information in this way introduces at least three circumstances which contribute to the job turbulence in the I.S. industry:

- new types of systems, with increased complexity and less structured formats, need to be built (Bahl and Hunt, 1984, p.121; Friedman and Cornford, 1989, p.339);
- the environment and resources for providing information become key issues, and stress is increased in the personnel through whom the information is produced (Ivancevich, Napier and Wetherbe, 1983, p.78).
- old methods of building systems, like following the traditional systems development life cycle, are becoming obsolete (Bahl and Hunt, 1984, p.121; Langle, Leitheiser and Naumann, 1984, p.274; Spock, 1985, p.111).

2.1.2.3.4 CHANGES IN COMPUTER-BASED SYSTEMS BUILDING METHODS

New systems building methods are widely demanded (e.g. Langle et al., 1984, p.274; Bahl and Hunt, 1984, p.121; Seagle and Berlardo, 1986, p.12; Dickson and Wetherbe, 1985, p.344; Spock, 1985, p.111). Three approaches which appear to have gained support are:

(i) PROTOTYPING

(See Harrison, 1985; Saunders, 1986; Connell and Brice, 1984; Langle et al., 1984; Jenkins, 1983; Boar, 1986; etc.)

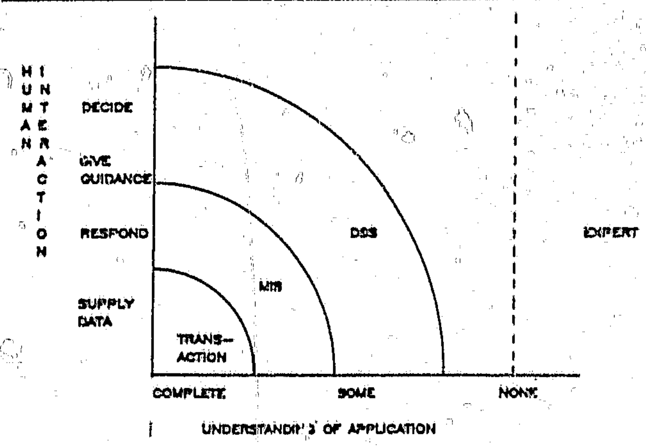

FIGURE 2.6
Types of systems in terms of applications and interaction (Teichroew, 1987)

(ii) INFORMATION CENTRES AND END USER COMPUTING

(See Benjamin, 1982, p.14; Canning, 1985a, p.9; Barr and Kochen, 1984, p.166; Abbey, 1984, p.114; Henderson and Treacy, 1986, p.3; Rivard and Huff, 1985, p.89, etc.)

These approaches have been made possible through so-called Fourth Generation Languages (see Survey of Productivity Aids, Data Processing, Nov 1985; Sumner, 1986; Nelson, 1985; Cobb, 1985; etc.) While this technology enables changes in systems development methods to be made, it brings with it further difficulties. The appropriate method for building each system must be identified (Canning, 1984b, pp.3 and 4; Sweet, 1985a, p.140), as it is unlikely that one approach will be suitable for all applications. However they are used, they force changes in the responsibilities of, and the skills required by software developers.

(iii) COMPUTER-AIDED SOFTWARE ENGINEERING

A third system building method which will influence the skills required by the systems developer of the future is based on software tools which combine word processing with graphics (and sometimes code generating) facilities. These design tools help ensure that systems are careful built and thoroughly cross-checked for completeness, while they provide the facility for design experimentation without generating volumes of paperwork. By automating the routine systems development tasks they allow developers to concentrate on meeting user requirements without the rigidity of the traditional systems development life cycle (Flanagan, 1988, pp.20-63).

2.1.2.3.5 THE NEED FOR I.S. DEPARTMENTS TO ADAPT TO REMAIN VIABLE

While each of the circumstances mentioned above contributes to the turbulence in the application development environment, a general system theory model was used to identify a direct link between evolving computer technology and the turbulence in job activities in application systems development. In his book 'Living Systems', J G Miller made the following points:

(i) In order to survive, a living system (like an organization or a department within a company) must interact with its environment (Miller, 1978, p.29).

(ii) Living systems can only exist in certain environments, so change across a relatively narrow range within that environment creates stress within the system (Miller, 1978, p.18).

(iii) Certain processes within a living system are necessary for life and can be called critical subsystems (Miller, 1978, p.32).

(iv) The development of information and logic processing machines provides artifacts on which critical subsystems rely (Miller, 1978, p.33). Of the 19 critical subsystems of an organization listed by Miller, at least eight of them (40%) have been identified as having a computer as a possible artifact (Miller, 1978, pp.606 and 607).

Change, therefore, in computer technology will create change in the environment and in the artifacts of critical subsystems of organizations. Once these changes disturb the steady state of the system, stress is produced within the system. To avoid the change and associated stress caused by moving the system away from a desired steady state, the system may alter itself to remain viable. Vickers (quoted by Miller, 1978, p.37) suggested that an organization may learn new skills or reorganize itself to help ensure its survival. In this way, changing computer technology is forcing I.S. departments to adapt by reorganizing and developing new skills. Unless this is done, departments run the risk of not remaining viable (see figure 2.2)

2.1.3 INPUT TO THE ROLES/SKILLS MODEL

One of the two conceptual models of future systems analysts' skills built in this study was constructed purely from a detailed review of the literature. In the first of three steps taken to build the roles/skills model, all the associations were identified which the future systems analysts are expected to have with their environments (see section 6.1.1). In the second step, the roles which a future systems analyst will be expected to perform within these associations were determined (see section 6.2.3). Finally the skills required to function effectively within these roles were linked to the roles. This was regarded as the roles/skills model (see figure 6.2).

For logistic reasons the specific literature review which was required to build this model is detailed in chapter 6.

2.2 PRIOR RESEARCH

Recognizing and evaluating important prior research is both part of the background to the current study and, in a sense, part of the literature survey. Before identifying their limitations in the context of building a skills profile for the future systems analyst, a brief description will be given of relevant prior research.

2.2.1 DESCRIPTION OF PRIOR RESEARCH

Although little work in the sphere of actually identifying the skills profile of the future systems analyst was identified in the literature, there was evidence of notable research which had been done in related areas. To assess the impact of each of these studies on the current research, they were grouped into the following categories:

- studies which suggested the structure of university syllabi;
- efforts to identify the skills required by I.S. developers;
- attempts to identify the role of the systems analyst in the future of I.S. development;
- research in the South African context.

After describing each study briefly, the contribution it made to the current research will be identified and any limitation in the context of identifying the skills profile of the systems analyst of the future, will be noted.

2.2.1.1 SUGGESTED UNIVERSITY SYLLABI

These studies were included in this section because the expected activities (and, therefore, expected skills) of the I.S. developers appeared to have been one of the inputs in determining the various syllabi. Three curricula were identified in this group:

- the ACM curriculum,
- the DPMA curriculum,
- a curriculum suggested by T A Pollack.

2.2.1.1.1 THE ACM CURRICULUM (Nunamaker, Couger and Davis, 1982)

(i) DESCRIPTION

The curriculum structure was based on the premise that graduates of the programme would be employed in:

- positions involving organizational I.S.

- functional areas in organizations;
- general management positions.

Nunamaker et al. (1982, p.784) wrote:

> 'The graduate of a professional I.S. program should be equipped to function in an early level position and should also have a basis for continued career growth.'

A list of knowledge and abilities required to work effectively in I.S. departments was given, and grouped into six categories of:

people

models

systems

computers

organizations

society

(ii) LIMITATIONS

In the context of this research the following limitations were identified:

- The objective of the study was to make recommendations for an I.S. curriculum. Obviously, therefore, its focus was not specifically on the skills required by the systems analyst of the future.
- The skills listed did not concentrate exclusively on systems analysis, but included other job categories in the I.S. industry.

- Because of the roots of the study and characteristics of the input documents used, there was the possibility that the conclusions reached were influenced by the computer science paradigm. This paradigm may not be totally appropriate in the I.S. environment.
- Among the reasons given for attempting to design the 1982 curriculum was that technology had evolved and I.S. analysis and development processes had improved since the 1970's when the previous syllabus was suggested. Further advances have been made in both technology and development processes since 1982, so perhaps the conclusions again need to be reassessed.

2.2.1.1.2 THE DPMA CURRICULUM (DPMA, 1985)

(i) DESCRIPTION

The objective of the curriculum was given as:

> 'To develop national educational standards for the discipline of Computeur (sic) Information Systems (C.I.S.) for the time frame 1987-1993.'
> (NOTE The working papers were not paginated.)

The version of the curriculum, therefore, was an update of the 1981 edition (DPMA, 1981). It was compiled following two national conferences and multiple regional conferences and committee meetings. The teaching objectives were established in the light of technical considerations (broad predictions on the evolution of computer-based technology), general teaching concepts (ideas on how to teach this subject) and the general background need for personnel to qualify as entry-level C.I.S. professionals. The curriculum was planned for a four year degree.

(ii) CONTRIBUTION

The following positive points influenced steps taken, and decisions reached, in the current research:

- The DPMA curriculum was aimed at an appropriate time-frame and took cognisance of the main thrusts of the evolving computer technology.
- An opinion-seeking questionnaire was used to solicit reaction to the proposed syllabus from practitioners and academics.
- In the context of the curriculum, specific skills were mentioned and used in section 6.3.

(iii) LIMITATIONS

As in the case of the ACM curriculum (Nunamaker et al., 1982), the goal of the DPMA research was to build a curriculum and not specifically to identify the skills of the systems analyst of the future. Consequently, while the material was used as input to the roles/skills model built in section 6.3, this input was inevitably limited.

2.2.1.1.3 BUSINESS INFORMATION SYSTEMS CURRICULUM FOR LARGE COMPUTER USERS (Pollack, 1981).

(i) DESCRIPTION

In partial fulfilment of the requirements for a PhD degree, Pollack presented the rationale, design and assessment of a business I.S. curriculum for large computer users. Besides a literature survey, data were collected from 21 large IBM computer users in the metropolitan Pittsburgh area to design the proposed curriculum. An opinion-seeking questionnaire was sent to a small group of educators, curriculum experts and business personnel to help evaluate the suggested syllabus. Pollack claimed that the curriculum developed in his study was sufficiently solid to be implemented, tested and refined in a four year undergraduate programme.

(ii) CONTRIBUTION

Two points are noted in this section:

- This study, like the DPMA, 1985, research, reinforced the value of the opinions of I.S. industry practitioners in establishing the skills required in the industry.
- Details of the syllabus content indicated skills which were required by entry-level I.S. personnel. These were used in building the roles/skills model in section 6.3.

(iii) LIMITATIONS

Besides having a different objective, the main limitation of

Pollack's work was the small sample population used both to design and evaluate the curriculum. Furthermore, it was unfortunate that the replies to the opinion-seeking questionnaire were processed in terms of percentages rather than more sophisticated statistical methods (see Siegel, 1956).

2.2.1.1.4 THE SELECTION OF SYSTEMS ANALYSIS AND DESIGN TOOLS AND TECHNIQUES (Aukerman, Schooley, Nord and Nord, 1989).

(i) DESCRIPTION

In this article a case was made for educational institutions not only to be leaders in innovation, but that educators also attempt to prepare students to perform tasks effectively and efficiently by using the methods and procedures currently being used in industry. The article reports on a study which was designed to provide information which might lead to a more efficient way to construct a learning environment for the education of systems analysts. Questionnaires were sent to selected systems analysts and selected academics to ask them to rate a list of 35 analysis and design techniques, and to rank the importance of 6 possible systems analyst job functions. Responses were received from 98 academics (47% return rate) and 183 systems analysts (37% return rate).

(ii) CONTRIBUTION

This article contributed in two ways to the approach taken in this study:

- The authors provide a list of analysis and design techniques which systems analysts can be expected to use (see section 7.3.2.10).
- The job functions listed in the article support the definition of systems analysis used in this research (see section 2.1.1.4).

(iii) LIMITATIONS

Unfortunately this article presents the findings of the researchers from a shallow base. No indication is given on how the questionnaire was constructed, on how the sampling was done, on the statistical procedures used to identify the differences of opinion and, only two references were made to the literature. These limitations detract from the value of the report as a contribution to the current study

2.2.1.2 I.S. DEVELOPERS' SKILL IDENTIFICATION

A number of studies have been conducted which attempt to identify the skills required by various categories of personnel in the I.S. industry. Eight studies are evaluated in this section.

2.2.1.2.1 GUIMARAES (1980)

(i) DESCRIPTION

This research appeared to have the objective of identifying systems analyst skills without grouping them into mutually exclusive categories with some identifiable linear relationship. Guimaraes claimed there were at least two basic differences between his approach and other attempted skills definitions. These were:

- firstly, he uniquely used the phases of an application life cycle as the basis for grouping skills;
- furthermore, within each phase he identified a hierarchy of appropriate skills, with the subordinate skills established as the functional prerequisites of the higher level, target skills.

(ii) CONTRIBUTION

There were four specific contributions which Guimaraes' work made to this research:

- Stimulus was given to this research through the idea that greater computer utilization is prevented primarily through a shortage of properly trained staff rather than deficiencies in equipment performance.
- Guimaraes suggested that the complexity and variety of activities performed under the title 'systems analysis and design' no longer allow for a 'do-it-all systems analyst'. This suggested that 'systems analysis' is a role which may be performed by more than one person. This idea was used in section 7.4.3.
- The concept of grouping skills together in hierarchies was used throughout chapters 5 and 6 of this study.
- Specific skills mentioned in Guimaraes' paper were used to build the roles/skills model in section 6.3.

(iii) LIMITATIONS

The following limitations of Guimaraes' work were noted:

- Because the systems development life cycle is likely to be changed by the evolving technology (see section 2.1.2.3.1), it was unfortunate that this formed the basis for his skills groupings.
- Guimaraes did not test his findings with any empirical research. Doing this would have added a dimension of credibility to his results.
- No attempt was made in Guimaraes' work to define 'a skill'. Sometimes he used a compound word 'competency/skill', but he also used 'knowledge of' as if it were a skill (e.g. knowledge of general systems theory or charting techniques or file oriented languages).

2.2.1.2.2 CHENEY AND LYONS (1980)

(i) DESCRIPTION

The study by Cheney and Lyons identified some of the employment trends and skill requirements in the I.S. industry. They reported on the perceptions of 45 I.S. managers from 32 large U.S. organizations. Data on workforce projections and perceived job skills required by programmers, systems analysts and DP Managers were gathered via personal interviews and questionnaires. Part of their study involved the ranking of specific skill areas in terms of the systems analyst's job.

(ii) CONTRIBUTION

The following points from Cheney and Lyons were used in this research:

- They made the point that the I.S. industry is going through a transition which may result in much of the work currently being done by computer professionals, becoming unnecessary.
- They claimed that if more certainty could be established in the type of skills required by the I.S. industry, this would aid staffing positions in the future (see section 1.7.4).
- Although reference was made to the ACM clustering of I.S. skills, the authors showed the value of exploring other patterns of skills groupings (see section 7.2.1).
- Specific skills identified in their work were used in building the roles/skills model in section 6.3.
- Cheney and Lyons also demonstrated the value of using the opinions of practitioners in identifying I.S. skills requirements.

(iii) LIMITATIONS

The limitations of their study were found in four areas:

- The sample size of I.S. managers on which the conclusions were drawn was small. Although the authors argued to the contrary, this could have biased their findings.
- The statistics used to process the opinions of the respondents would have been more appropriate for interval rather than ordinal data (see section 3.6.1).

- This study was completed in 1980, so it could be argued that the experiment needs to be repeated to ensure that the findings have not been invalidated by recent changes in the application systems development environment (see section 2.1.2.3).
- No indication was given of the source of the list of skills which the participants in their study were asked to rank. There is the possibility that significant skills were omitted from this list.

2.2.1.2.3 BENBASAT, DEXTER AND MANTHA (1980)

(i) DESCRIPTION

While a number of hypotheses were tested by Benbasat et al., the objective of their study (called 'retrospective reconstruction' by Vitalari, 1985, p.221) was to identify skills perceived as useful by I.S. managers and systems analysts in I.S. departments at different levels of maturity. The list of skills sent to the participating companies was based on the 1972 ACM curriculum. Incorporated in this list were changes recommended by the MIS Research Center, University of Minnesota. The augmented list was regrouped into 'generalist' and 'specialist' categories. Data from the 35 respondents to the questionnaire were used to test the hypotheses. The researchers concluded that, irrespective of the I.S. department's level of maturity, generalist skills were perceived to be more useful than specialist skills.

(ii) CONTRIBUTION

The research of Benbasat et al. influenced the current research in three specific ways:

- There was further evidence of the value of using mailed questionnaires to collect the opinions of I.S. practitioners concerning skills required in the computer industry.
- The researchers used the concept of sending questionnaires to a senior member of staff in an I.S. department, with a request to distribute the questionnaires to systems analysts within the department for completion. This approach was used in this research (see section 4.2.3).
- The concept of a 'performance' skills cluster quoted from a report by the University of Minnesota MIS Research Center, was used in chapters 5 and 6 of this research.
- These researchers identified a method to differentiate between more or less mature I.S. departments (and found that a relationship appeared to exist between generalist/specialist skills and these levels of maturity). This method was used when identifying factors which influence the skills mix required by future systems analysts (see section 7.5.2.1).

(iii) LIMITATIONS

Three limitations of the research by Benbasat et al. were identified:

- Although the response rate to their mailed questionnaire was high (66%), the sample size was small.

- The ordinal data collected in response to the questionnaire was processed using parametric statistical procedures (see section 3.6.1).
- The findings were based on data collected before 1980. In the light of changes in the I.S. environment in the past decade (see section 1.3.2), a case could be made for not relying too heavily on their results until the experiment is repeated in a contemporary setting.

2.2.1.2.4 HAROLD (1983)

(i) DESCRIPTION

Harold asserted that although the body of knowledge relevant to some categories of I.S. personnel (viz. I.S. manager and senior programmer) were well represented in terms of examinations offered by various certification programmes, this was not so for the systems analyst.

As a preamble to a questionnaire on the subject, therefore, Harold outlined the history of initial steps taken towards finalizing a systems analyst certification programme. He included details of the current (1983) position of this programme and provided an outline of its committee's recommendations.

(ii) CONTRIBUTION

The contribution which this article by Harold made towards this research falls into three areas. These are:

- He reinforced the evidence that a lack of consensus exists on the body of knowledge fundamental to the systems analyst.
- He emphasized the importance of making a clear distinction between 'knowledge' and 'ability/skill'.
- He detailed specific skills required by the systems analyst, particularly those that are systems development life cycle and development methodology independent.

(iii) LIMITATIONS

Obviously the value of Harold's work will be limited until the findings of the questionnaire he distributed are known.

2.2.1.2.5 VITALARI (1985)

(i) DESCRIPTION

Vitalari investigated the characteristics of the practicing system analyst's knowledge base. He claimed his approach differed from previous studies in two ways. These differences are:

- the study focused on the knowledge used by systems analysts in the requirements determination phase of systems development (and did not attempt to identify general skills required throughout the systems development life cycle);
- the view of the systems analyst's knowledge base was assembled from an evoked set of knowledge categories, taken from the problem solving transcripts of the 18 experienced systems analysts who participated in the study.

Although Vitalari admitted that the results of his research were exploratory and must be regarded as preliminary, his findings provided:

- a list of knowledge categories which both high- and low-rated systems analysts used in solving problems;
- an indication of some differences between high- and low-rated systems analysts in terms of their attitudes to their application development environment.

(iii) CONTRIBUTION

In spite of its totally different objective, Vitalari's research made a contribution to the current study in the following areas:

- he criticised lists of skills which have not been based on empirical data;
- he provided an evaluation of earlier work done in the area of systems analysis skill identification.

(iii) LIMITATIONS

Besides the obvious limitation that Vitalari attempted to identify a systems analyst's knowledge-base and not a set of systems analyst skills, his work has limited value in the context of this research, because:

- it concentrated on current (1985) systems analysis activities;
- it was confined to the requirements definition stage of systems development.

2.2.1.2.6 CROCKER (1984)

(i) DESCRIPTION

Crocker's study was concerned with the work experience received by practicing systems analysts (in the U.K.) and the formal training they were given. After attempting to gain the support of the computer installation managers, Crocker asked them to distribute questionnaires on the subject to their systems analysts. The questionnaire comprised a list of 110 skills drawn from the literature on systems analyst training, skills and techniques. Those participating were asked to indicate which of these skills they had used during the previous two years. Eventually 52 organizations returned a total of 256 completed questionnaires (34,6% response rate). These data were analyzed using simple percentages, because the responses did not meet the criterion of being statistically random.

From these replies Crocker found that 24 skills from the list were used by a minimum of 40% of the respondents.

(ii) CONTRIBUTION

Obviously the skills which Crocker identified as relevant to systems analysis were used as input to the roles/skills model in section 6.3. The description of the purpose of systems analysis and the stages of systems analysis, helped in defining systems analysis by establishing the boundaries of the task (see section 2.1.1.4).

(iii) LIMITATIONS

In the context of this current research, Crocker's study had the following limitations:

- the terms ' systems analyst' and 'skill' were not clearly defined;
- the study was confined to skills used to perform current (and not future) systems analysis;
- processing the data only in terms of percentages detracted from the value of the study;
- there was no clear indication of the extent to which the identified skills were required;
- when compared with other lists of systems analyst's skills, significant groups of skills were missing from Crocker's study (see section 6.3.1).

2.2.1.2.7 ROON (1986)

(i) DESCRIPTION

The objectives of Roon's paper were to:

- sketch the changing I.S. environment;
- attempt to identify the education, training and skills required in this changing environment;
- identify ways of providing interesting career paths to I.S. personnel which would limit skill obsolescence.

Roon predicted a shift in the knowledge required in the I.S. industry away from purely technical areas, to business orientated areas. If the prediction proves to be correct, it will result in an increased demand for I.S. personnel with commercially-based skills.

(ii) CONTRIBUTION

The value of Roon's paper was that he confirmed the increasing significance of a commercial background for future systems analysts.

(iii) LIMITATIONS

The subjective conclusions to which Roon came tended to be non-specific and were not supported by any empirical testing.

2.2.1.2.8 JENKINS (1986)

(i) DESCRIPTION

The purpose of Jenkins' study was to identify the subject areas and amount of training needed for an entry-level position as a 'business systems analyst'. He made two approaches to a sample population of 400 I.S. personnel. The participants were requested to evaluate the importance of a list of 33 skills and knowledge requirements to entry-level business systems analysts.

A total of 191 replies was received to the first questionnaire and 125 replies to the second questionnaire. The skills identified from these responses were grouped into three categories:

- proficient
- knowledgeable

- familiar.

(ii) CONTRIBUTION

The specific skills mentioned in this study were used in the building of the roles/skills model (see section 6.3).

(iii) LIMITATIONS

In the context of this research, Jenkins' study had the following limitations:

- there was no indication of how the participants were selected;
- his study was an attempt to identify only current, entry-level business systems analyst skills;
- although mode scores were used in presenting the results of the study, the data were analyzed using only frequency counts and percentages, which tended to make the research appear superficial.

2.2.1.2.9 GREEN (1989)

(i) DESCRIPTION

The research is based on the supposition that the systems development effort depends to a large extent on how well systems analysts and users work together. Problems are likely to occur if expectations on either side are not met. Beliefs about what constitute systems analysts' responsibilities during systems development, and what motivates them to perform the tasks associated with these responsibilities, can contribute to unfulfilled expectations and degraded systems development success. The purpose of this study was to try to identify if there are perceptual differences between systems analysts and users about how systems analysts perform their jobs. After conducting two pilot studies, a questionnaire was constructed which provided the respondents the opportunity to rank the importance of 21 systems analyst skills, and 20 possible job roles. These questionnaires were distributed to 70 companies which agreed to participate in the study, with a view to ascertaining both users' and systems analysts' opinions. A total of 872 replies were received from 52 companies (471 from systems analysts and 401 from users). These data were processed in this research.

Significant differences were observed in the perceptions of the two groups. It could be demonstrated that the users placed more emphasis on the technical skills of the systems analyst, while from their perception, the analysts placed a higher value on the need for interpersonal skills.

(ii) CONTRIBUTION

Through his research, Green adds credence to a number of approaches on which this research was based. In summary form, these are:

- establishing a link between the systems analysts' roles and skills, a concept used in the building of the second conceptual model in this study (see section 6.3);

- providing specific input to the systems analysts' roles identified in the literature;
- providing a list of 21 appropriate systems analysts' skills and a definition of each skill listed;
- providing an example of research which was based on data collected from an unknown sample of systems analysts (see section 4.2.3.4).

(iii) LIMITATIONS

Obviously the main limitation of Green's research, in the context of this study, was that the objectives set for his study focused on the current situation and the relationship between users and systems analysts. His findings, therefore, had to be adapted to a study of future systems analyst skill requirements.

A second perceived weakness was Green's use of statistics. It is surprising to find that mean (and not median) scores were used to compare the opinions of the users and the systems analysts on each dimension in the questionnaire (see section 3.6.1.1).

2.2.1.3 ROLE OF THE SYSTEMS ANALYST IN THE FUTURE

Two articles are grouped in this section. Both provided input to this research but, unfortunately, both tended to be superficial.

2.2.1.3.1 MARTIN (1983)

(i) DESCRIPTION

A theme recurring throughout Martin's book was that a higher level of automation is needed in developing I.S. applications. Because the technology is available to achieve this, major changes are being experienced in a broad spectrum of I.S. job categories. Referring specifically to systems analysts, Martin wrote:

> 'Perhaps the most important point to make is that in most corporations there needs to be a total change in many systems analysts' jobs.' (Martin, 1983, p.332).

This change, Martin claimed, demands a frame of mind that is freed from the techniques of the past. It requires constant search for better ways of building systems. Besides identifying aspects which influence what he described as the new role of the systems analyst, Martin listed a range of specialist job categories which he claimed would develop within this role.

(ii) CONTRIBUTION

In some ways this book (and especially the chapter on the changing role of the systems analyst) can be regarded as the catalyst which motivated this current research. It was felt that the following claims made by Martin needed to be tested:

- that many systems analysts' jobs will change completely;
- that the systems analyst will have a new role in application systems development;
- that systems analysis is a role and not a person;

- that the systems analysis role will be sub-divided into multiple specializations.

Each of these claims was confirmed by this research (see sections 7.4, 7.5 and 8.2.1.2).

The specific systems analyst skills mentioned by Martin were used in building the third level of the roles/skills model in section 6.3. What was of more value, however, was his perception of the specific roles which a systems analyst was expected to fill. Martin's ideas in this area were used in the building of the second level of the roles/skills model (see section 6.3).

(ii) LIMITATIONS

In his predictions on the changing role of the systems analyst Martin tended to argue from the specific to the general. This led to his making certain apparently unsubstantiated statements (e.g. 'Often, the Information Centre approach is applied on too limited a scale.' (Martin, 1983, p.332), or 'When applications can be implemented rapidly, much of the need to study them disappears.' (Martin, 1983, p.335). So, while in this chapter Martin made one of the few documented attempts to identify the changing role of the systems analyst, the new job responsibilities he envisaged were not carefully defined, nor were his opinions rigorously tested.

2.2.1.3.2 MEISSNER (1986)

(i) DESCRIPTION

In spite of the title given to this article, the changing role of the systems analyst was mentioned only towards the end of the article, and then not totally in context. The objective of writing the article was neither stated nor clear.

(ii) CONTRIBUTION

Meissner added momentum to the idea that systems analysis consists of multiple roles which could be performed by more than one individual. He emphasised the significance of careful thought processes as a systems analysis activity and the importance of a good rapport with the user of the system as an integral part of successful systems development. The systems analyst's roles which he identified were used in building the second level of the roles/skills model in section 6.3.

(iii) LIMITATIONS

The title of Meissner's article was misleading in that only a small section had a direct relationship to the changing role of the systems analyst. The value of his other perceptions to the I.S. industry were limited and usually without rigorous supportive evidence (e.g. 'The most effective role for us as systems analysts is to be an enabler.' (Meissner, 1986, p.14), 'The real basis for professionalism is not data, expertise, titles or degrees. It is wisdom, not knowledge.' (Meissner, 1986, p.15).

2.2.1.4 RESEARCH IN THE SOUTH AFRICAN CONTEXT

The only study in the South African context which could be regarded as relevant to the current research was work done by the National Productivity Institute (NPI) for the Computer Society of South Africa in 1982/3 on the manpower training and development needs of the South African computer industry (NPI, 1983).

This report added momentum to this study by identifying the shortage of systems analysts in South African organizations and the need to correct this situation.

Although the authors of the report recognized that the mix of skills required by the (systems) analyst is changing, two points were noted:

(i) The reason for this change was cited as the increased use of on-line systems. This has been identified as only a small part of the changing I.S. environment (see section 1.3.2).

(ii) As a consequence of the constraints of the terms of reference of the NPI project, their recommendations did not include any details of systems analysts' skill requirements.

2.2.2 SUMMARY OF LIMITATIONS OF PRIOR RESEARCH

In the context of identifying the skills profile of the systems analyst of the future, prior research in this and closely related areas, was found to have the following limitations:

2.2.2.1 MOST OF THE WORK WAS DATED

Some of the studies were done in the late 1970's and early 1980's and, consequently, now tend to be dated (e.g. Nunamaker et al., 1982; Cheney and Lyons, 1980; Benbasat et al. 1980.)

2.2.2.2 FUTURE SKILLS WERE SELDOM IDENTIFIED

The objective of some of the prior research was to identify CURRENT (and not FUTURE) systems analysts' skills (e.g. Vitalari, 1985; Crocker, 1984; Jenkins, 1986; Green, 1989).

2.2.2.3 SOME FINDINGS WERE SYSTEMS DEVELOPMENT LIFE CYCLE BASED

Some of the prior research grouped systems analysts' skills into categories based on the traditional systems development life cycles (e.g. Vitalari, 1985; Guimaraes, 1980).

2.2.2.4 CLEAR DEFINITIONS WERE SOMETIMES LACKING

Terms central to the research (e.g. 'skill', 'systems analyst') were not always clearly defined. This led, for example, to the use of the phrase 'knowledge-of' as if it meant 'skill' (see Guimaraes, 1980; Crocker, 1984.)

2.2.2.5 THE WHOLE SYSTEMS ANALYST JOB WAS NOT ALWAYS RESEARCHED

Vitalari (1985) confined his research to just the requirements definition tasks of systems analysis.

2.2.2.6 FINDINGS WERE SOMETIMES BASED ON GENERALIZATIONS

The authors of some of the prior research tended to argue from the specific to the general. This sometimes resulted in their making unsubstantiated statements (e.g. Martin, 1982; Meissner, 1986; Roon, 1986).

2.2.2.7 SOME OF THE EMPIRICAL WORK SHOWED WEAKNESSES

Limitations were found in the empirical work of some of the prior research (See Table 2.2).

TABLE 2.2
Summary of weaknesses in prior research

No empirical data	Guimaraes, 1980 Roon, 1986
Small sample size	Vitalari, 1985; Pollack, 1981; Cheney and Lyons, 1980; Benbasat et al., 1980
No random sampling	Crocker, 1984
No details of sampling	Jenkins, 1986, Aukerman et al., 1989
No details of statistical procedures	Aukerman et al., 1989
Data processed using only percentages	Pollack, 1981; Crocker, 1984; Jenkins, 1986
Data processed using parametric statistics	Benbasat et al., 1980; Cheney and Lyons, 1980; Green, 1989

These limitations in the context of this study provided a foundation for establishing the characteristics of this research programme (see section 3.1).

2.3 SUMMARY OF THE CHAPTER

The objective of this chapter was to establish the foundations of the research.

The first section of the chapter was a review of the literature which was presented so that:

- the theories used as a basis for the research approach, and for various procedures followed at stages within the approach, could be identified in context;
- the evolution of the systems analyst task could be followed to that point when the current turbulence in the systems development environment demands further changes in the discipline;
- the causes of the turbulence, and the inter-relationships between these causes, could be identified.

The second section of the chapter was an evaluation of prior research, in terms of the objectives set for the study. This section shows clearly that this research is built on work done in similar areas. The characteristics of the research approach (detailed in the next chapter) are influenced directly by the perceived limitations of previous studies.

CHAPTER THREE

CHARACTERISTICS OF THE RESEARCH

In this chapter a comprehensive account is given of the research methods used in this study. Based on the perceived attributes of the research, the reasons for the approach taken are identified and the research is classified in terms of the Ives, Hamilton and Davis model (1980, p.921). The boundaries, assumptions and limitations of the research are stated and the chapter closes with a description of the use of statistics at various stages in the study.

3.1 THE ATTRIBUTES OF THE CURRENT RESEARCH

In order to build on the foundations laid by prior research in this and closely related areas, but to prevent their limitation in terms of the objectives of this study (see section 1.5), this research needed the following attributes:

- all significant terms had to be clearly defined;
- focus had to be on the total spectrum of systems analyst job responsibilities;
- the skills profile to be identified had to be for the systems analyst of the future;
- the conclusions had to be based on representative empirical data;
- the grouping of required skills had to be independent of traditional systems development life cycles.

3.2 THE RESEARCH METHOD

The method used to arrive at the conclusions of this research are described in this section.

3.2.1 THE RESEARCH PROBLEM

The application development industry is in a state of turbulence. Multiple issues are influencing the type of computer-based application systems which need to be built and the way that the systems can be built (see section 2.1.2.3). Part of this turbulence is changing the role that the systems analyst is playing in the systems development process (see section 1.4). It is suspected that as a direct consequence of this role changing, the future systems analyst will require a new set of skills. Against this background, this research was aimed at identifying the skills profile of the systems analyst of the future.

3.2.2 FACTORS WHICH INFLUENCED THE RESEARCH APPROACH

The approach taken in this study did not follow the pattern of building an hypothesis from an in-depth literature survey which could be tested by collecting and analyzing empirical data (e.g. Campbell, 1954, pp.8 and 86). The reasons for this were embedded in the research itself. The research strategy which had to be taken, therefore, was dictated entirely by the purpose of the study (see Benbasat, 1983, p.52). This section identifies those factors which influenced the research strategy.

(i) A STUDY OF THE FUTURE

Because the research attempted to identify the skills required by the systems analyst of the future, obviously no control could be

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(i) A STUDY OF THE FUTURE

Because the research attempted to identify the skills required by the systems analyst of the future, obviously no control could be exercised over the environment being studied. This automatically excluded the possibility of experimental manipulation which is required in a research which monitors the change of an independent variable.

(ii) IDENTIFYING FUTURE SYSTEMS ANALYSTS' SKILLS

This descriptive research, which was conceptual and abstract in nature, did not attempt to test any specific hypotheses or establish any relationships between variable groups in the I.S. environment. Its purpose was an attempt to build the skills profile of the systems analyst of the future based on the opinions documented in the literature, and the opinions of those involved in the application software development industry (see Kryt, 1983, p.124).

(iii) WIDE RANGE OF OPINION

Opinions on what skills will be required by the systems analyst of the future were expected to differ widely (an expectation which proved to be correct (see section 5.2.2.1.2)). Because the conclusions of the research were based on people's opinions in this regard, two specific objectives were set:

- data collected would not be accepted at face value;
- steps should be included in the research process which would help to ensure no significant opinions were overlooked.

To meet these objectives, all opinions identified were tested through comparisons. This was achieved by building two conceptual skills models independently of one another (chapters 5 and 6). The conclusions of the research were reached by amalgamating the skills identified in these two models (section 7.3.2).

(iv) POSSIBLE UNIQUE OPINIONS IN THE SOUTH AFRICAN COMPUTER INDUSTRY

To enhance the value of the study, a research objective was set to compare and contrast the opinions of those who participated in the empirical study (all members of the South African computer industry) with the opinions documented in the literature, which is primarily not South African. Any significant differences of opinion would be an indication to the South African industry to be aware of:

- a possible lack of foresight;
- the possibility that conditions in the local application development environment could make the direct importing of technology into that environment inappropriate.

For these reasons the empirical research was done as independently as possible from the survey of the literature. Certainly no attempt was made to reflect opinions identified in the literature in the dimensions of the questionnaire.

3.2.3 THE NATURE OF THE RESEARCH

The nature of the study is set by identifying the paradigm underlying the research, by establishing the characteristics of the research and by classifying the research approach.

3.2.3.1 THE RESEARCH PARADIGM

Because the study precluded the possibility of exercising any control over the environment being studied, this research could not follow the well-defined steps of a scientist conducting a laboratory experiment. The paradigm used as a foundation of this study was therefore borrowed from the organizational and social sciences (see e.g. Bailey, 1982 and Smith, 1981). By taking a lead from Kerlinger (1974, p.379), it was possible to identify common elements between this research and an *ex post facto* study (with the obvious difference that the environment could not be controlled, not because the phenomenon being studied had already occurred, but because it has not yet happened).

3.2.3.2 RESEARCH CHARACTERISTICS

As a direct result of the paradigm which formed a base to the study, it could be established that the research had the following characteristics:

(i) DUAL OBJECTIVES

The research approach of the organizational science, has received criticism from some quarters. The following assertion is an example of this criticism:

> '.... the conventional notions of methodological and scientific rigor that have directed research in the organizational sciences have been deficient as guidance mechanisms .... (therefore, the) standards of research rigor, although important to a field's credibility, need to be supplemented by another set of standards relating to the practical relevance or utility of research.' (Thomas and Tymon, 1982, pp.345 and 346.)

To help void this criticism, dual objectives were set for this study. These objectives were:

- to ensure that methodological rigor was followed (e.g. in the sampling procedures, statistical processing and use of deductive reasoning);
- to ensure that the research was practically relevant in terms of its value to the practitioner in the I.S. industry.

The dual objectives, (one methodological and scientific, the other practical) made a major contribution to establishing the nature of the research.

(NOTE: The detailed objectives of the research were stated in section 1.5.)

(ii) FIELD STUDY

Much of the data used to establish the findings of tne research were empirical, collected using a mailed questionnaire (see chapter 4). The questionnaire was used to attempt to establish the opinions of members of the I.S. industry on the skills required by the systems analyst of the future. This type of research is what has been called a FIELD STUDY (Kerlinger, 1973, p.406), or a DESCRIPTIVE STUDY (Bailey, 1982, p.38). Its exploratory nature is characterized by an attempt to identify what the situation is (or what it is likely to become). In common with this category of research, no effort was made to identify or predict relationships between any entities identified either in the present or future I.S. environment.

(iii) HYPOTHESIS GENERATING

For the most part, there were no prior hypotheses to be tested in this research, nor were there validated measures which enabled specific constructs to be examined. This research was, therefore, hypothesis generating rather than hypothesis testing in nature (see Baroudi and Ginzberg, 1986, p.547), and established a base for further systematic research into the skills required for future application systems development (see section 8.3).

3.2.3.3 CLASSIFICATION OF THE RESEARCH

While the course of the research action, therefore, had to be different in execution (and interpretation) from that of a scientist who experiments, a similar approach was documented by Kryt (1983), and in certain respects, Pollack (1981).

The specific characteristics which influenced the classification of the research in respect of the model suggested by Ives, Hamilton and Davis (1980), were:

- it did not involve the use of dependent and independent variables;
- it did not involve a specific research hypothesis (or hypothesis testing);
- it tended to be descriptive in nature.

These are the characteristics of research which has been classified into the Type 1a category (Ives, et al., 1980, pp. 921 and 922).

3.2.3.4 DESCRIPTION OF THE RESEARCH

3.2.3.4.1 INITIAL STEPS

The initial steps in the research required the term 'system analyst' to be defined and the evidence and reasons for the skills profile of the systems analyst of the future to be questioned to be established. The skills required by future systems analyst were identified by building two models and combining the skills identified in each.

3.2.3.4.2 THE JOB RESPONSIBILITIES/SKILLS MODEL

The first model to identify the skills required by the systems analyst of the future was built from empirical data collected by means of a mailed questionnaire.

(i) EXPERT OPINION

To ensure the questionnaire dimensions were empirically derived, the participation of a group of experts in the building and implementation of I.S. was solicited. These experts included both practitioners and academics. Without prior knowledge of the study or its purpose, the experts were sent three open-ended questions on the skills required by the systems analyst of the future. To ensure that the most value was gained from their opinions, the replies received from this first approach were formatted into a set of structured answers to the original three questions. The same experts were approached again.

This second approach had two objectives. Firstly, to ask the participants to indicate the degree to which they thought each dimension was an appropriate answer to the original questions. The second objective was to ask the experts if - in their opinion - any possible answer to the questions had been overlooked during the first round of opinion seeking. The replies to this second approach to the experts were used to build a questionnaire which was distributed to a large sample of practicing systems analysts.

(ii) THE QUESTIONNAIRE

Using the replies from the experts, a questionnaire was constructed with the following format:

Section 1 - an indication of the respondent's current job responsibilities.

Section 2 - a self-assessment of current skills.

Section 3 - a question on methods of building application software in the future.

Section 4 - a question on the systems analyst's job responsibilities in the future.

Section 5 - a question on the skills required by the systems analyst of the future.

Section 6 - a self-assessment of the respondents' preparedness for working as a systems analyst in the future.

Section 7 - demographic data.

(See section 4.2.2.2.)

As a result of a pilot study, changes were made to the wording in certain sections of the questionnaire. These changes made the questionnaire easier to understand and simpler to complete.

The reliability and validity of the measuring instrument were established primarily through the logical method of constructing the questionnaire, a form of the test-retest approach and, after the replies were received, by calculating inter-item correlations (see section 4.3.1).

(iii) SAMPLE

No register of practising systems analysts in South Africa exists. Groups of questionnaires were therefore distributed to the I.S. departments of a randomly selected sample of companies. These companies were representative of industry type, installation size and geographic regions. Senior members of the I.S. departments in these companies were asked to distribute the questionnaires to practising systems analysts in their companies.

(iv) PROCESSING THE REPLIES

The replies received from the practising systems analysts were processed in three ways:

(a) To establish the representativeness of the respondent population, the demographic data from the replies were compared to the demographic data of the replies to an independently conducted survey.

(b) Respondents' opinions were compared to identify areas of agreement and disagreement. Attempts were made to establish possible reasons for disagreement.

(c) Areas of agreement were used to build the job-responsibilities/skills model. This model was one of the inputs used to identify the skills required by the systems analyst of the future.

3.2.3.4.3 THE ROLES/SKILLS MODEL

From surveying the literature it became apparent that systems analysts are expected to function within different roles (e.g. a problem solver, a systems specifier, a project team member (see section 6.2.2)). In order to identify each of these roles, a record was kept of the relationships, or associations which systems analysts have as part of their working environment (e.g. with their managers, users, colleagues). This list of associations was regarded as the first level of the roles/skills model (see section 6.1).

The second level of the model was built by deduction. Each systems analyst role identified in the literature was associated with one or more of the level 1 associations (e.g. as a fact finder, the systems analyst will need to be an interviewer, a diplomat and an observer (see table 6.2)).

Each skill identified during the literature survey was linked to the roles in the second level of the model. Then, if necessary, any further skills required for the systems analyst to perform effectively within the roles were deduced. This list of skills constituted the third level of the roles/skills model.

There was obviously redundancy and overlapping when these associations, roles and skills were linked. No effort was made at this stage to resolve this, as it was regarded as a step towards ensuring that no future systems analysts' skill had been overlooked.

3.2.3.4.4 COMBINING THE TWO MODELS

The skills required by the systems analyst of the future were identified in section 7.3.2 by combining the job responsibilities/skills model and the roles/skills model. To minimize duplication and superfluity, and to help to avoid any omissions, the following steps were taken:

(i) A group of occupational categories used to assist students to choose appropriate careers was identified in the literature (see table 7.1).

(ii) By linking these occupational categories with the verbs taken from the literature definitions of systems analysis, it was established that these occupational categories were significant to systems analyst activities (see table 7.2).

(iii) A factor analysis of the empirical data added credence to the idea that systems analysis can be defined in terms of the occupational categories (see table 7.3).

(iv) The skills clustering of previously published research was compared and contrasted with these categories to identify a group of ten generic skills clusters (see section 7.2.2).

(v) All the skills identified in this study were combined and classified into these ten categories (see section 7.3.2).

3.2.3.4.5 RESEARCH CONCLUSIONS

Because it appeared unlikely that any single individual would have competence in so broad a spectrum of skills, this grouping of skills led to the identification of a possible new dispensation of job categories in the I.S. development industry. Within these job categories generalist, specialist and essential skills were identified (see section 7.5.2).

3.3 BOUNDARIES OF THIS RESEARCH

This research specifically excluded the following:

(i) PERSONALITY TRAITS

No attempt was made in this study to identify any personality traits or inherent personal capabilities which may be required by the systems analyst of the future.

(ii) KNOWLEDGE BASE

It is acknowledged that skills cannot exist in isolation and that the effective systems analyst requires a base of knowledge from which to work (see Vitalari, 1985). No attempt was made, however, to contribute to the epistemology of systems analysis.

(iii) EFFECTIVE PERFORMANCE

There was little evidence in the literature of a clear understanding of the underlying behaviours which harness systems analyst skills into effective performance (Vitalari and Dickson, 1983 p.949). This research was not an attempt to contribute in any way to the development of this theme.

(iv) EDUCATION AND TRAINING

While the results of this research will have a direct influence on what constitutes appropriate training and education for the future systems analyst, designing such schedules was outside the scope of this study.

3.4 ASSUMPTIONS MADE IN THIS STUDY

The assumptions on which the research was based included:

- that the respondents to the questionnaire (and, for that matter, the authors whose work was used) understood the basic terminology and used words consistently;
- that the participants in the empirical research would and could express their considered opinions;
- that the technological forecast on future methods of systems development were sufficiently accurate not to invalidate the skills profile based on that forecast;
- that the nature of the work done in small I.S. departments (i.e. less than ten employees) is inconsistent with the main thrust of I.S. activity (see section 4.2.3.2).

3.5 LIMITATIONS OF THE RESEARCH

Besides the shortcomings which related directly to the building of the conceptual models (which are detailed in the chapters describing the building of the models (see sections 4.3.3 and 6.4)), it was recognized that this research had the following limitations:

(i) None of the opinions used to build either conceptual model could be verified by observation. The study, therefore, was based on the beliefs of a small group of practitioners, academics and researchers. These beliefs and opinions could not be verified or substantiated by monitoring the actual performance of systems analysts (see Vitalari, 1985, p.223).

(ii) The research did not attempt to link the skills identified as necessary for the future systems analyst with how these skills would be used by a person who could be ranked as a 'good' systems analyst. Any attempt to establish an association between these skills and a level of performance excellence, was excluded from the study.

(iii) Although a stringent effort was made to base the study in documented theories and prior research, both the building of the conceptual models (in chapters 5 and 6) and the establishing of the skills profile of the future systems analyst (section 7.3.2) ran the risk of being open to subjective interpretation. Respondents to the questionnaire and researchers could have been working from different mental sets. In fact, this limitation could explain some of the broad spectrum of opinions identified in both the empirical work and the literature survey (see Mitchell, 1984, p.70).

(iv) A significant technological advance (or a combination of advances) in the application systems development environment could sharply compress the estimated timescales in the research. Were the technological advances sufficiently spectacular, some (or perhaps, all) the findings of the research could be invalidated.

3.6 USE OF STATISTICS

In this section characteristics and parameters of the statistical tests are identified, and the statistical tests and procedures are described. The data processed were the opinions collected in response to the questionnaire (see chapter 5 and appendix 'L').

3.6.1 CHARACTERISTICS AND PARAMETERS OF STATISTICAL TESTS

Based on the nature of the data collected, the details of why the particular statistical tests were done are provided in this section.

3.6.1.1 TYPE OF TESTS USED

Because the opinions of respondents were reflected on a descriptively anchored five point Likert-type scale (see section 4.2.2.2), the data collected via the questionnaires were regarded as ordinal in nature (Siegel, 1956, p.24; Bailey, 1982, p.365; Blalock, 1960, p.13).

To ensure that the statistical tests used are as powerful as possible, there is a school of thought which supports the use of parametric statistical procedures on ordinal data. Typical of this school is the opinion of Baroudi and Orlikowski. They write:

> '.... researchers are encouraged to use the parametric test most appropriate for their study and resort to non-parametric procedures only in the rare cases of assumption violation'. (Baroudi and Orlikowski, 1989, p.89).

Examples of parametric statistics being used on ordinal data were found in a wide spectrum of related literature (e.g. Harty, Adkins and

Sherwood, 1984, p.304; Alavi, 1985, p.174; Ivancevich, 1983, p.802; Perez and Schuter, 1982, p.163; Parisian, 1984, pp.46-64).

In this research, however, a more conservative approach was taken. Following the lead given by a number of authorities, (e.g. Siegel, 1956, p.26; Blalock, 1960, p.188; Drury, 1983, p.63; Alavi, 1984b, p.561; Bailey, 1982, p.402), non-parametric tests were used to analyze the ordinal data. This decision had the added advantage of not requiring assumptions to be made about the homogeneity of variance or normality of the sample population (see Freund and Williams, 1977, p.361).

3.6.1.2 RELATIONSHIP BETWEEN SAMPLES

In every case that a comparison between group opinions was made, it was based on the assumption that the groups represented independent samples. This was concluded because:

(i) each sample was drawn at random from different populations;

(ii) there was no evidence that the samples were related or matched;

(iii) in each case the sample populations were of different sizes.

(See Siegel, 1956, pp.61 and 95.)

3.6.1.3 TIES IN THE DATA

Some sources claim the presence of a high proportion of ties in the data result in certain non-parametric tests being invalidated (e.g. Mann-Whitney U Test (Blalock, 1960, p.201) and Spearman Rank Correlation (Blalock, 1960, p.321). In this research the opinion followed is one expressed by Siegel. When describing an example of the use of the

Mann-Whitney U Test, he writes:

> 'As this example demonstrates, ties (in the data) have only a slight effect. Even when a large portion of the scores are tied .... the effect is practically negligible.' (Siegel, 1956, p.125).

In spite of the ties in the data, therefore, opinions were compared using the Mann-Whitney and Kruskal-Wallis tests (see section 5.2).

3.6.1.4 TWO-TAILED TESTS

Because identifying the direction of the differences of opinion was not of primary concern, in each case two-tailed tests were used (see Siegel, 1956, p.13).

3.6.1.5 LEVEL OF SIGNIFICANCE

It was noted that there is a restraint on setting the level of significance too low because the smaller the probability of rejecting the true hypothesis, the larger the probability of accepting a false hypothesis, particularly if the sample size is small (see Freund and Williams, 1977, p.284). To limit any differences detected as being due to chance to less than 5 times in a 100, the level of significance for most statistical procedures was set at 0,05. Sometimes it was necessary to conduct repeated tests on the same data (e.g. when comparing the opinions of the groups within the sample population). When this was necessary, it was acknowledged, in spite of views to the contrary (e.g. Johnson, 1984, p.502), that the probability of detecting differences due to chance would increase, so the level of significanee was decreased accordingly, usually to 0,01 (Brownlee, 1965, p.300 and pp.316-318).

3.6.1.6 DEGREES OF FREEDOM

In each case, the degrees of freedom for the test being conducted was taken from the output of the statistical package used (see section 3.6.3).

3.6.2 STATISTICAL TESTS AND PROCEDURES

Statistics were used in this research in four ways:

(i) Descriptive statistics were used to indicate the location and spread of the data.

(ii) Statistics were used to compare the opinions of the experts and the practicing systems analysts. These comparisons were made per dimension per question in the questionnaire (see section 5.2). In each case, the degree of confidence with which the opinions of the individual groups could be regarded as representing the opinion of the sample population, was determined. Consequently, each person's opinion on each item was used to determine the extent to which the groups disagreed on each issue (Alavi, 1984b, p.560).

(iii) The reliability and validity of the questionnaire as a measuring instrument was tested by calculating inter-item correlations.

(iv) As part of the process of identifying a new set of generic skills clusters, factor analysis was used as a descriptive tool.

3.6.2.1 DESCRIPTIVE STATISTICS

Besides providing full details of the raw data collected in response to the questionnaire (see appendices 'H' and 'I'), descriptive statistics were used to provide an indication of the dispersion of opinions expressed in the responses. These descriptive statistics included:

- frequency counts,
- median, upper and lower quartile scores,
- percentage based frequency tables.

Descriptive statistics from all the responses to sections 4 and 5 of the questionnaire are given in appendix 'K' while important comparisons and distributions are included in various places in the text (e.g. tables 5.5 and 5.12). No attempt has been made in the percentage based frequency tables to ensure that the count sums to exactly 100%. The figures presented were taken directly from the output from the statistical package (see section 3.6.3).

3.6.2.2 TESTING OF OPINIONS

The opinions of groups of respondents to the questionnaires were compared and contrasted. This analysis of variance was done for each dimension of the questionnaire. For each test:

THE NULL HYPOTHESIS (HO) was that there was no difference of opinion between the sample groups (i.e. the groups could not be said to disagree);

THE ALTERNATE HYPOTHESIS (H1), therefore, was that a difference of opinion could be identified, and that the groups could be said to disagree.

Two separate tests were used to test the hypotheses (and in each case the characteristics and parameters described in section 3.6.2.1 applied).

- The Mann-Whitney U Test was used in each case when the opinion of 2 groups were being compared (Siegel, 1956, p,116; Vitalari and Dickson, 1983, p.951; Alavi, 1984b, p.561).
- Because of its versatility and that it does not require equal sample sizes (and in spite of its recognized limitations (see e.g. Miller, 1981, p.168)), the Kruskal-Wallis Test was used to compare the opinions of more than two groups in the sample population (Siegel, 1956, p.184).

3.6.2.3 INTER-ITEM CORRELATIONS

An inter-item correlation was done between all the variables in sections 2, 3, 4 and 5 of the questionnaire (see appendix 'L'). These correlations were used to demonstrate the reliability and validity of the questionnaire as a measuring instrumen see section 4.3.1). The strength of the relationship between these items of data were indicated by using Kendall's Tau B (Blalock, 1960, p.321; Bohrnstedt and Knoko, 1982, p.296; Hamilton and Ives, 1980, p.10; McKeen, 1983, p.56; McCall, 1970, p.314; Danziger and Kraemer, 1986, p.231).

3.6.2.4 FACTOR ANALYSIS

It is acknowledged that factor analysis is a parametric statistical process (based on the calculation of r^2), and it is conceded that in this study the sample size ($n = 159$) tended to be small in relation to the number of variables processed (m = 58). There is, however, evidence in the literature of this technique being used in similar circumstances purely as a descriptive technique, with no inferential connotations (see e.g. Bailey, 1982, p.353; Ives, Olson and Baroudi, 1983, p.789 and Mahamood, 1987, p.310). A description of exactly how the technique was used to support a process of identifying new systems analysts' skills into clusters which are independent from a traditional or a perceived systems development life cycle, is given in step 3 of section 7.2.1.

3.6.3 STATISTICAL PACKAGE

All statistical calculations were computed on an IBM mainframe using Release 5 of SAS Institute Incorporated's Statistical Analysis System.

3.7 SUMMARY OF THE CHAPTER

In this chapter the characteristics of the research programme were given to provide a comprehensive account of the research methods used in this study.

The attributes of the research were established by building on the foundations of prior research done in this area and other closely related areas.

The research problem was clearly stated to emphasize the importance, to practitioners and academics, of knowing the skills profile of the systems analyst of the future.

The factors which determined the research approach were identified and their influence on the choice of research strategy were noted.

These factors were ultimately the reason for choosing a research paradigm from the social sciences and the characteristics of the research were a direct result of this choice.

Although the research did not follow the familiar pattern of hypothesis testing, it was possible to classify the study into the Type 1a category of the Ives, Hamilton and Davis model (a category into which 29,6% of the research they identified could be placed (Ives, Hamilton and Davis, 1980, p.921)).

The next section of the chapter was details of the steps followed to build the two conceptual models and the process followed to identify the skills profile of the future systems analyst. This was followed by a description of the steps taken to group these skills into clusters which are independent of a systems development life cycle.

The chapter closed with details of how statistics were used to analyze the empirical data collected during the study and to support some of the deductive reasoning in the research.

CHAPTER FOUR

THE EMPIRICAL STUDY: DATA COLLECTION

4.1 INTRODUCTION TO DATA COLLECTION

The next stage of the research was to use a foundation of prior research to build the first of the systems analysts' skills models. This model was based on the opinions of a sample population of experts and systems analysts in the South African computer industry (see figure 4.1).

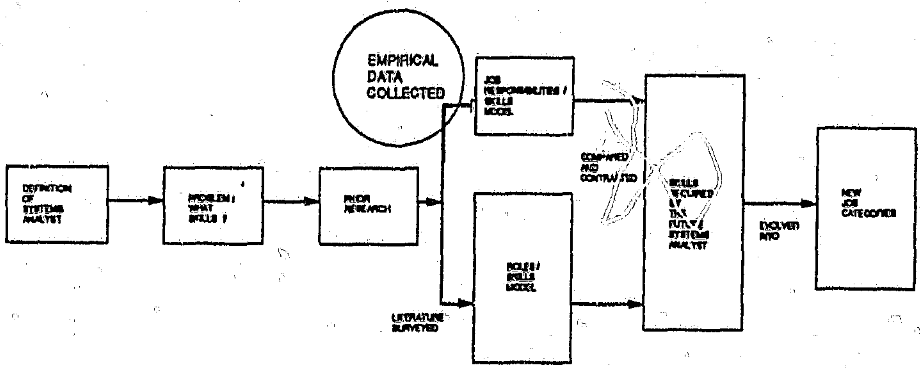

FIGURE 4.1
This stage of the research in context

Details will be given of how the questionnaire was built and distributed to the sample population. An effort will be made to establish the degree of confidence with which the opinions used to build this model can be regarded as representative.

The chapter has two sections:

- collecting the data,
- evaluating the data collection procedures used.

4.2 COLLECTING THE DATA

The empirical data used in this research was collected using mailed questionnaires. This section describes:

- the objective of the questionnaire,
- the steps followed in the construction of the questionnaire,
- the structure of the questionnaire,
- the distribution of the questionnaire,
- the response to the questionnaire.

The steps followed to conduct this empirical survey are presented diagrammatically in figure 4.2.

4.2.1 OBJECTIVE OF THE QUESTIONNAIRE

The objective of the questionnaire was to gather the opinions of a large population of practising systems analysts on the skills required by the systems analysts of the future.

4.2.2 CONSTRUCTION OF THE QUESTIONNAIRE

Because the directions which can be taken in a rapidly evolv

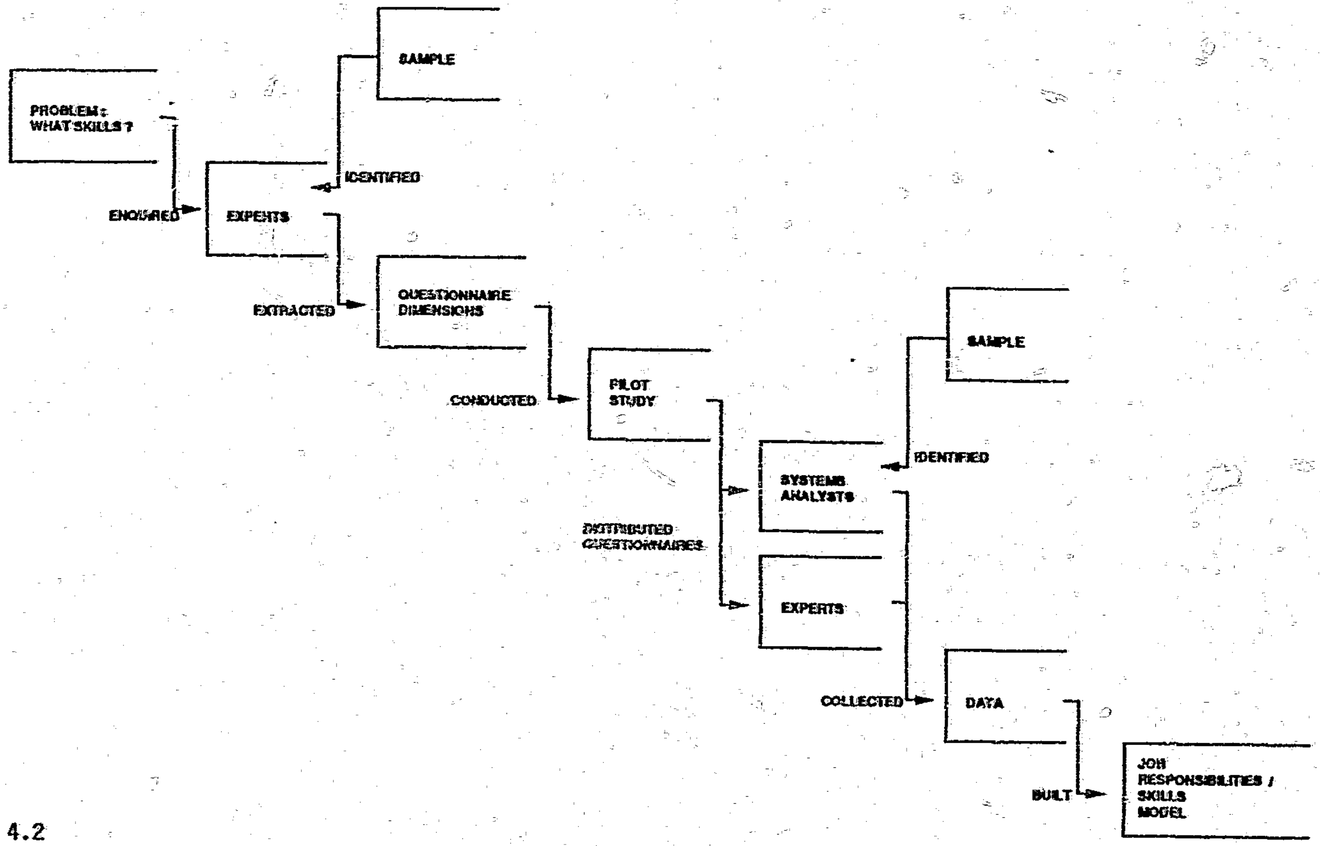

FIGURE 4.2

Steps followed to conduct the empirical survey technological environment are uncertain, widely divergent views regarding the future skill requirements for systems analysis were anticipated. In an effort to establish some form of consensus as a basis for the research (and to avoid personal bias and a single perception) a small group of experts was approached to provide the dimensions which formed the basic structure of the questionnaire. This section describes:

- collecting expert opinion
- the structure of the questionnaire
- evaluating the questionnaire in a pilot study.

4.2.2.1 COLLECTION OF EXPERT OPINION

The opinions of a group of experts directly involved in the process of application software development were gathered to provide the dimensions of the major part of the questionnaire. This section describes:

- identifying the sample of experts,
- collecting expert opinion: round one,
- collecting expert opinion: round two.

4.2.2.1.1 SAMPLE OF EXPERTS

The initial step in gathering the empirical data was to make contact with a small group of experts who were known to be directly involved in the development of computer-based applications. These experts, identified in 'The 1985 South African Who's Who in Computers' (Systems, May 1985) fell into two categories.

The first category, the PRACTITIONER experts, were a random selection of those personnel named who indicated that they were involved in the management of business application software development. A total of 34 experts was identified in this group.

The second category, the ACADEMIC experts, were identified through being the leading academics in the field of Business Information Systems at South African Universities. There were 13 participants in this group (see table 4.1).

4.2.2.1.2 COLLECTING EXPERT OPINION: ROUND ONE

As a means of diminishing some of the negative psychological factors of face-to-face discussion (particularly the distorting effect of the majority opinion, dominating personalities and group compulsion (Perez and Schuter, 1982, p.160), the experts were approached via a mail-shot. In September 1985 each expert was sent an explanatory letter, a list of definitions and three open-ended questions about the future role of the systems analyst in business application software development (see appendices 'A' and 'B').

To help focus the experts' thoughts on the skills required by the systems analyst of the future, the three questions were asked in a specific order. Firstly, the experts were asked to identify the methods which they thought would be used in the future to develop computer-based systems. In the second question the experts were asked to identify the expected job responsibilities of the future systems analyst. The final question asked the experts to list the necessary skills which will be required by the systems analyst of the future to perform these job responsibilities.

To help maintain the momentum of the research programme, the experts were asked to reply to the questions by the end of September 1985. By this dead-line, replies were received from 6 academics and 16 practitioners (see table 4.1). This constituted a 47% response-rate.

TABLE 4.1
Details of expert participation

	Practitioners	Academics	Total	Percentage
Number identified	34	13	47	100%
Round 1 replies	16	6	22	47%
Round 2 replies	23	9	32	68%

A total of 60 skills, covering a broad spectrum of capabilities, was identified from these replies. These skills are listed in table 4.2. An analysis of these replies high-lighted the following problems:

(i) More than half the skills were identified as necessary by just one person (11 skills by single academics and 22 skills by single practitioners, giving a total of 33 skills identified by single individuals as being required in the future by systems analysts).

(ii) A total of 42 of the 60 skills were mentioned by one or more individuals from one of the groups of experts, but by no-one from the other group (13 skills identified by academics and not practitioners, and 29 skills mentioned just by practitioners but not by academics).

(iii) Significant differences were found in the amount of time and effort given by the experts to replying to the questions. Some replies were hand-written on the original question paper, while one reply was the abbreviated minutes of a management meeting called by the expert to discuss the questions.

(iv) It was not always clear whether the experts were using some of the key words in the study consistently (e.g. it was not certain if each respondent who suggested that the future systems analyst should have communication skills would have regarded interviewing, verbal communicating, report writing, presentation preparing, teaching, etc. as being equally important).

(v) There was no way of knowing the strength of the respondents' opinions. It was possible that a skill was identified because it was regarded as definitely required, because it may be required or because it could be good to have it under certain specific circumstances.

These problems made collating the data without making assumptions, impossible. It was decided, therefore, to approach the same group of experts again to ask them to clarify their first set of answers.

4.2.2.1.3 COLLECTING EXPERT OPINION: ROUND TWO

The data collected from the initial approach to the experts was grouped into the categories used in a similar study (Crocker, 1984, p.68) to provide more structured answers to the original questions. The experts were asked to confirm the significance of each of the possible answers and, if necessary, to make comments about each question or introduce any new variable which they felt had been overlooked in the previous round.

The second approach to the originally identified experts was made with a return date for mid-November 1985. It was encouraging that the response rate to this second approach to the experts (68%) was higher than that achieved in the initial approach (see table 4.1). Perhaps the participants found it easier to respond to the less open-ended questions.

The frequency counts of the replies received is given in appendix 'C'. The median scores of their opinions on the skills required by future systems analysts is given in table 4.2.

These data were used directly in the structuring of the questionnaire to be sent to a sample group of practising systems analysts.

4.2.2.2 STRUCTURE OF THE QUESTIONNAIRE (See appendix 'G')

The questionnaire was designed to ensure that respondents:

(i) were, in fact, practising systems analysts;

(ii) were given the opportunity to follow a particular train of thought to focus their attention on the skills required for the future systems analysts;

(iii) were able to record their opinions on a descriptively anchored five point Likert-type scale (with scores alternating in direction at least per section);

(iv) where appropriate, were provided with an OTHER category to include dimensions they felt had been overlooked previously.

The questionnaire had the following seven sections:

Section 1 - This section was designed to identify the respondent's current job activities. This information was used to ensure that only data from respondents who were currently practising systems analysts were included in the research.

Section 2 - The objective of this section was to attempt to identify the respondent's current systems analysis skills. (The dimensions in this section were the same as those used in section 5, but the wording was different, they were presented in a different order and they were scored randomly in alternate directions).

Section 3 - The question in this section was designed to focus the participant's attention on the methods and tools which will be used in the future development of computer-based application systems.

Section 4 - This question asked the respondents to give their opinion of future systems analyst's possible job responsibilities.

Section 5 - In this section the participants were asked to give their opinions on the importance of a range of skills which may be needed by the systems analyst with the job responsibilities identified in the previous section.

Section 6 - This single question was an attempt to determine how prepared the respondents felt they were to perform effectively as systems analysts in the future.

Section 7 - This section was designed to capture demographic details about the participants.

NOTE

(i) The dimensions of sections 3, 4 and 5 were taken directly from the replies received to the questions put to the experts in the previous step in the research programme.

(ii) The categories of organizations used in section 7 were taken from Miller, 1978, p.602.

4.2.2.3 THE PILOT STUDY

4.2.2.3.1 DESCRIPTION OF THE PILOT STUDY

A pilot study, mirroring the procedures of the main study, was conducted during April 1986. The group of 16 people who participated in the exercise was made up of 7 senior students and 9 practitioners from two different companies. A verbal explanation of their role in the research programme was given to the participants. Each participant was then handed the questionnaire, a covering letter and a list of specific points to consider when completing the questionnaire (see appendix 'D').

Those participating in the pilot study were asked to provide comment on the following points:

(i) The time it took to complete the questionnaire.

(ii) The effectiveness of the format and wording of the questions in procuring the required infcrmation.

(iii) The problems encountered from reversing the direction of scoring of dimensions.

4.2.2.3.2 RESULTS OF THE PILOT STUDY

The results of the pilot study showed that the questionnaire was long, but not too long and that few or no problems were encountered resulting from the reverse in the direction of scoring of dimensions. (Later both the findings were found to be questionable. During the main study, respondents complained of both the questionnaire length and unnecessary confusion caused by reversing the scoring directions.)

TABLE 4.2

Systems Analyst skills identified by experts as being required in the future, with median scores (1 = not required; 3 = could be required; 5 = definitely required. n=32).

Development Tools/Methods	
Determining Appropriate Development Methods	4
Determining Appropriate System Controls	5
Determining Appropriate System Security	5
Evaluating Software Packages	4
Using Structured Analysis Methods	4
Using Automated Systems Development Methods	5
Using Prototyping Techniques	5
Using Techniques Associated with Databases	5
Applying Information Technology	5
Construction Algorithms	3
COBOL Programming	3
FORTRAN Programming	1
Implementing Applications Packages	4
AIA Programming	2
Using Fourth Generation Languages	5
Social/Communication	
Working In and With a Team	5
Dealing with People	5
Being Diplomatic	5
Interviewing	5
Verbal Communicating	5
Report Writing	5
Presentation Preparing	5
Teaching	5
Selling Ideas	4
Environment	
Organisation Structuring	3
Identifying User Functions	4
Implementing Office Procedures	3
Establishing Corporate Data Requirements	4
Business Practices Skills	4
Analysis	
Evaluating Existing Procedures	4
Thinking Logically	5
Problem Solving	5
Acting as Change Agent	5
Fact Finding	5
Implementing Procedures	4
Organization And Methods Skills	4
Identifying User/Management Needs	5
Hardware	
Designing Installation Configurations	3
Designing Computer Networks	3
Using Computer Networks	4
Determining Telecommunication Requirements	3
Finance	
Cost Estimating	4
Cost/Benefit Analysis	4
Costing	4
Auditing Computer Systems	3
Quantitative Methods	
Statistics	3
Management/Project Management	
Managing/Motivating People	5
Task Prioritizing	4
Strategic Planning	4
Identifying Competitive Advantages	3
Building Competitive Positions	3
Decision Making	4
Managing Change	4
Reviewing Performances	4
Project Planning	4
Project Controlling	4
Progress Monitoring	4
Scheduling	4
Estimating Timescales	4
Critical Path Analysis	3
Decision Making	4

TABLE 4.2

Systems Analyst skills identified by experts as being required in the future, with median scores (1 = not required; 3 = could be required; 5 = definitely required. n=32).

Skill	Median
Development Tools/Methods	
Determining Appropriate Development Methods	4
Determining Appropriate System Controls	5
Determining Appropriate System Security	5
Evaluating Software Packages	4
Using Structured Analysis Methods	4
Using Automated Systems Development Methods	5
Using Prototyping Techniques	5
Using Techniques Associated with Databases	5
Applying Information Technology	5
Construction Algorithms	3
COBOL Programming	3
FORTRAN Programming	1
Implementing Applications Packages	4
ADA Programming	2
Using Fourth Generation Languages	5
Social/Communication	
Working In and With a Team	5
Dealing with People	5
Being Diplomatic	5
Interviewing	5
Verbal Communicating	5
Report Writing	5
Presentation Preparing	5
Teaching	5
Selling Ideas	4
Environment	
Organisation Structuring	3
Identifying User Functions	4
Implementing Office Procedures	3
Establishing Corporate Data Requirements	4
Business Practices Skills	4
Analysis	
Evaluating Existing Procedures	4
Thinking Logically	5
Problem Solving	5
Acting as Change Agent	5
Fact Finding	5
Implementing Procedures	4
Organization and Methods Skills	4
Identifying User/Management Needs	5
Hardware	
Designing Installation Configurations	3
Designing Computer Networks	3
Using Computer Networks	4
Determining Telecommunication Requirements	3
Finance	
Cost Estimating	4
Cost/Benefit Analysis	4
Costing	4
Auditing Computer Systems	3
Quantitative Methods	
Statistics	3
Management/Project Mamgement	
Managing/Motivating People	5
Task Prioritizing	4
Strategic Planning	4
Identifying Competitive Advantages	3
Building Competitive Positions	3
Decision Making	4
Managing Change	4
Reviewing Performances	4
Project Planning	4
Project Controlling	4
Progress Monitoring	4
Scheduling	4
Estimating Timescales	4
Critical Path Analysis	3
Decision Making	4

(i) UNCHANGED DIMENSIONS

There appeared to be a number of dimensions which could be expected to reflect the same opinions by a substantial majority of respondents (e.g. the need for verbal communication skills and the need for skills in business activities). Because of the nature of the research (see section 3.2.3), these dimensions were retained in the final questionnaire in order to measure the strength of agreement across respondent groups (see sections 5.2.1 and 5.3.1).

(ii) DROPPED DIMENSIONS

Four dimensions were dropped from section 5 as a direct result of the pilot study. The reasons for excluding these dimensions, are summarized in table 4.3.

TABLE 4.3
Dimensions dropped as a result of the pilot study.

DIMENSION	REASON
Using computer networks	Ambiguous
Costing	Ambiguous
Managing change	Not regarded as systems analyst skill
Decision making	Duplicate

(iii) ADDITIONAL DIMENSION

One additional dimension was included as a result of the pilot study. It was suggested that the skill of building systems which can be audited be included in the group of auditing skills.

(iv) REPLACED DIMENSIONS

Those participating in the pilot study suggested that two dimensions in section 5 be replaced:

(a) 'Using techniques associated with databases' was changed to 'Designing logical data models'.

(b) 'Applying information technology' was changed to 'Determining specific users' information requirements'.

The above changes were made to the questionnaire before it was used in the main study (see appendix 'G'), but the data collected in the pilot study were excluded from the sample of data processed.

4.2.3 DISTRIBUTION OF THE QUESTIONNAIRE

The questionnaires were to be distributed to a sample population of practising systems analysts. There was, however, a problem. No register of practising systems analysts existed. To overcome this problem, a combination of the approaches used by Crocker (1984) and Benbasat et al (1980) was followed. This approach had five steps.

(i) An effort was made to identify the total population of systems analysts in the South African I.S. industry.

(ii) The total population of companies which employed I.S. personnel with the responsibility of developing and implementing commercially orientated computer-based systems, was identified.

(iii) The distribution of systems analysts across these companies was estimated.

(iv) The total number of questionnaires to be mailed was determined by selecting a sample population of companies and varying the number of questionnaires sent to each group of companies (depending on the number of I.S. staff employed by the individual companies).

(v) The questionnaires were mailed to senior staff members of the I.S. departments of companies in the sample population. These senior personnel were requested to distribute the questionnaires to a selection of systems analysts in their organizations.

4.2.3.1 ESTABLISHING THE EXISTING POPULATION OF SYSTEMS ANALYSTS

Because no register of practising systems analysts existed, not only were the names of the people from whom the sample population was to be drawn unknown, but other sources were needed to establish the total population of systems analysts.

Two sources were identified which provided an indication of the approximate size of the existing population of systems analysts in South Africa.

(i) PE/CPL SALARY SURVEY

Staff shortages identified in the 1984 Salary Survey (P-E, 1984, p.8) provided numbers of personnel required by the South African computer industry in various 'analyst' categories. By combining these categories (see table 4.4) it could be assumed that the expected population was approximately 1 800 systems analysts for 1985.

TABLE 4.4
Number of analysts (all categories) in the South African computer industry, 1984 (from P-E, 1984, p.8).

	HAVE	NEED
Systems Analysts	536	680
Business Analysts	147	183
Analyst Programmers	727	899
Totals	1 410	1 762

(ii) NATIONAL PRODUCTIVITY INSTITUTE REPORT

The figures in table 4.4 were supported by those given in the National Productivity Institute's report on the South African computer industry. In this report it was claimed that there were 1 800 systems analysts in the industry in 1983 (and the numbers were required to grow at a rate of 120 per annum (NPI, 1983, p.213).

While these figures gave some indication of the total population of systems analysts in the South African computer industry, the problem of not being able to identify them directly (for the purpose of sampling) still remained. The first step taken towards overcoming this problem was to identify the companies which employed systems analysts.

4.2.3.2 IDENTIFYING THE POPULATION OF COMPANIES EMPLOYING SYSTEMS ANALYSTS

Three types of organizations which employed systems analysts were identified in the 1986 Computer Users' Handbook (see table 4.5):

- companies with in-house I.S. departments;
- bureaux and software houses;
- companies offering I.S. consulting services.

It was recognized that this list from the Computer Users' Handbook was incomplete because information is volunteered to the publishers. Some organizations, for example those in the government sector, were not included on the list (see section 4.3.2, Potential Problem 9).

Not all the companies listed in the Computer Users' Handbook automatically qualified for inclusion in the population from which the sample was selected. To help ensure that people who participated in the research were those with the relevant background, job responsibilities and insight, the criteria below were used to exclude certain organizations from the sample population:

(i) Any company which employed fewer than ten personnel was excluded (because the possibility existed that the nature of the work done in these very small environments could be inconsistent with the main thrust of I.S. activity (see Further Research in section 8.3.3).

(ii) Both in-house and consultancy groups which did not indicate that their employees were involved in the development of commercially orientated applications were excluded (because this research concentrated on the role of the systems analyst in the business environment).

(iii) Consultancies not offering 'a complete DP service' were not regarded as part of the sample population (because they might not have had personnel employed as systems analysts).

(iv) Bureaux and software houses not offering 'systems analysis and design facilities' were also excluded from the sample population (because there was the possibility that they did not have people employed as systems analysts).

As a result of this screening process 287 companies with in-house I.S. departments, 11 consultancies and 85 bureaux/software houses who employ systems analysts, were identified (see table 4.5).

4.2.3.3 IDENTIFYING THE DISTRIBUTION OF SYSTEMS ANALYSTS ACROSS COMPANIES

Although the types and number of organizations which employed systems analysts could be identified (see section 4.2.3.2), still no details were available on the number of systems analysts who worked in each group of companies. To overcome this problem a lead was taken from Crocker. He quoted a study by the Institute of Manpower Studies which:

> '.... showed that the number of systems analysts employed by any individual organization was directly related to their total establishment for computing personnel' (Crocker, 1984, p.4).

Based on these findings, it was concluded that the distribution of systems analysts across the categories of companies would follow the number of I.S. personnel employed within each category. These figures were available from the 1986 Computer Users' Handbook. Once the exclusions (identified in section 4.2.3.2) had been made, it was found that approximately 80% of the I.S. personnel were employed in in-house

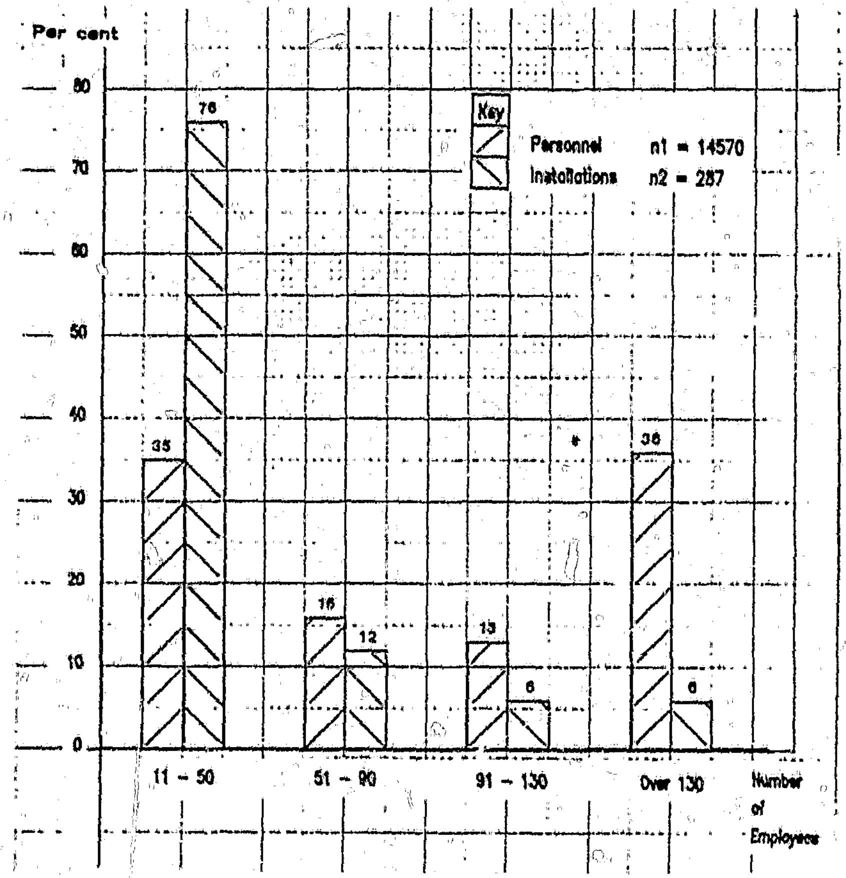

FIGURE 4.3
A comparison of the percentages of personnel employed and the percentages of installations across I.S. department sizes (from 1986 Computer Users Handbook)

I.S. departments, about 5% by consultancies and the remaining 15% by bureaux and software houses (see table 4.5). It was assumed, therefore, that the distribution of systems analysts across the categories of companies would follow approximately the same ratios.

The companies with in-house I.S. departments presented a further problem. When the number of companies in this category was sub-divided into groups (according to the number of personnel employed) it was found that:

- the majority of companies (76%) had relatively small I.S. departments of between 11 and 50 employees.
- the majority of staff (36%) were employed by the relatively larger I.S. installations of above 130 employees.

(See figure 4.3.)

4.2.3.4 DETERMINING THE NUMBER OF QUESTIONNAIRES TO DISTRIBUTE

It was decided to provide approximately 20% of the practising systems analysts in South Africa with an opportunity to supply input to the research. This required the distribution of approximately 400 questionnaires (see section 4.2.3.1). To help ensure that the sample population was representative, the questionnaires were distributed in proportion to the number of staff employed by the companies in each category identified. (Determining these proportions in terms of the number of companies in each category would have resulted in a bias in favour of the systems analysts working in the smaller companies (see figure 4.1).)

Because of the disproportionate ratios between the number of companies and the number of systems analysts employed by the companies in each category (see table 4.5), two steps were taken:

(i) A disproportionate stratified sampling technique was used in each category (Bailey, 1982, p.105). This resulted in 131 companies being selected from a total population of 383 (see table 4.5).

(ii) The number of questionnaires sent to each company ranged from two to six, depending on the number of I.S. personnel employed by the company (see table 4.5).

In total 406 questionnaires were mailed, of which 317 were sent to companies with in-house I.S. departments, 33 were sent to consultancies and 56 to bureaux and software houses. This distribution pattern approximates the distribution of I.S. personnel across these categories (see table 4.5).

TABLE 4.5
Sample population of companies and number of questionnaires mailed

ORGANIZATIONS	NUMBER COM-PANIES	APPROX PERCENT STAFF	SELECTION	NUMBER SELECTED	QUESTIONNAIRES PER COMPANY	TOTAL
In-house I.S. Departments						
11 - 50 employees	219	25	1 in 4	55	2	110
51 - 90 employees	34	15	1 in 2	17	3	51
91 - 130 employees	16	10	ALL	16	3	48
over 130 employees	18	30	ALL	18	6	108
Consultants	11	5	ALL	11	3	33
Bureaux/Software Houses	85	15	1 in 6	14	4	56
Total	383	100		132		406

4.2.3.5 MAILING THE QUESTIONNAIRES

Questionnaires were mailed in batches to senior personnel in I.S. departments in the sample population of companies in mid-May 1986. A covering letter to the senior members of staff explaining their role in the distribution of the questionnaires accompanied each batch (see appendix 'E'). Attached to each questionnaire was another letter (addressed to the perspective participant) and a self-addressed, stamped envelope (see appendices 'F' and 'G'). The return date for responses was set for 6 June 1986.

Because the questionnaires were designed to ensure anonymity, respondents who were particularly interested in the research were invited to write under separate cover to indicate that they wished to be sent details of interim results.

4.2.4 RESPONSE TO THE QUESTIONNAIRE

The frequency distribution for each dimension of the questions in section 4 and section 5 of the questionnaire is given in appendix 'K'. In this section details are given of the response rate and the steps taken to ensure that the data could be regarded as representing the opinions of the sample population.

4.2.4.1 THE RESPONSE RATE

By the 6 June 1986, 169 questionnaires had been returned. Of these, seven were completed by individuals who indicated (in section 1 of the questionnaire) that they were not practising systems analysts, and five replies were incomplete. All 12 of these replies were excluded from the sample processed. Later a further six replies were received, but because processing of the data had commenced, they too were excluded from the data processed (see table 4.6).

TABLE 4.6
Details of the replies received to the mailed questionnaire

Number of questionnaires distributed		406 (100%)
Replies received		
Incomplete	5	
Completed by wrong group	7	
Late	6	
Total replies excluded		18 (4,4%)
Total replies processed		159 (39,2%)
Total replies received		177 (43,6%)

The effective response rate of 39,2% compared favourably with those of similar studies (see table 4.7) and was regarded as adequate for the exploratory nature of the study.

TABLE 4.7
Published response rates to mailed questionnaires in similar studies

STUDY	NUMBER OF QUESTIONNAIRES DISTRIBUTED	RESPONSE RATE
Crocker, 1984, p.13	739	34,6%
Hamilton and Ives, 1983, p.3	291	37,8%
Rivard and Huff, 1985, p.92	1 074	40%
Sumner, 1986, p.199	55	43%
Langle et al., 1984, p.275	500	14%

4.2.4.2 THE REPRESENTATIVENESS OF THE RESPONSE

Although it was recognized that non-respondents inevitably introduce an element of bias into empirical research (McNeill, 1975, p.37; Behr, 1983, p.156), determining the opinions of the non-respondents of this questionnaire proved difficult. There were three reasons for this:

(i) The actual sample of systems analysts was not known (see section 4.2.3);

(ii) Each questionnaire was distributed through a third person and any further approaches to the sample would again have to inconvenience that third person;

(iii) The replies were anonymous, so the respondents could not be identified (see Bailey, 1982, p.176).

Consequently, testing the extent of the response bias took the following form:

- attempted person-to-person telephone calls;
- a comparison of demographic data from this research with that of an independently conducted survey;
- a comparison of the opinions of early and later respondents.

4.2.4.2.1 TELEPHONE CALLS TO NON-RESPONDENTS

Efforts were made to speak to ten non-respondents directly by telephone (seven in the PWV area, two in Cape Town and one in Durban). After numerous calls, contact was made with only two non-respondents (both in the PWV area) both of whom said they forgot to reply to the questionnaire because of pressure of work. The trivial nature of the evidence collected using this approach (compared with the effort and costs involved) resulted in the data collected being dismissed as inconclusive. No further attempts were made to make direct contact with the non-respondents.

4.2.4.2.2 COMPARISON OF DEMOGRAPHIC DATA WITH AN INDEPENDENT SURVEY

To help establish that the non-respondents were a random sample (Shipman, 1981, p.60), some of the demographic data of the respondents to The South African Data Processing Salary Survey (1986) (P-E, 1986) were compared with that of the participants in this research. Data were extracted from the Salary Survey (which also reflected the position as at mid-year 1986) which referred to all categories of analysts (including analyst-programmers) to comply with the inclusion/exclusion rule enforced through section 1 of the questionnaire (see section 4.2.2.2).

The following comparison of respondents to the two surveys were made (see figures 4.4 to 4.8):

- distribution across geographic regions;
- ratio of males to females;
- years employed in the computer industry;
- highest academic qualification;
- cumulative size of installations.

(See Behr, 1983, p.156.)

(i) REGIONS

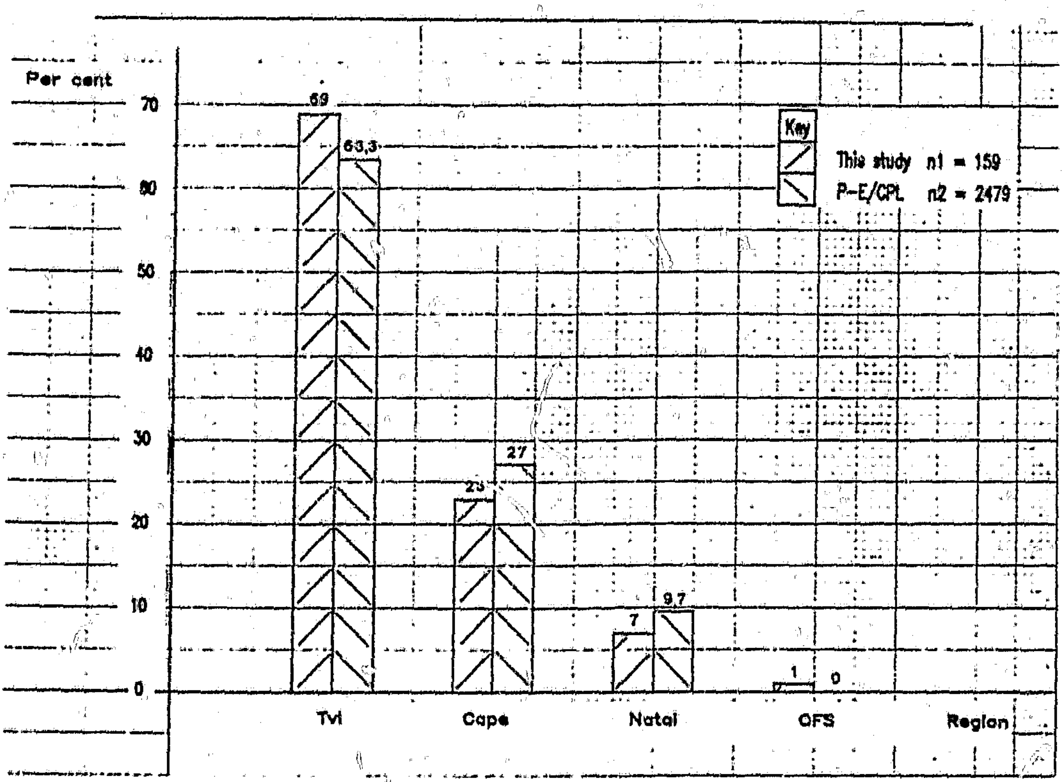

FIGURE 4.4
Comparison of survey results across regions

It was evident that a close similarity existed in the distribution of the respondents to both surveys across geographic regions (see P-E, 1986, Salary Tables).

(ii) GENDER

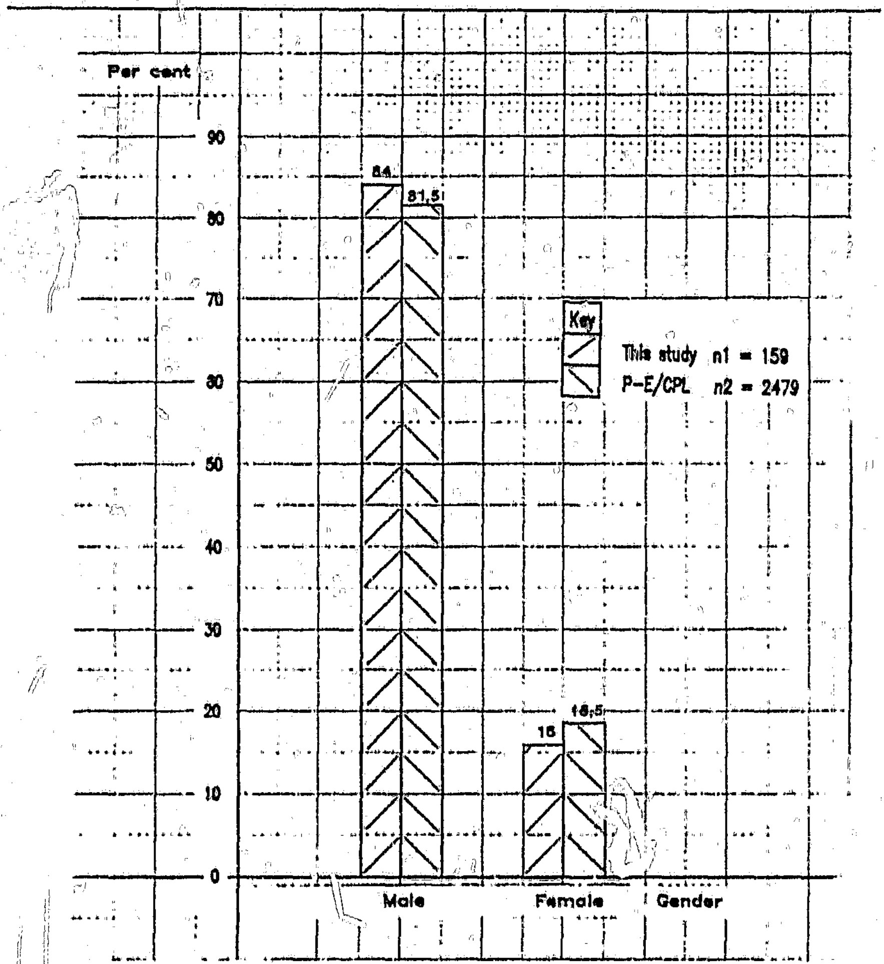

FIGURE 4.5
Comparison of the number of male and female respondents

Approximately the same percentages of male and female responded to both surveys (see P-E, 1986, Salary Tables).

(iii) ACADEMIC QUALIFICATIONS

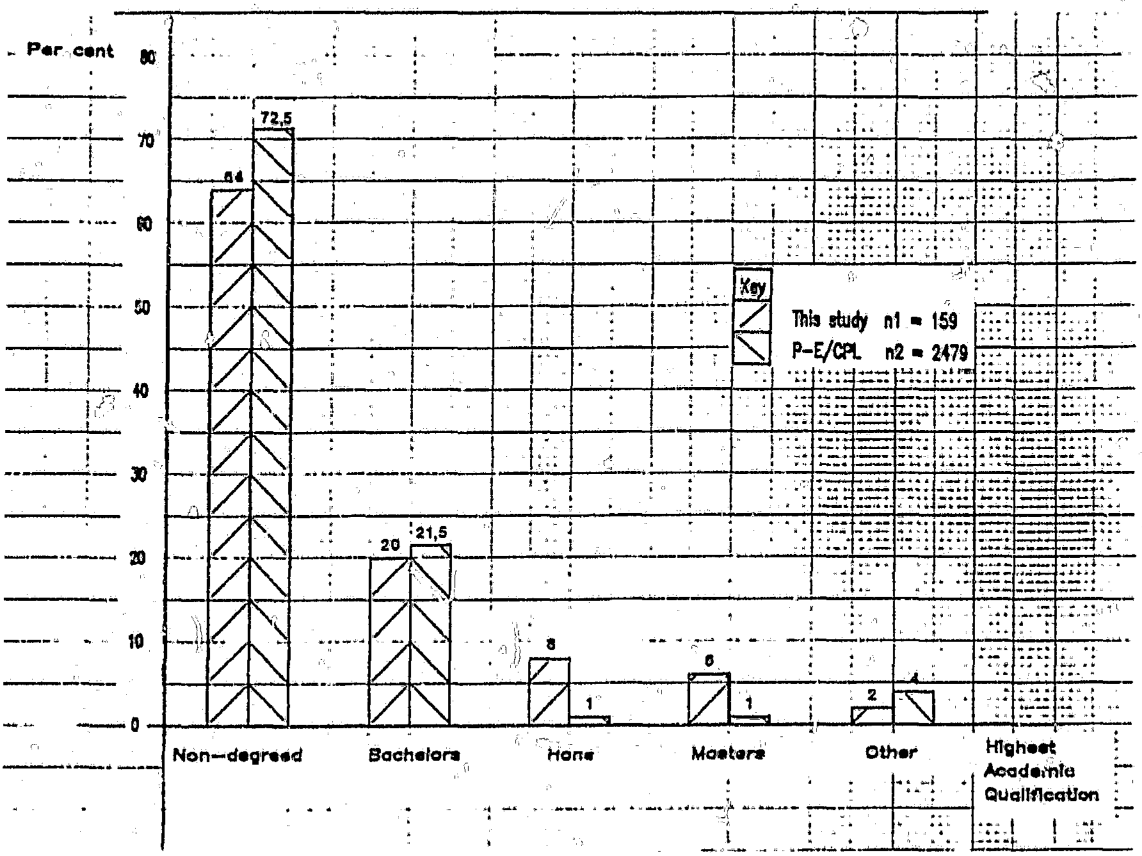

FIGURE 4.6
Comparison of highest academic qualification of respondents to each survey

There was evidence that a larger percentage of respondents in the current research had higher degrees than was the case for the Salary Survey (P-E, 1986 Introduction). Perhaps the reason for this was that people with higher academic qualification were likely to be more sympathetic to the objectives of the research and therefore asked to respond to the questionnaire. Two points are noted:

(i) Academic qualification was not identified as a reason for differences of opinion in the current research (see section 5.2.2.1);

(ii) Both surveys had respondents spread across the whole range of significant academic qualifications.

(iv) YEARS IN COMPUTER INDUSTRY

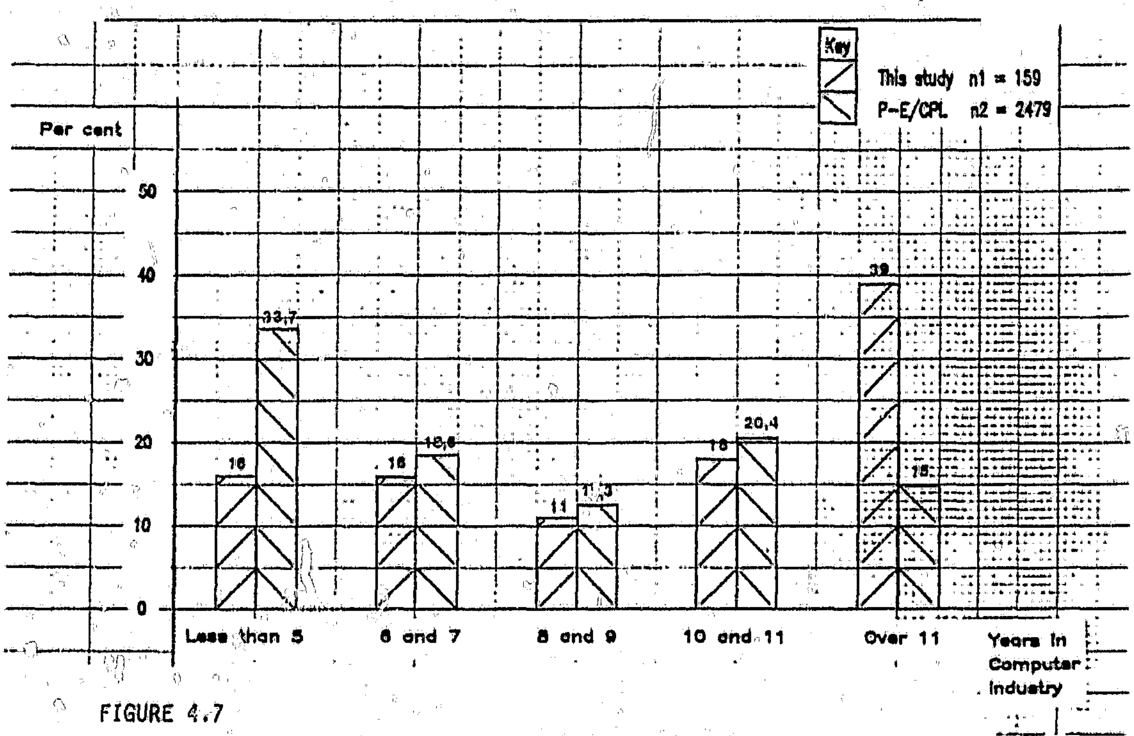

FIGURE 4.7
Comparison of the number of years which survey respondents have spent in the computer industry

Compared with details from the Salary Survey, (P-E, 1986) more senior personnel tended to respond to the questionnaire used in the current research. To provide helpful input to this research required experience, and perhaps questionnaires were therefore distributed to the more senior members of the I.S. departments. Certainly each group within these categories was represented in this research.

(v) INSTALLATION SIZE

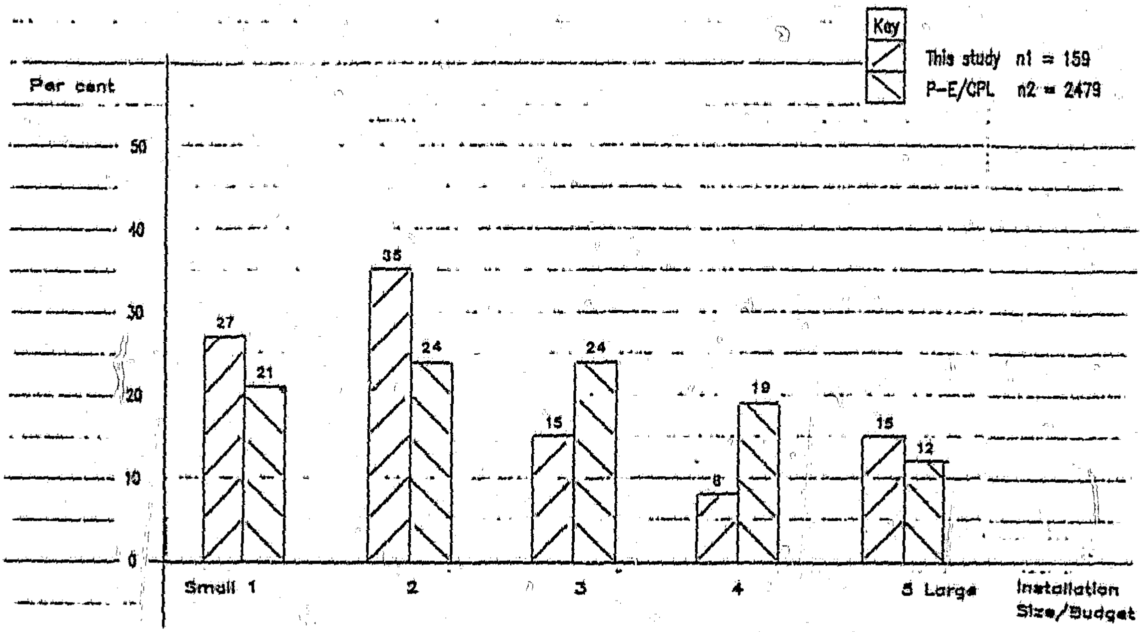

FIGURE 4.8
Comparison of the percentage of the size of installations in which the survey respondents were employed

Unfortunately the current research and the Salary Survey (P-E, 1986) did not use the same variable to record the size of the installations in which the respondents were employed. In the current research, 'size' was measured by the total number of people working in the installation. In the Salary Survey 'size' was measured by annual D.P. budget (P-E, 1986, Participants). The only comparison that could be made in this regard, therefore, was to compare size in terms of the number of people with size in terms of annual budget. This may be valid because a high percentage of the I.S. budget is likely to be allocated to people costs (Keen, 1981, p.78; Jackson, 1986, p.29; Cash et al., 1983, p.411). While figure 4.8 suggests that this study used more data from the smaller installations, the inconsistent distribution of data from the sizes of installations could be explained by the inexact measures. Figure 4.8 does show that in neither survey was the sample biased in favour of a particular group of installations.

(vi) CONCLUSION ON THE COMPARISON OF RESULTS WITH AN INDEPENDENT SURVEY

The similarities between the distributions of demographic data (in figures 4.4 to 4.8) from two independent surveys which were conducted at approximately the same time, but with different objectives, gave strength to the argument that the respondents to both surveys were random samples.

4.2.4.2.3 A COMPARISON OF THE OPINIONS OF EARLY AND LATER RESPONDENTS

Although the view does not appear to be widely held, Goode and Hatt claimed that, for most questionnaire-based studies, there are differences between those who reply promptly and those who delay their responses (Goode and Hatt, 1952, p.180). The authors made the assertion that, if very little difference can be identified between the opinions of the early and later respondents, it is a fair assumption that the sampling bias is not great.

The opinions of three groups of respondents (concerning the skills required by the systems analysts of the future) were compared using the Kruskal-Wallis test (Siegel, 1956, p.184). The groups were as follows:

GROUP 1 - The 6 respondents whose replies were received first.

GROUP 2 - The 6 respondents whose replies were received immediately before the cut-off date.

GROUP 3 - The 6 respondents whose replies were received too late to be included in the data processed.

Table 4.8 provides a summary of the results. In only two cases out of a possible 58 could the null hypothesis that the three groups are from the same sample population, be rejected (at the 0,50 level). It was noted that problem solving was one of the skills on which there was no agreement (in terms of its future importance as a systems analyst skill) among the whole group of practising systems analysts (see table 5.11). In the case of Ada programming skills, it was noted that this skill was not regarded as necessary to the future systems analyst, so any disagreement here can be regarded as spurious (see section 5.2.2.1).

If this is a valid test (the small sample size could have contributed to the small number of rejections), it could be claimed that there was little evidence of sampling bias in the response to the questionnaire.

TABLE 4.8
A list of systems analyst skills on which the groups of early and later respondents disagree in terms of future importance (n=18)

	df	KRUSKAL-WALLIS ($\alpha < 0{,}05$)
Problem solving	2	0,014
ADA programming	2	0,043

4.2.5 CONCLUSION ON COLLECTING THE DATA

A technique of sending questionnaires to senior members of the staff in I.S. departments for distribution to their systems analysts was used to compensate for the lack of a register of practising systems analysts.

An opinion-seeking questionnaire was carefully constructed and tested through a pilot study. A total of 406 questionnaires (equivalent to approximately 20% of the total systems analysts' population) was distributed to 131 randomly selected companies.

Replies were received from 170 respondents of which 159 (39,2%) could be used to represent the opinions of the sample population.

It can be said that there is virtually no way of answering the question of the possible bias caused by non-respondents to a mailed questionnaire (Black and Champion, 1976, p.398; McNeill, 1985, p.37). Although this is recognized, this research two approaches were used to test for this bias:

(i) Firstly, similarities were established between the demographic data in this research and that of the 1986 Salary Survey (P-E, 1986). The results suggested that the respondents to both surveys were representative samples.

(ii) Secondly, a lack of evidence of a sampling bias was found by comparing the opinions of early and late respondents.

In spite of the relatively low response rate, therefore, the opinions of the respondents was claimed to represent the opinions of the carefully identified sample.

4.3 EVALUATING THE EMPIRICAL RESEARCH PROCEDURES

The limitations of using mailed questionnaires to gather data have been well documented (Bailey, 1982, p.157; Kerlinger, 1973, p.414; Goode and Hatt, 1952, p.132; Jauch, Osborn and Martin, 1980, p.520). This made it important to establish confidence in the reliability of the data collected in this research (and, therefore, confidence in the conclusions drawn). To achieve this the following steps were taken:

- the reliability and validity of the questionnaire as a measuring instrument were established,
- where possible, efforts were made to counter known limitations,
- where it was not possible to counter known limitations, each outstanding problem was identified.

4.3.1 EFFECTIVENESS OF THE QUESTIONNAIRE AS A MEASURING INSTRUMENT

This section establishes the contribution which the reliability and validity of the questionnaire as a measuring instrument made to the levels of confidence in the research results.

4.3.1.1 RELIABILITY

Generally the reliability of a questionnaire as a measuring instrument is assessed using either the test-retest cycle or the sub-divide (split-half) test (Ives et al., 1983, p.788, Shaw and Wright, 1967, p.16). Neither of these approaches was used in this research because:

(i) Time constraints on the research programme, together with the method used to identify the sample population (see section 4.2.3.2), made the use of the test-retest approach impossible.

(ii) Bailey made the point that because a questionnaire measures multiple concepts, the split-half test is difficult, if not impossible, to administer for the questionnaire as a whole (Bailey, 1982, p.179).

The methods used to establish the reliability of the measuring instrument in this research, therefore, were to:

- build reliability into the questionnaire at the time at which it was designed;
- measure the questionnaires' reliability after the event, through inter-item correlations.

(i) RELIABILITY AND QUESTIONNAIRE STRUCTURE

A form of the test-retest approach was built into the questionnaire (see section 4.2.2). Among the questions asked of the respondents wore:

- an assessment of their current skills as a systems analyst (section 2 of the questionnaire);
- their opinion of the skills required by the systems analyst

of the future (section 5 of the questionnaire);

- their assessment of their own preparedness for being a systems analyst in the future (section 6 of the questionnaire).

To enhance the reliability of the questionnaire as a measuring instrument, the following procedure was used to demonstrate that a relationship existed between these three variables.

(a) An 'unpreparedness factor' was determined for each respondent by identifying each case where the respondent's perceived current skill level was lower than the level which, in his/her opinion, would be required for the systems analyst of the future.

A value was given to this 'unpreparedness factor' by assigning 1 point for each level of negative difference between the current skill level (section 2 score) and the perceived future skill requirement (section 5 score). So, if the level of skill required in the future was seen to be 5 (definitely required) and the respondent assessed his/her current skill level as 3 (average), then the 'unpreparedness factor' was regarded as 2.

(b) The 'unpreparedness factor' (labelled the 'perceived skills factor shortage'), was plotted against the score of the respondent's answer to the question on his/her perceived preparedness for future systems analysis (section 6 score). Figure 4.9 shows the highest, lowest and median scores for each group. The results ranged from a median of 12,5 for those who felt most prepared for the future, to a median of 38,5 for those who felt they had a significant lack of required skills.

There are two reasons why the results of the comparisons illustrated in figure 4.9 must be regarded as non-absolute.

REASON 1 - The data used to determine the 'unpreparedness factor' was ordinal and, therefore, could not be used for absolute computations (see section 3.6.1).

REASON 2 - Just how prepared individuals claimed to be for performing the functions of the systems analyst of the future depended on what skills were missing from their current skills matrix. When determining the 'unpreparedness factor', cognisance was taken of the level of importance each respondent gave to each skill. Respondents could have set these importance levels incorrectly and consequently the results could be misleading.

(c) Figure 4.9 was used, however, to illustrate nothing more than a trend. It shows that as respondents felt they were more prepared for the position of a systems analyst in the future, so their perceived skills shortages (the figure 4.9 discrepancy between their current skills and the skills they would require in the future) decreased. This trend showed that the answers to the questionnaire were, in fact, reflecting a consistency. This was regarded as characteristic of a reliable measuring instrument.

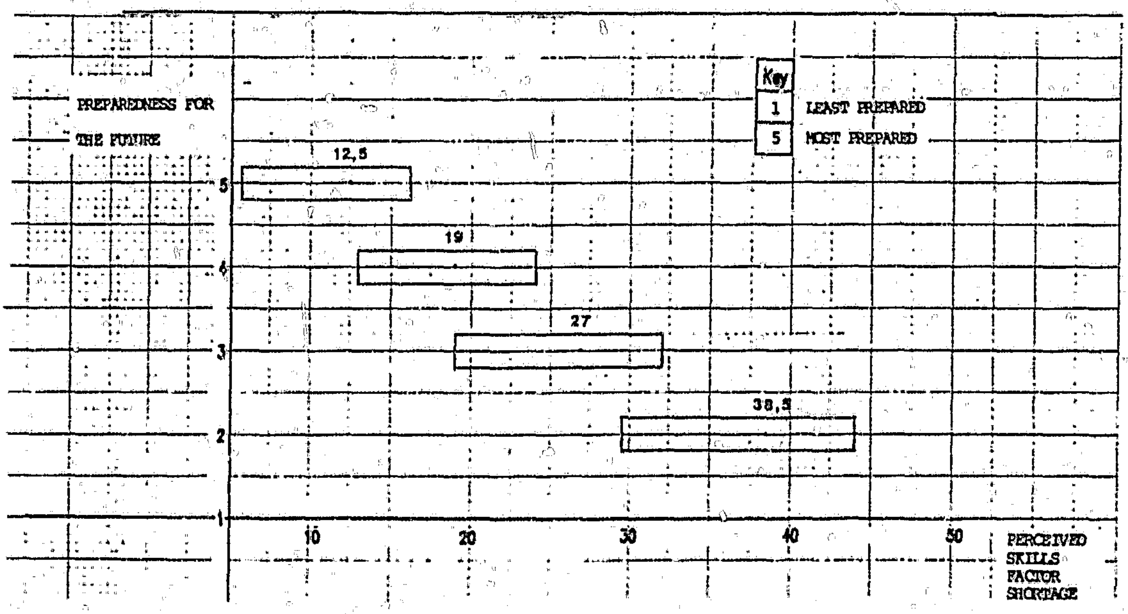

FIGURE 4.9
A diagram showing the respondent's trend towards preparedness for the future as the skills shortages for the future decrease

(ii) INTER-ITEM CORRELATION

The consistency of the results achieved using the questionnaire is demonstrated by the following four tables (tables 4.9 to 4.12). These tables have been compiled from the Kendall's Tau-B correlations detailed in appendix 'L'. The purpose of extracting the particular groupings presented in the first group of tables (4.9 to 4.11) was to demonstrate the validity of the questionnaire by showing that certain groupings of job responsibilities and skills (see groupings from the literature survey in section 6.3), do have strong correlations.

Positive correlations were identified between respondents' opinion on the value of certain future system analyst job responsibilities and their associated skills (table 4.9).

Positive correlation were identified between respondents' opinion on the value of certain skills which would be used across multiple job responsibilities by future systems analysts (table 4.10).

Correlations were high between groups of future systems analyst skills which are expected to be closely associated (table 4.11).

The purpose of table 4.12 was to show that there were no significant correlations between job responsibilities and skills which obviously have no expected relationships. While there are obviously other groupings which could have been chosen, those presented here were based on issues such as diverse methods of acquiring systems, or unrelated job responsibilities and skills (see section 6.3).

This information demonstrated that the questionnaire was measuring the same thing across a diverse sample population. These results helped to substantiate the claim that the questionnaire was a reliable measuring instrument. There is no reason to suspect that the exclusion of the correlation coefficients of any other combination of variables (complete details are provided in appendix 'L') has introduced bias into this conclusion.

TABLE 4.9

A list of some of the positive correlations between future systems analyst skills and predicted job responsibilities (n=191)

SKILL	JOB RESPONSIBILITY	KENDALL TAU	PROB > IRI
Using structured analysis methods (V9)	Use formal analysis procedures (C1)	,539	,0001
	Design systems (C11)	,338	,0000
	Formally document users needs (C5)	,374	,0000
Project controlling (V15)	Control systems development (C21)	,282	,0000
	Monitor systems development (C20)	,348	,0000
	Evaluate systems development (C22)	,322	,0000
	Conduct post-implementation evaluation (C25)	,356	,0000
Determine appropriate development methods (V22)	Identify appropriate development methods (C10)	,383	,0000
	Revise development method standards (C18)	,293	,0000
Evaluating application packages (V27)	Select packages (C26)	,605	,0001
	Implement packages (C27)	,554	,0001
	Customize packages (C28)	,488	,0001
Using prototyping techniques (V29)	Prototype systems (C14)	,569	,0001
Teaching (V50)	Act as consultant (C34)	,297	,0000
	Train users (C33)	,310	,0000
Reviewing performance (V56)	Evaluate performance of systems developers (C24)	,482	,0001
	Report on systems development (C23)	,410	,0001
	Evaluate systems development (C22)	,409	,0001
	Monitor systems development (C20)	,372	,0000

TABLE 4.10

A list of some of the positive correlations between future systems analyst job responsibilities and predicted skills (n=191)

JOB RESPONSIBILITY	SKILL	KENDALL TAU	PROB > IRI
Conduct feasibility studies (C4)	Cost-benefit analyzing (V12)	,370	,0000
	Estimating timescales (V20)	,329	,0000
	Estimating costs (V19)	,277	,0000
Problem solving (C8)	Thinking		
	Problem solving (V4)	,345	,0000
Plan systems development (C19)	Estimating timescales (V20)	,450	,0000
	Project planning (V15)	,446	,0000
	Determining appropriate development methods (V22)	,317	,0000
	Critical-path analysis (V21)	,360	,0000
Increase business skills (C30)	Skills in business practices (V8)	,344	,0000
Generate systems (C12)	Using automated systems development methods (V31)	,315	,0000
Evaluate systems development (C22)	Estimating timescales (V20)	,430	,0001
	Cost-benefit analyzing (V12)	,369	,0000
	Reviewing performance (V56)	,409	,0001
	Estimating costs (V19)	,321	,0000
	Progress monitoring (V18)	,368	,0000
	Project controlling (V16)	,362	,0000
Traditional programming (C13)	COBOL programming (V24)	,494	,0001

TABLE 4.11

A list of some positive correlations between groups of future systems analyst skill (n=191)

KENDALL TAU B CORRELATION COEFFICIENTS/PROB > IRI

	V47	V50	V51
V47	1,00000	0,36540	0,31457
	0,0000	0,0000	0,0000
V50	0,3540	1,00000	0,37791
	0,0000	0,0000	0,0000
V51	0,31457	0,37791	1,00000
	0,0000	0,0000	0,0000

V47 = Verbal communicating
V50 = Teaching
V51 = Selling ideas

	V16	V43	V44	V45
V16	1,00000	0,33306	0,25367	0,33812
	0,0000	0,0000	0,0003	0,0000
V43	0,3306	1,00000	0,69262	0,55414
	0,0000	0,0000	0,0001	0,0001
V44	0,25367	0,69262	1,00000	0,48331
	0,0003	0,0001	0,0000	0,0001
V45	0,33812	0,55141	0,48331	1,00000
	0,0000	0,0001	0,0001	0,0000

V16 = Project controlling
V43 = Working in and with a project team
V44 = Dealing with people
V45 = Being diplomatic

	V12	V19	V20
V12	1,00000	0,54338	0,29297
	0,0000	0,0001	0,0000
V19	0,54338	1,00000	0,40085
	0,0001	0,0000	0,0001
V20	0,29297	0,40085	1,00000
	0,0000	0,0001	0,0000

V12 = Cost-benefit analyzing
V19 = Estimating costs
V20 = Estimating timescales

(CONT)

TABLE 4.11 (CONT)

	V10	V11	V58
V10	1,00000	0,72399	0,28412
	0,0000	0,0001	0,0001
V11	0,72399	1,00000	0,38706
	0,0001	0,0000	0,0000
V58	0,28412	0,38706	1,00000
	0,0001	0,0000	0,0000

V10 = Determining appropriate system security
V11 = Determining appropriate system controls can be audited
V58 = Building systems which can be audited

TABLE 4.12

A list of job responsibilities and skills which have no association and an absenc of correlation (n=191)

JOB RESPONSIBILITY	SKILL	KENDALL TAU	PROB > IRI
Traditional programming (C13)	Using prototyping techniques (V29)	-0,163	,0076
	Verbal communicating (V47)	-0,128	,0487
Prototype systems (C14)	Constructing algorithms (V23)	-0,033	,5901
	Using structured analysis methods (V9)	-0,058	,3571
Select packages (C26)	Using fourth generation language (V30)	,005	,9326
	Statistics (V42)	,093	,1307
Increase business skills (C30)	Critical-path analysis (V21)	,066	,3071
	Project controlling (V16)	,090	,1830

4.3.1.2 VALIDITY

To help establish the level of certainty which can be attributed to the conclusions of this research, the questionnaire was assessed as a measuring instrument in terms of its:

face validity,

criterion validity, and

construct validity.

(i) FACE VALIDITY (also called CONTENT VALIDITY by Kerlinger, 1973, p.459)

Face validity results from the careful and systematic building of the questionnaire (Goode and Hatt, 1952, p.237; Ives et al., 1983, p.788). The extent to which this has been achieved for any particular measuring instrument is based on a subjective assessment and excludes the use of statistics (Nunnally, 1970, p.138). The questionnaire used in this study was carefully designed and built:

- each section automatically led to the next to help focus the respondent's attention on the skills required by the systems analyst of the future (see section 4.2.2);
- the dimensions of each question were derived directly from information gathered from the practitioner and academic experts (see section 4.2.2);
- before the questionnaire was distributed to the practising systems analysts, each individual question was evaluated for content, validity and clarity by those participating in the pilot study (see section

4.2.2.3).

On the strength of these judgemental issues, face validity was claimed for the questionnaire.

(ii) CRITERION VALIDITY

Because of the exploratory nature of the research (see section 3.2.3) the criterion validity of the questionnaire could not be established by comparing the results of the survey with currently known facts (Kerlinger, 1973, p.460). Although a comparison was made between the skills identified in the empirical study with those identified through the literature survey, 2 points must be noted:

(a) The skills identified in the literature could not be regarded as representing the opinions of practising systems analysts in medium to large I.S. departments in South Africa. Consequently, even if there had been a high level of agreement, it could not have been used to substantiate content validity.

(b) In fact, when this comparison was made, some areas of disagreement were identified (see section 7.3.1).

(iii) CONSTRUCT VALIDITY

Bailey claimed that in order to establish this category of validity is difficult, if not impossible for the questionnaire as a whole (Bailey, 1982, p.178). It has been argued further that:

> '.... a final claim of construct validity cannot be made until the questionnaire and theory (behind it) have been subjected to several alternative forms of testing with consistent findings' (Ives et al., 1983, pp.788 and 789).

Because of the nature of this research, which was not testing a specific theory but rather exploring trend (see section 3.2.3), construct validity for the questionnaire could not be established.

4.3.1.3 SUMMARY OF RELIABILITY AND VALIDITY

Although a final demonstration of the validity of the measuring instrument is not possible within one study, the arguments above do provide evidence for claiming reliability and validity of the questionnaire. Consequently the data collected can be used with confidence to represent the opinions of the sample population (see Baroudi and Ginzberg, 1986, p.550).

4.3.2 ATTEMPTS TO COUNTER THE LIMITATIONS OF USING A QUESTIONNAIRE

Bailey identified typical sources of error when using questionnaires (Bailey, 1982, pp.111 and 112). Based on his ideas, potential problems of this research are listed below, together with the steps taken to counter their effect.

POTENTIAL PROBLEM 1: The approach for data may not have been regarded as legitimate.

COUNTER: All correspondence had official letterheads and the return address for the questionnaires was the institution through which the research was done.

POTENTIAL PROBLEM 2: The value of the research may not have been appreciated by individuals in the sample population.

COUNTER: In the covering letter the respondent's attention was drawn to the value of the research (see appendix 'F').

POTENTIAL PROBLEM 3: The respondent may have regarded the questions being asked them as an invasion of their privacy.

COUNTER: The anonymity of the respondent was assured.

POTENTIAL PROBLEM 4: The questions about the future skills of a systems analyst, whose role is changing, may have been regarded as too general and vague.

COUNTER: Those participating in the pilot study were specifically asked to assess each question in this context. They reported no problems in this regard.

POTENTIAL PROBLEM 5: The respondents may not have felt that the correct questions were being asked.

COUNTER: Space was provided on the questionnaire for the respondents to comment and/or add their own ideas regarding the subject.

POTENTIAL PROBLEM 6: The respondents may have tried to provide the information they thought was wanted.

COUNTER: Although this problem may not have been countered completely, no questions were asked which could be regarded as 'sensitive' and the anonymity of the respondents was assured.

POTENTIAL PROBLEM 7: The respondents may not have wanted to reveal their ignorance.

COUNTER: In the covering letter and on the questionnaire, it was pointed out that there were no right or wrong answers but each individual's opinion was of value.

POTENTIAL PROBLEM 8: Data collected through mailed questionnaires is likely to be corrupted by response bias (particularly the central tendency and halo effect (see Kerlinger, 1973, pp.548 and 549)).

COUNTER: The questionnaire was constructed so that scores were in different directions from section to section (and for random questions within section 2 (see appendix 'G')).

(NOTE: This scoring in different directions confused some respondents who needed to correct their answers. One participant wrote specifically to express his irritation.)

POTENTIAL PROBLEM 9: The sample population did not include systems analysts working for some government or semi-government organizations (see section 4.2.3.2).

COUNTER: A small number of random telephone interviews established that the activities of the systems analysts working on business applications in these environments were in no way different from those who were included in the sample population.

4.3.3 LIMITATIONS OF THE EMPIRICAL RESEARCH

It is recognized that the following limitations of using a questionnaire to collect accurate data for this research were not countered:

(i) Apparently a significant amount of research related to the computer industry has been attempted recently. One expert claimed that, in his company, requests to respond to questionnaires are received almost weekly (Evans, 1985). There was evidence, therefore, that a situation of survey saturation was possibly being approached. This could have accounted for a percentage of non-response.

(ii) Because the exact sample population was not known, direct contact with participants was problematic. As a direct consequence, for example, a follow-up of non-respondents, either to encourage them to reply to the questionnaire (Bailey, 1982, p.171) or to identify whether they held any opinions which would have influenced the conclusions of the research, was sufficiently difficult as to be abandoned.

(iii) When mailed questionnaires are used to collect data, it is not possible to probe respondents to identify their answers (Bailey, 1982, p.157). This limitation could have influenced this research in four ways:

- It was not possible to ensure that the respondents used jargon consistently (e.g. words like 'change agent' and 'development centre').

- It was not possible to establish whether the opinions expressed by the respondents reflected what they really thought about the future of systems analysis, rather than what they hoped would be the future of systems analysis.
- It was not possible to determine how often participants provided answers which were primarily reactive responses to the stimulus of the questionnaire, rather than considered opinions about the future of their industry.
- It was not possible to control the characteristics of the respondents in terms of such factors as experience, education or cognitive style - any of which may have influenced the responses (see section 4.2.3 and section 5.2.2.1.5).

(iv) In a rapidly evolving technological industry it is likely that the environment in which any one individual is employed will remain relatively stable for a period of time (e.g. while purchased equipment or tools are being amortized) and then change dramatically (e.g. when new equipment or tools are acquired). The perceptions of an individual employee could be influenced significantly by the current status of the environment in terms of this technological 'leap-frogging'. It could not be established whether the respondents had recently undergone, or were just about to experience a dramatic technological change in their work environment.

(v) From the replies received, it was possible to identify cases where the respondent demonstrated the lack of a clear understanding of the definition of a 'skill'. Although a definition was provided on the first page of the questionnaire, some respondents indicated that they thought BEING AWARE OF (e.g. user department politics) or KNOWLEDGE OF (e.g. office procedures) were required systems analysis skills (see section 2.1.1.4).

(vi) The opinions held by the participants in the empirical research were to be compared and contrasted with opinions identified in the literature survey. Consequently no effort was made to alter the dimensions of the questionnaire (which was based on expert opinion), in the light of ideas and opinions expressed in the literature. On one hand this was a limitation because the opinions of the practising systems analysts on the value of certain skills remained unknown. On the other hand, however, it made the contrasting of the two conceptual skills models more pronounced (see section 7.3.1).

4.4 SUMMARY OF THE CHAPTER

This chapter provided details of the procedures followed to collect data for the building of the empirically based job responsibilities/skills model.

The objective of the questionnaire, the steps followed in constructing the questionnaire and the structure of the questionnaire, were explained.

Details were given of how the sample population were identified, and of the steps followed to distribute the questionnaire to approximately 20% of the practising systems analysts in the South

African computer industry.

The middle sections of the chapter provided details of the response to the questionnaire. They showed that the 39% response rate (159 responses were used) could be regarded as representative of the South African systems analysts.

The chapter closed with an attempt to evaluate the research procedure in terms of the effectiveness of the questionnaire as a measuring instrument, and by detailing the steps followed to counter the limitations of using a mailed questionnaire to gather the data.

It is conceded that there were limitations associated with the research procedures followed. Sufficient evidence existed however, to demonstrate that the data, collected to identify opinions (rather than absolute exactness), could be used with confidence as the opinions of the sample.

The next chapter describes the way the data were processed to compare the opinions of groups of respondents and to build the job responsibilities/skills model.

CHAPTER FIVE

BUILDING THE JOB RESPONSIBILITIES/SKILLS MODEL

5.1 INTRODUCTION TO ANALYZING THE DATA

The data collected as part of the empirical research were used to build the first of the conceptual skills models used in the study. Figure 5.1 shows where this stage of the study fits into the overall research programme.

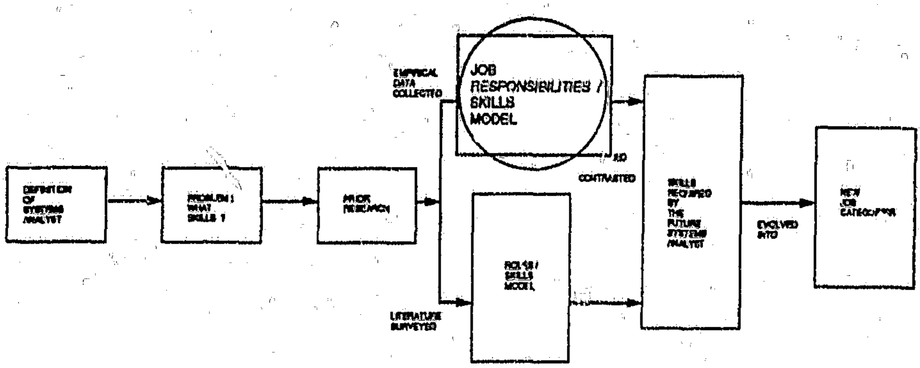

FIGURE 5.1
This stage of the research in context

The data collected in response to the questionnaire were processed in two ways:

(i) The opinions of the three groups of respondents (academic experts, practitioner experts and practising systems analysts) were compared and contrasted. Doing this met one of the objectives of the research (see section 1.5 and 3.1).

(ii) As the next step towards identifying the skills of the future systems analyst, the data were used to build the job responsibilities/skills model.

5.2 COMPARISONS OF RESPONDENTS' OPINIONS

In an effort to identify if there were any significant differences between the perceptions of the skills profile of the future systems analyst (which could lead, for example, to unmet expectations in career path planning or on-the-job training) within the South African computer industry, the opinions of the respondents were compared and contrasted. These comparisons were done by postulating a number of hypotheses. For each comparison the null hypothesis was that the respondents could not be said to disagree on the significance of a particular variable to the future systems analyst, and the alternate hypothesis was that the groups of respondents disagreed. These tests were done, firstly, on the respondents' opinions on the future job responsibilities of the systems analysts and then on the skills required by the systems analyst of the future (see figure 5.2).

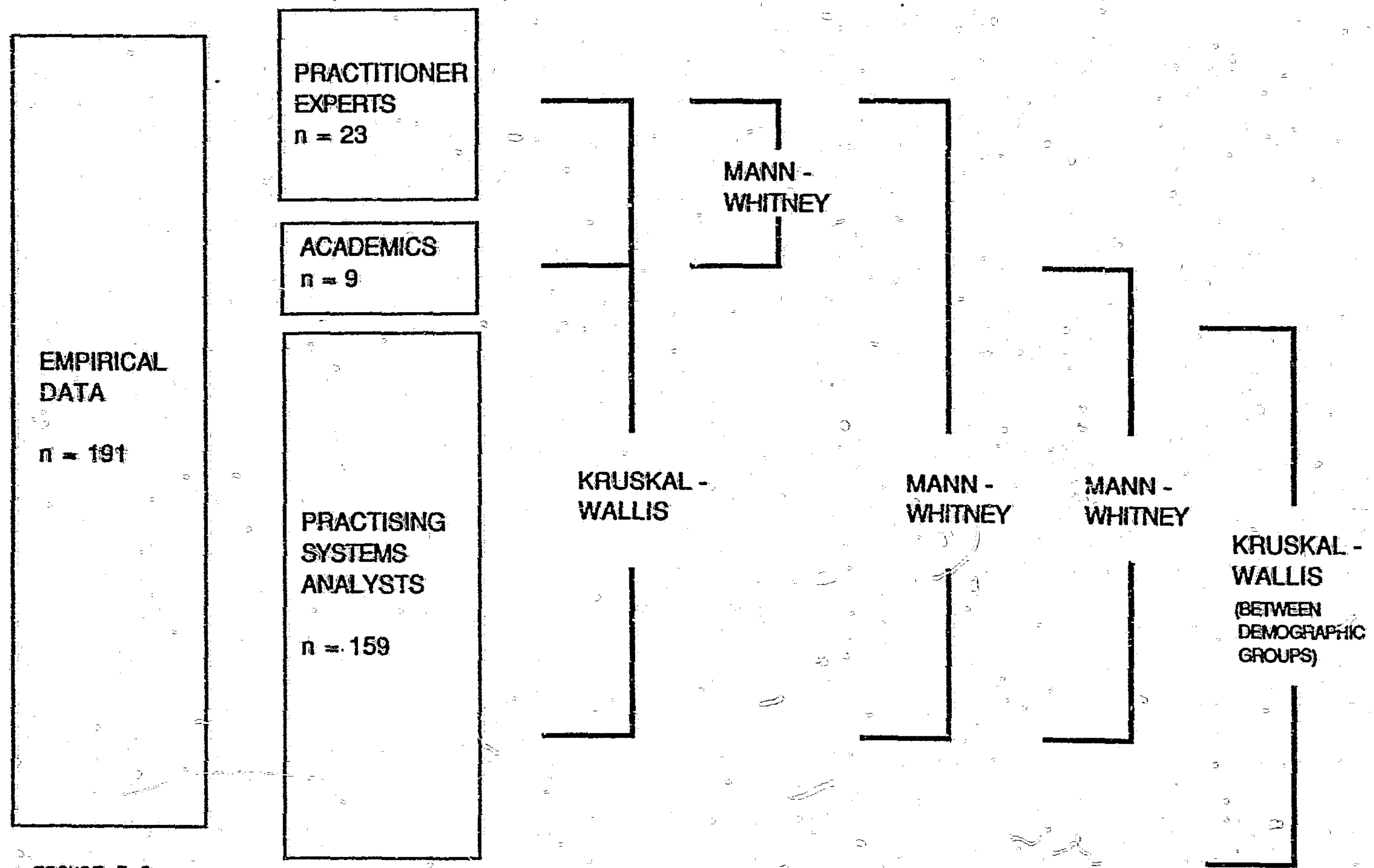

FIGURE 5.2
Statistical comparisons of empirical data

5.2.1 THE RESPONDENTS' OPINION ON THE FUTURE JOB RESPONSIBILITIES OF THE SYSTEMS ANALYST.

Details of the data collected from the questionnaires are provided in appendix 'C' (the opinions of the experts) and appendix 'H' (the opinions of the practising systems analysts), with descriptive statistics on sections 4 and 5 of the questionnaire being provided in appendix 'K'. In this section the opinions of the sample population concerning the job responsibilities of the future systems analyst will be established.

Initially statistical tests were used to isolate areas of disagreement and, where areas of disagreement could not be identified, the median scores were used to represent the opinions of the sample population (Freund and Williams, 1977, p.28).

5.2.1.1 AREAS OF DISAGREEMENT CONCERNING THE FUTURE JOB RESPONSIBILITIES OF THE SYSTEMS ANALYST

In an effort to isolate the areas of disagreement concerning the future job responsibilities of the systems analyst, the following steps were taken:

(i) The sample population was divided into its constituent groups (practitioner experts, academic experts and practising systems analysts).

(ii) For each dimension:

- H0 - no difference of opinion (groups could not be said to disagree)
- H1 - difference of opinion (groups disagree).

(See section 3.6.2.2.)

5.2.1.1.1 THE RESULTS OF TESTS USING ALL THE DATA

(i) STATISTICAL PROCESSES

As a direct result of the method of building the questionnaire (which was constructed after the opinions of the experts had been identified), eight of the thirty-five dimensions in sections 4 were changed, and the order of presenting the questions was altered (see section 4.2.2.3). The opinion of each respondent (in each group of the sample population) to each dimension common to both questionnaires was processed using the Kruskal-Wallis Test. Table 5.1 details those dimensions for which the null hypothesis had to be rejected. Provided the differences in the questionnaires did not influence the replies, it can be claimed that in each of these cases there was disagreement on the relative importance of the job responsibilities of the systems analyst of the future.

(ii) ANALYSIS OF THE RESULTS OF THE TESTS

From the opinions of the three groups within the sample population, three specific areas of disagreement were identified:

(a) The significance of the traditional areas of analysis in future job responsibilities
e.g. conduct feasibility studies,
produce detailed specifications.

(b) The importance of certain project management responsibilities to the systems analyst
e.g. control systems development,
evaluate performance of systems developers.

(c) The value of certain aspects of systems analysts' contact with the user
e.g. work in the user department,
act as a consultant.

TABLE 5.1
A list of systems analyst job responsibilities on the future importance of which the sample population disagreed (n=191)

	KRUSKAL-WALLIS		
	CHISQ	df	(α < 0,05)
Use of formal analysis procedures	9,82	2	,007
Cost-analyze systems	11,04	2	,004
Conduct feasibility studies	12,21	2	,002
Formally document users' needs	13,72	2	,001
Produce detailed specifications	10,54	2	,005
Understand system dependencies	6,54	2	,038
Traditional programming	16,43	2	,000
Integrate new and existing systems	8,42	2	,015
Control systems development	6,48	2	,039
Evaluate performance of systems developers	6,62	2	,037
Work in the user department	7,14	2	,028
Act as a consultant	6,30	2	,043
Keep abreast of technology	15,87	2	,000

In an effort to analyze the data further, additional statistical processing was done. The groups within the sample population were paired, and the opinions of these pairs of groups were compared in order to identify further areas of disagreement and the direction of the disagreement (see figure 5.2).

5.2.1.2 A COMPARISON OF EXPERT OPINION

The data collected from the experts is presented in detail in appendix 'C'. These data were processed by identifying job responsibilities:

- on which a broad spectrum of opinion was held;
- for which there was statistically supported evidence of disagreement.

(i) BROAD SPECTRUM OF OPINION

Table 5.2 is a list of job responsibilities on which expert opinion covered the five categories in the range from 'very important' to 'not important'. This list included responsibilities from each group of activities which could constitute the analyst's job. This appeared to be sufficient evidence to conclude that experts disagreed among themselves on the job responsibilities of the future systems analyst.

(ii) STATISTICAL TESTS FOR DISAGREEMENT

For each dimension, the opinion of each respondent in each of the expert groups was processed using the Mann-Whitney U Test (see section 3.6.2.2).

For each dimension:

HO - no difference of opinion (groups could not be said to disagree

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

There was no case in which the null hypothesis could be rejected as a consequence of this test. While this suggests that any differences identified in the opinions of the two groups of experts, therefore, could be attributed to chance and not to their belonging to different populations, the small sample sizes did reduce the power of this test. These results, therefore, were regarded as no more than an indication of no disagreement.

TABLE 5.2

Those job responsibilities on which the expert opinion covered the range from 'very important' to 'not important' (n=32)

Analysis
- Conduct feasibility studies
- Formally document user needs
- Produce detailed specifications

Systems development
- Generate systems
- Tune generated systems

Project management
- Evaluate performance of systems developers

Application packages
- Select packages

User contact
- Work in the user department
- Become a user
- Act as a consultant

Technology
- Revise standards for development methods

5.2.1.1.3 A COMPARISON OF THE OPINIONS OF THE PRACTITIONER EXPERTS AND THE PRACTISING SYSTEMS ANALYSTS.

(i) STATISTICAL PROCESSES

For these comparisons again the Mann-Whitney Test was used. For each dimension:

HO - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

Table 5.3 details the dimensions for which the null hypothesis had to be rejected. The significance of these job responsibilities to the future systems analyst constituted areas of disagreement between the practitioner experts and the systems analysts.

(ii) ANALYSIS OF THE RESULTS OF THE TEST

Most of the dimensions on which disagreements were detected in this test concerned traditional systems analyst activities. In all but one case (use formal procedures to determine requirements) the median score of the practising systems analysts' opinion was higher than that of the practitioner experts. This showed that even among those who are directly involved in systems development, the future of existing systems analyst responsibilities is not clear. There was, however, one surprising result from this test. It was anticipated that there would have been total agreement between the groups on the importance of systems analysts of the future keeping abreast of the evolving technology (see section 6.3.1), but this hypothesis could be rejected at the 0.01 level.

TABLE 5.3
A list of systems analyst job responsibilities on which the sample population (practitioner experts and practising systems analysts) disagreed in terms of future importance (n=182)

	CHISQ	df	MANN-WHITNEY (IZI < 0,01)
Cost analyze systems	8,40	1	,004
Conduct feasibility studies	10,97	1	,001
Formally document users' needs	8,00	1	,005
Use formal procedures to determine requirements	8,87	1	,003
Integrate new and existing systems	7,23	1	,007
Keep abreast of technology	16,04	1	,000

5.2.1.1.4 A COMPARISON OF THE OPINIONS OF THE ACADEMIC EXPERTS AND THE PRACTISING SYSTEMS ANALYSTS

(i) STATISTICAL PROCESSES

The steps followed in making these comparisons of opinions were identical to those outlined in section 5.2.1.1.3. Again the Mann-Whitney Test was used. For each dimension:

HO - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

As a result of these tests, only once could the null hypothesis be rejected at the 0,01 level. The academics and practising systems analysts could be said to disagree on the systems analyst of the future being responsible for traditional programming (see table 5.4).

TABLE 5.4
A list of systems analyst job responsibilities on which the sample population of academics and systems analysts disagreed in terms of future importance (n=168)

	CHISQ	df	MANN-WHITNEY (IZI < 0,01)
Traditional programming	11,27	1	,001

(ii) ANALYSIS OF THE RESULTS OF THE TEST

Provided the procedure followed constituted a valid test, the following conclusions can be drawn:

(a) It was noticed that there was significantly less evidence of disagreement of opinion between the practising systems analysts and the academics than between other groups within the sample population. This was unexpected because of the different environments within which these groups function.

(b) There was no evidence of disagreement on the importance of some of the traditional systems analysts' job responsibilities in the future
e.g. formally document users' needs,
produce detailed specifications.
This was also unexpected considering the different

environments of the two groups in the sample.

(c) Based on the median scores of respondents' opinions it was obvious that the one future systems analysts' job responsibility on which there was a statistically supported disagreement, (traditional programming) was less important to the academics than the practising systems analysts.

5.2.1.2 FUTURE JOB RESPONSIBILITIES ON WHICH NO DISAGREEMENT COULD BE IDENTIFIED

The job responsibilities on which no disagreement could be statistically identified are listed in table 5.5. The following points are noted:

(i) The least disagreement was identified in the areas of systems development and implementation. According to the sample population, the future systems analyst's important job responsibilities are likely to include:

generating systems and tuning generated systems,
prototyping systems,
building whole systems.

Equally important could be the selecting and implementing of application packages.

(ii) The systems analyst could be expected to be involved in determining the most appropriate application system development method for each particular project.

(iii) Future systems analysis could involve an element of project management.

(iv) Overriding all responsibilities, the systems analyst of the future could be expected to possess increased skills in business practices.

5.2.1 SUMMARY OF THE OPINIONS OF THE RESPONDENTS ON THE JOB RESPONSIBILITIES OF THE SYSTEMS ANALYST OF THE FUTURE

From the data collected, there appeared to be doubt about the importance of the traditional systems analyst job activities. Job responsibilities like conducting feasibility studies and formally documenting users' needs were not regarded by all the respondents as maintaining their significance.

Although there was not total agreement on the idea, there was a body of opinion which suggested that project management activities will be part of the future systems analyst's job responsibilities. In fact, there was agreement that systems analysts will be responsible for planning, monitoring and reporting on systems development.

The systems analyst tended to be envisaged as a generalist with a wide base of job responsibilities. This was particularly so in the context of the systems analyst's role in systems development and implementation. The sample population agreed that the future systems analyst will be involved in the designing, building, generating, tuning and prototyping of application systems. This constitutes a move away from the idea that these are specialist activities performed using tools and a technology outside the area of systems analysis.

TABLE 5.5

FUTURE JOB RESPONSIBILITIES ON WHICH NO DIFFERENCE OF OPINION COULD BE IDENTIFIED STATISTICALLY (n=191)

JOB RESPONSIBILITY	DIMENSION	Q1	MEDIAN	Q3	FREQUENCY TABLE (PERCENTAGES) 1	2	3	4	5
ANALYSIS									
Identify work flows and procedures	C3	4	4	5	-	3,7	14,7	42,6	38,9
Problem solving	C8	4	5	5	0,5	0,5	3,9	31,1	58,9
DEVELOPMENT									
Identify appropriate development method	C10	4	4	5	0,5	5,3	10,0	39,5	44,7
Design systems	C11	4	5	5	-	2,1	8,9	33,2	55,8
Generate systems	C12	3	4	5	1,1	4,7	22,6	36,3	35,3
Prototype systems	C14	3	4	5	1,6	8,9	18,4	40,5	30,5
Build whole systems	C15	3	4	5	0,5	6,6	20,0	39,8	31,9
Time generated systems	C16	3	4	5	3,2	8,5	25,0	33,0	30,3
Revise development standards	C18	4	4	5	1,0	2,1	16,8	39,8	40,3
PROJECT MANAGEMENT									
Plan systems development	C19	4	5	5	0,5	1,0	6,3	29,8	62,3
Monitor systems development	C20	4	5	5	0,5	2,1	6,8	34,6	56,0
Evaluate systems development	C22	4	4	5	1,1	2,1	10,6	41,8	44,4
Report on systems development	C23	4	4	5	0,5	3,1	17,3	37,2	41,9
Conduct post-implementation evaluations	C25	4	4	5	1,0	3,1	12,0	34,0	49,7
APPLICATION PACKAGES									
Select packages	C26	3	4	5	4,2	8,4	16,3	28,9	42,1
Implement packages	C27	3	4	5	2,6	10,0	23,2	33,2	31,1
Customize packages	C28	3	4	5	7,6	9,5	22,8	27,8	32,3
USER CONTACT									
Increase business skills	C30	4	5	5	1,6	1,6	3,7	31,4	61,8
Become a user	C31	2	3	4	16,9	24,3	25,9	22,2	10,6
Share responsibility for system with user	C32	3	4	5	2,6	4,2	18,8	34,0	40,3
Train user	C33	4	5	5	2,1	5,2	13,6	28,3	50,8

1 = NOT IMPORTANT   5 = VERY IMPORTANT

While there was doubt about some of the areas of contact between systems analysts and the user, (e.g. working in the user department or acting as consultants to the user), there was no doubt about the importance of systems analysts increasing their business skills. Each group of the sample population rated this as an important future job responsibility.

If these trends reflect the changing role of the systems analyst, new skills will have to be developed for the systems analyst to meet these job responsibilities.

5.2.2 THE RESPONDENTS' OPINION ON THE SKILLS REQUIRED BY THE SYSTEMS ANALYST OF THE FUTURE

Details of the data collected from the questionnaires is provided in appendix 'C' (for opinions of the experts) and appendix 'I' (for the opinions of the practising systems analysts), with descriptive statistics on sections 4 and 5 of the questionnaire being provided in appendix 'K'. In this section the opinions of the sample population concerning the skills required by the future systems analyst will be established.

Again initially, statistical tests were used to isolate areas of disagreement and, where areas of agreement were identified, the median scores were used to represent the opinions of the sample population (Freund and Williams, 1977, p.28).

5.2.2.1 AREAS OF DISAGREEMENT CONCERNING THE SKILLS OF THE FUTURE SYSTEMS ANALYST

In an effort to identify the areas of disagreement concerning the skills of the future systems analyst, the following steps were taken:

(i) The sample population was divided into its constituent groups (practitioner experts, academic experts and practising systems analysts).

(ii) For each dimension:

HO - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

5.2.2.1.1 THE RESULTS OF TESTS USING ALL THE DATA

(i) STATISTICAL PROCESSES

As a result of the method of building the questionnaire (which was constructed after the opinions of the experts had been identified), nine of the fifty-seven dimensions in sections 5 were changed, and the order of presenting the questions was altered (see section 4.2.2.3). The opinion of each respondent (in each group of the sample population) to each dimension common to both questionnaires was processed using the Kruskal-Wallis Test. Table 5.6 details those dimensions for which the null hypothesis had to be rejected. Provided the differences in the questionnaires did not influence the replies, it can be claimed that in each of these cases there was disagreement on the relative importance of the skills required by the systems analyst of the future.

TABLE 5.6

A list of systems analyst skills on which the sample population disagreed in terms of future importance (n=191)

	KRUSKAL-WALLIS		
	CHISQ	df	($\alpha < 0,05$)
Acting as a change agent	13,84	2	,001
Skills in business practices	11,53	2	,003
Using structured analysis methods	8,80	2	,012
Cost-benefit analyzing	9,22	2	,010
Project planning	10,27	2	,006
Project controlling	12,69	2	,002
Scheduling	9,70	2	,008
Estimating costs	13,14	2	,001
Critical path analysis	7,74	2	,021
Constructing algorithms	13,56	2	,001
COBOL programming	7,90	2	,019
Using prototyping	6,70	2	,035
Implementing new user structures	8,49	2	,014
Implementing new system procedures	12,70	2	,002
Determining corporate data requirements	22,71	2	,000
Determining specific users' info. requirements	9,05	2	,011
Working in/with a project team	8,22	2	,016
Dealing with people	10,03	2	,007
Being diplomatic	18,56	2	,000
Selling ideas	11,69	2	,003
Task prioritizing	7,64	2	,022
Strategic planning	11,33	2	,004
Decision making	20,86	2	,000
Revising performance	8,29	2	,016

(ii) ANALYSIS OF THE RESULTS OF THE TEST

Four specific areas of disagreement were identified from the list in table 5.6:

(a) The significance of skills associated with the traditional areas of systems analysis:

e.g. using structured analysis methods,
cost-benefit analyzing,
critical path analysis;

(b) The value of project management skills:

e.g. project planning,
project controlling,
scheduling and estimating;

(c) The importance of skills associated with strategic planning activities:

e.g. determining corporate data requirements,
strategic planning;

(d) The usefulness of skills needed to function as part of a project team:

e.g. working in/with a project team,
being diplomatic,
dealing with people.

In an effort to analyze these differences of opinion further, and to identify the direction of the disagreement, additional statistical processing was done. Opinions were compared between different pair-grouping in the sample population and between groups (based on the demographic data) of the systems analysts.

5.2.2.1.2 A COMPARISON OF EXPERT OPINION

Details of the replies from the experts are given in appendix 'C'. In this section the data are processed in two ways:

- in terms of the breadth of opinion the experts held on the significance of each skill;
- using statistics to identify areas of actual disagreement.

(i) BROAD SPECTRUM OF OPINION

Table 5.7 is a list of skills on which expert opinion covered the five categories in the range from 'very important' to 'not important'. The diversity of the skills in this list suggested that the experts disagreed among themselves on the skills required by the systems analyst of the future.

(ii) TESTING THE LEVEL OF DISAGREEMENT AMONG THE EXPERTS

For each dimension, the opinion of each respondent in each of the expert groups was processed using both the Mann-Whitney U Test (see section 3.6.2.2). Again in each case:

HO - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree).

TABLE 5.7

Those skills on which the expert opinion covered the range from 'very important' to 'not important' (n=32)

Development centre tools/methods
- Applying Information Technology

Project management
- Critical-path analysis

Finance
- Cost-benefit analysis
- Costing
- Auditing computer systems

Quantitative methods
- Statistics

Hardware
- Designing installation configurations
- Designing computer methods
- Determining telecommunication requirements

Software
- Constructing algorithms
- COBOL programming
- Implementing application packages

Environment
- Organization structuring
- Establishing corporate data requirements
- Business practices

Analysis
- Organization and methods skills

Management
- Building competitive positions

Again, for each dimension:

H0 - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

As a result of this test, only once could the null hypothesis be rejected at the 0,01 level. The academics and expert practitioners disagreed on the importance to the future systems analyst of the skill of being diplomatic (see table 5.8).

TABLE 5.8
The systems analyst's skill on which the experts disagreed in terms of its future importance (n=32).

			MANN-WHITNEY
	CHISQ	df	(IZI < 0,01)
Being diplomatic	7,68	1	,006

(iii) SUMMARY OF EXPERT OPINION

In spite of the apparent diversity of opinion found within the expert group, with one exception these differences could not be substantiated statistically (although it was noted that the small sample size would have lowered the power of the tests). It does seem unlikely that the differences of opinion identified in the sample population could be accounted for by the differences of opinion between the experts.

5.2.2.1.3 A COMPARISON OF THE OPINIONS OF THE PRACTITIONER EXPERTS AND THE PRACTISING SYSTEMS ANALYSTS

(i) STATISTICAL PROCESSES

For comparison of opinions between these two groups again the Mann-Whitney Test was used. For each dimension:

HO - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

Table 5.9 details those dimensions for which the null hypothesis had to be rejected. The importance of these skills to the future systems analyst constituted areas of disagreement between the practitioners and the systems analysts.

(ii) ANALYSIS OF THE RESULTS OF THE TEST

Most of the dimensions on which disagreements were detected in this test were associated with traditional systems analyst activities e.g. cost-benefit analysis,
scheduling,
implementing office and system procedures.

This was surprising. It was anticipated that the opinions of those who are directly involved in systems development would reflect a continued strong need for these skills (see section 6.3.2).

TABLE 5.9

A list of systems analyst skills on which the sample population (practitioner experts and practising systems analysts) disagree in terms of future importance (n=182)

			MANN-WHITNEY
	CHISQ	df	(IZI < 0,01)
Acting as change agent	10,74	1	,001
Skills in business practice	8,45	1	,004
Project planning	9,44	1	,002
Project controlling	11,02	1	,001
Scheduling	8,09	1	,005
Estimating costs	9,01	1	,003
Constructing algorithms	8,53	1	,004
Implementing new user structures	7,79	1	,005
Implementing system procedures	6,96	1	,008
Determining corporate data requirements	21,85	1	,000
Determining specific user requirements	8,97	1	,003
Selling ideas	10,77	1	,001
Strategic planning	9,39	1	,002
Decision making	9,59	1	,002

A second group of skills on which there was disagreement was linked to project management activities

e.g. project planning,

project controlling,

progress monitoring.

The importance allocated to these skills by some members of the sample population added further evidence to the idea that a broadening of the range of systems analyst skills is anticipated (see section 6.3.1.15).

Again it was noticed that there was disagreement on the significance of both skills as a change agent and skills in business practices. This was quite unexpected for two reasons:

(i) both these groups within the sample population were involved directly in the development of application software, and more consensus was expected on what are fundamental issues;

(ii) the literature survey showed that both skills are regarded as important to the future systems analyst (see section 6.3.1.2 and 6.3.1.18).

5.2.2.1.4 A COMPARISON OF THE OPINIONS OF THE ACADEMIC EXPERTS AND THE PRACTISING SYSTEMS ANALYSTS

(i) STATISTICAL PROCESSES

The steps followed in making this comparison of opinions were identical tc those outlined in section 5.2.2.1.3.

The Mann-Whitney Test was used and for each dimension:

H0 - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2.)

Table 5.10 details those dimensions for which the null hypothesis had to be rejected at the 0.01 level. The academic experts and the practising systems analysts disagreed on the importance of these skills to the future systems analyst.

TABLE 5.10

A list of systems analyst skills on which the sample populations of academics and systems analysts disagree in terms of future importance (n=168)

	CHISQ	df	MANN-WHITNEY (|Z| < 0,01)
COBOL programming	7,66	1	,006
Implementing system procedures	7,06	1	,008
Working in/with project team	7,30	1	,007
Dealing with people	9,54	1	,002
Being diplomatic	18,79	1	,000
Decision making	14,09	1	,000

(ii) ANALYSIS OF THE RESULTS OF THE TEST

Provided the procedure followed constituted a valid test the following conclusions can be drawn:

(a) Again (as in section 5.2.1.1.3) there was less evidence of disagreement between these groups than between other groups in the sample population. Again this was unexpected because of the diverse nature of the environments in which the academics and practising systems analysts operate.

(b) Evidence of disagreement was found particularly in interpersonal relationship skills. From the median scores of each dimension, it was identified that the practising systems analysts felt more strongly than the academics that human relationship skills would be needed in future systems analysis. This could be the root of the disagreement on the future value of these skills identified in section 5.2.2.1.

5.2.2.1.5 THE RESULTS OF TESTS USING THE DATA FROM THE SYSTEMS ANALYSTS

(i) STATISTICAL PROCESSES

In an effort to further analyze the reasons for the disagreements identified earlier in this section, the opinions of the practising systems analysts were grouped according to their demographic data and processed using the Kruskal-Wallis Test. For each dimension:

H0 - no difference of opinion (groups could not be said to disagree)

H1 - difference of opinion (groups disagree)

(See section 3.6.2.2)

Table 5.11 lists those skills for which the null hypothesis had to be rejected and a disagreement acknowledged. Figures 5.3 to 5.9 are frequency counts which help to identify the details of the disagreements.

(NOTE: The frequency counts represent the opinions of the systems analyst respondents (with n = 159). There were two reasons why the count for certain charts was less than 159. The first was that there were occasions when a small number of observations were missing from the data. The second reason was that when comparisons were made across industry types, to enhance the clarity of the diagrams, only those industries with more than 10 observations were included in the chart. Where appropriate, the relevant reasons will be noted in comments on the affected tables. There was no reason to believe that the data not used introduced a bias into the results.)

(ii) FACTORS WHICH CONTRIBUTE TO DISAGREEMENTS

The following demographic factors were identified as contributing to disagreements between the systems analysts (which, in turn, contributed to the disagreements identified in the opinions of the sample population). In the other cases of disagreement identified in table 5.11, comparing frequency counts did not give conclusive evidence for the reason of the disagreements.

TABLE 5.11

Areas of disagreement among the practising systems analysts (n=159)

SKILL	DEMOGRAPHIC ITEM	KRUSKAL-WALLIS CHISQ	df	($\alpha < 0,05$)
Identifying user function	YCI	23,50	11	0,015
Problem solving	AGE	16,10	7	0,024
Problem solving	YPP	13,36	5	0,020
Acting as a change agent	REG	15,19	5	0,009
Skills in business practices	SOI	9,75	4	0,045
Using structured analysis methods	TOI	17,05	9	0,047
Determining appropriate security	YPP	11,44	5	0,043
Building competitive positions	AGE	14,60	7	0,041
Evaluating packages	AGE	16,74	7	0,019
Evaluating packages	TOI	27,73	9	0,001
Implementing packages	AGE	18,50	9	0,009
Implementing packages	TOI	21,84	9	0,009
Determining corporate data req.	YCI	20,73	11	0,036
Determining specific information needs	YCI	20,91	11	0,034
Statistics	AGE	18,24	7	0,010
Selling ideas	YCI	22,08	11	0,023
Reviewing performance	TOI	18,85	9	0,026

KEY

REG = Region

SOI = Size of installation

TOI = Type of industry

YCI = Years in computer industry

YPP = Years in present position

TYPE OF INDUSTRY/USING STRUCTURED ANALYSIS METHODS

Respondents from the finance/insurance and mining sectors regarded skill at using structured analysis methods as more important than respondents in the manufacturing and software house/computer vendor industries (see figure 5.3).

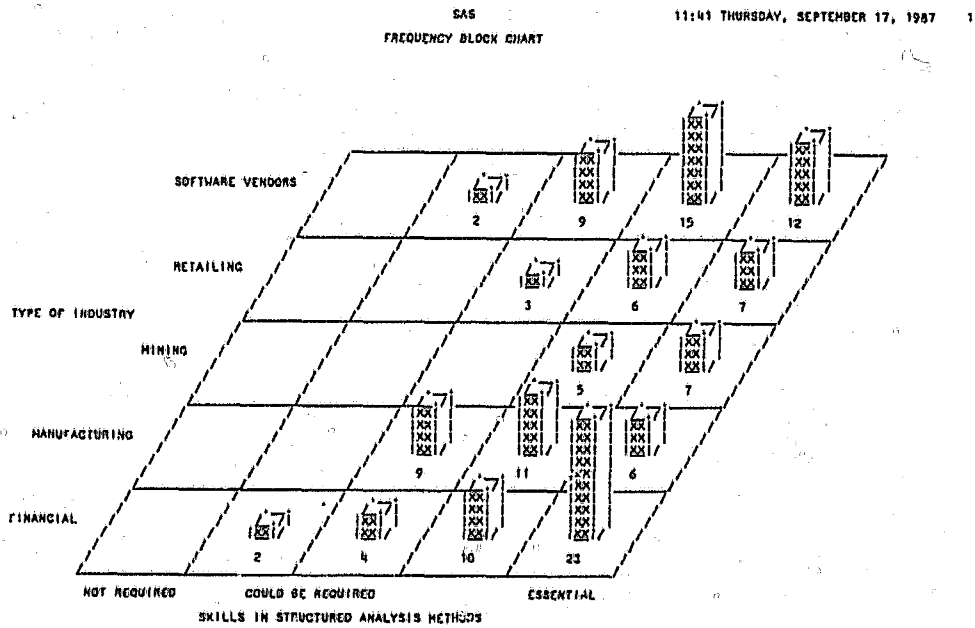

FIGURE 5.3

Frequency counts comparing type of industry attitudes to skills in using structured analysis methods.

n=159.

TYPE OF INDUSTRY/EVALUATING PACKAGES

Respondents from the software houses/computer vendors, mining and finance/insurance industries regarded skills in evaluating packages as more important than respondents in the retail and manufacturing sectors (see figure 5.4).

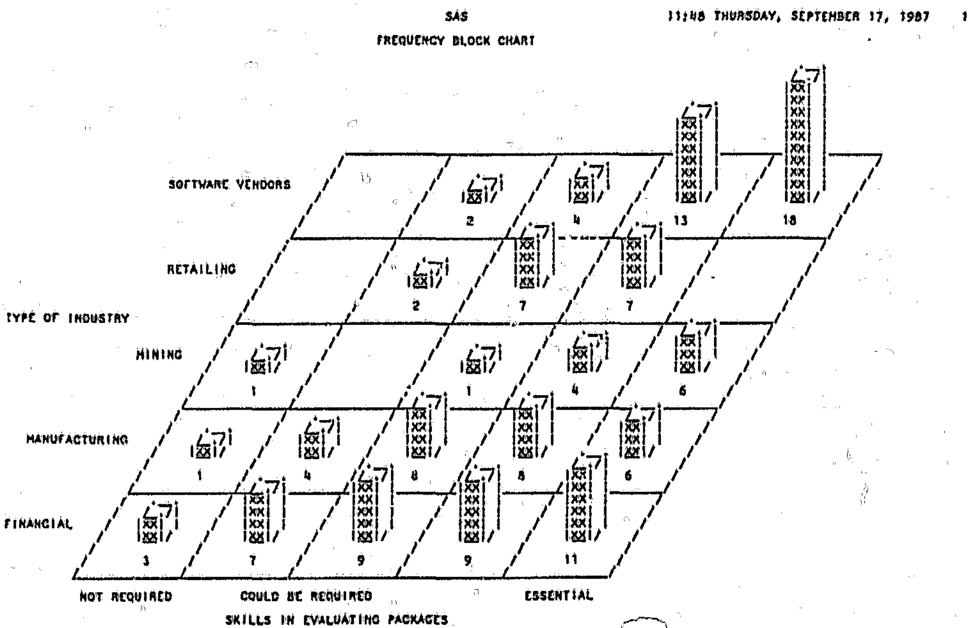

FIGURE 5.4
Frequency counts comparing type of industry skills in evaluating packages.
n=159.

TYPE OF INDUSTRY/IMPLEMENTING PACKAGES

Respondents from the software houses/computer vendor industries regarded skills in implementing packages as more important than respondents who work in the retail, manufacturing and finance/insurance sectors (see figure 5.5).

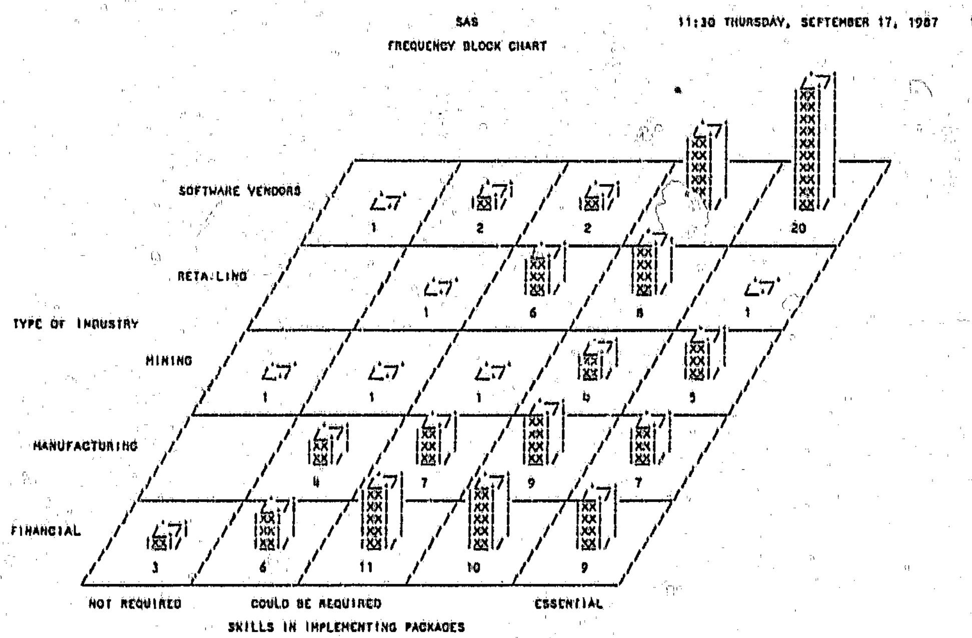

FIGURE 5.5
Frequency counts comparing type of industry attitudes to skills in implementing packages.
n=159.

AGE/BUILDING COMPETITIVE POSITIONS

Respondents in the 25-35 age bracket regarded skills in building competitive positions as more important than respondents in other age brackets (see figure 5.6).

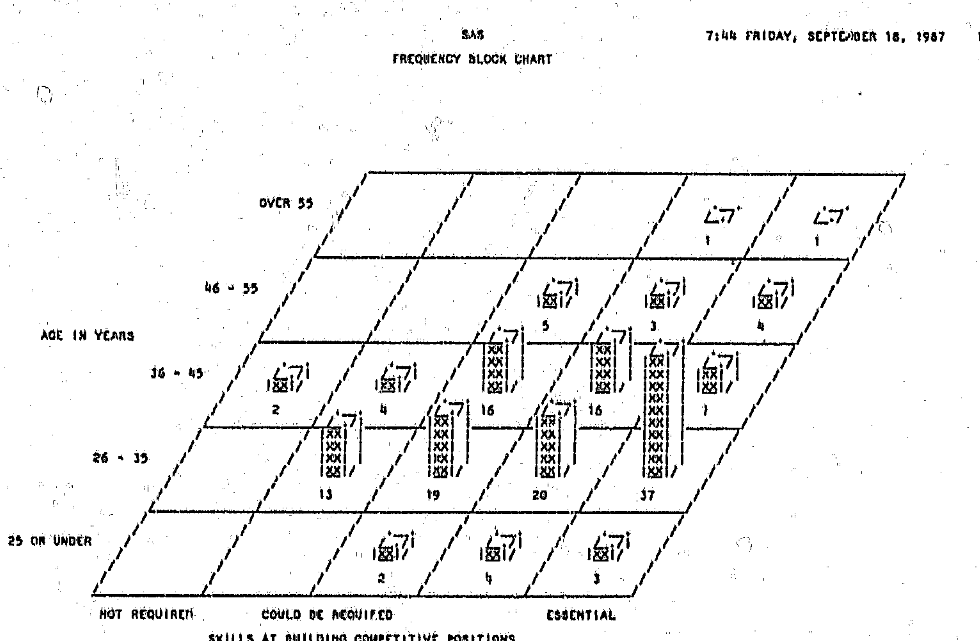

FIGURE 5.6

Frequency counts comparing age group's attitudes to skills in building competitive positions.

n=159.

AGE/EVALUATING PACKAGES

It appeared that the importance of skills in evaluating packages increased as the respondent's age increased (see figure 5.7).

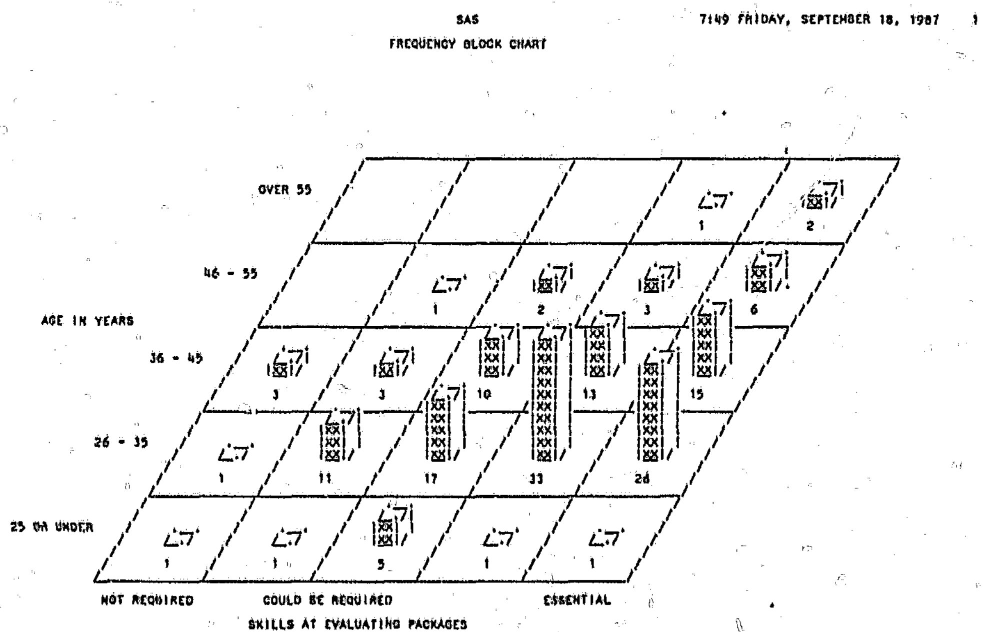

FIGURE 5.7

Frequency counts comparing age group's attitudes to skills in evaluating packages.

n=159.

REGION/CHANGE AGENT

Skills as a change agent appeared to be regarded as more important in the PWV area than in the coastal regions of Natal, Eastern Cape and Western Cape (see figure 5.8).

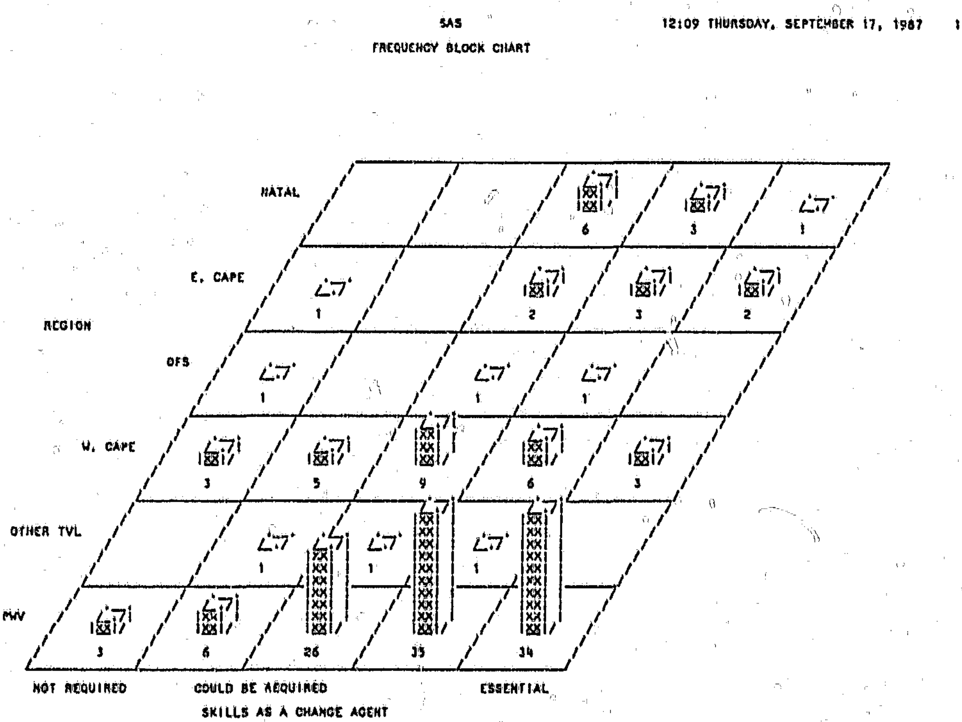

FIGURE 5.8
Frequency counts comparing regional attitudes to skills as a change agent.
n=159.

SIZE OF INSTALLATION/SKILLS IN BUSINESS PRACTICES

It appeared as if skills in business practices were more important to those who worked in the smaller installations (see figure 5.9).

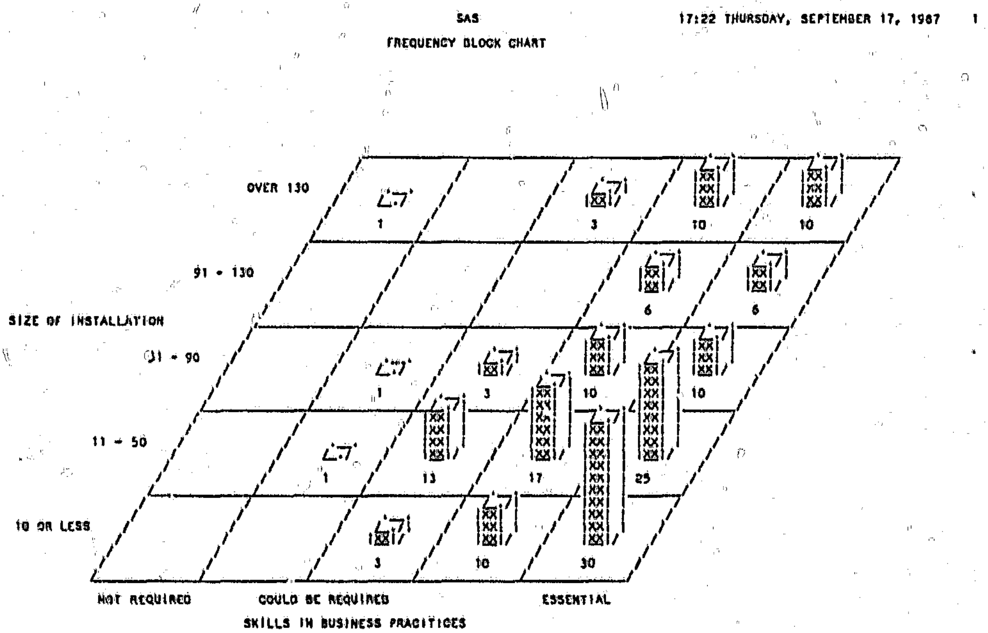

FIGURE 5.9
Frequency counts comparing size of installation attitudes to skills in business practices.
n=159.

5.2.2.1.6 SUMMARY OF DISAGREEMENTS

Disagreements concerning the skills required by the systems analyst of the future covered a broad range of activities. Some reasons for the disagreements could be traced to factors such as differences in the respondents' perceptions of future systems analyst job responsibilities, and differences associated with demographic details. In some cases, however, no apparent reasons for the disagreements could be isolated. Perhaps factors like the maturity of the I.S. department (Nolan, 1979, p.115) or the strategic relevance of the systems on which the respondents had worked (Cash et al., 1983, p.26) contributed to the lack of agreement (see section 7.6).

5.2.2.2 SKILLS REQUIRED BY THE FUTURE SYSTEMS ANALYST ON WHICH THERE WAS NO DISAGREEMENT

A list of future systems analyst skills (together with their median, upper and lower quartile and standard deviation scores) on which there was no statistically supported difference of opinion among the respondents to the questionnaire, is given in table 5.13. The skills groupings used in this table follows those of the questionnaire sent to the experts (see appendix 'C'). These groupings were based on the answers received from the experts to the original open-ended questions distributed during the early stages of the empirical research (see section 4.2.2.1.2). To help retain consistency, the same groupings were used to analyze these data, but as a first step towards linking the empirical findings with the conclusions of the literature survey (see

TABLE 5.12

SKILLS REQUIRED FOR THE FUTURE SYSTEMS ANALYST ON WHICH THERE WAS NO DISAGREEMENT (n=191)

JOB RESPONSIBILITY	DIMENSION	Q1	MEDIAN	Q3	FREQUENCY TABLE (PERCENTAGES) 1	2	3	4	5
ANALYSIS									
Evaluating existing procedures	V1	4	5	5	-	-	18,8	26,2	55,0
Fact finding	V2	4	5	5	-	-	7,9	28,8	63,4
Thinking logically	V5	5	5	5	-	-	-	16,8	83,2
Identifying user/management needs	V6	4	5	5	-	-	8,4	18,3	73,3
Determining appropriate system controls	V11	4	5	5	-	-	11,5	27,2	61,3
Identifying competitive advantages	V13	3	4	5	-	9,9	27,2	26,7	36,1
PROJECT MANAGEMENT									
Progress monitoring	V18	4	5	5	-	-	9,4	32,5	58,1
Estimating timescales	V20	4	5	5	-	-	11,5	33,5	55,0
DEVELOPMENT									
Determining appropriate development method	V22	4	4	5	-	-	18,8	41,4	39,8
FORTRAN programming	V25	1	1	2	50,5	26,1	17,6	5,9	-
ADA programming	V26	1	1	2,5	49,7	25,4	19,9	5,0	-
Using fourth generation languages	V30	4	5	5	-	-	13,1	19,9	67,0
Using automated development methods	V31	3	4	5	-	-	27,7	31,4	40,8
IMPLEMENTATION									
Implementing office procedures	V34	3	4	5	-	13,6	30,9	28,3	27,2
Organization and methods skills	V35	3	4	4	-	11,0	29,3	35,1	24,6
DATABASE									
Designing logical data models	V37	4	5	5	-	-	9,9	24,6	65,4
HARDWARE									
Designing installation configurations	V39	2	3	4	16,8	19,9	25,1	17,3	20,9
Designing computer networks	V40	2	3	4	18,3	15,7	25,1	17,3	23,6
Determining telecommunication requirements	V41	3	3	5	12,0	12,6	27,7	20,4	27,2
COMMUNICATIONS									
Interviewing	V46	4	5	5	-	-	9,9	25,1	64,9
Verbal communicating	V47	5	5	5	-	-	-	21,5	78,5
Report writing	V48	4	5	5	-	-	6,3	35,1	58,6
Presentation preparing	V49	4	5	5	-	-	-	30,9	69,1
Teaching	V50	4	5	5	-	-	16,8	31,9	51,3
MANAGEMENT									
Managing/motivating people	V52	5	5	5	-	-	-	24,1	75,9
AUDITING									
Auditing computer systems	V57	3	4	5	-	13,1	31,9	29,3	25,7
Building systems which can be audited	V58	4	5	5	-	1,3	12,7	22,2	63,9

1 = NOT IMPORTANT   5 = VERY IMPORTANT

section 7.3.1), the skills listed in table 5.12 were analyzed in the five categories below (see figure 5.10).

CATEGORY 1 - those skills which were listed, but which were regarded as not being required by the future systems analyst, (a median score of 1).

CATEGORY 2 - those skills which could (under certain circumstances) be regarded as necessary to the future systems analyst, (a median score of 3).

CATEGORY 3 - the skills regarded as necessary to the future systems analyst (a median score of 4 or 5) were sub-divided further:

CATEGORY 3.1 systems analyst skills based on the definition used in section 2.1.1.4;

CATEGORY 3.2 skills required to make the systems analysts more effective in their tasks (supportive skills);

CATEGORY 3.3 skills which reflect the changing role of the systems analyst.

5.2.2.2.1 SKILLS WHICH COULD BE REGARDED AS NOT REQUIRED BY THE SYSTEMS ANALYST OF THE FUTURE (Category 1)

The skills which fell into this category were surprising, not because of their rejection by the sample population, but because they were ever included in the list of skills required by the future systems analyst (see section 4.2.2). It is difficult to imagine how third generation programming in FORTRAN or ADA would ever be skills required by systems analysts in the future.

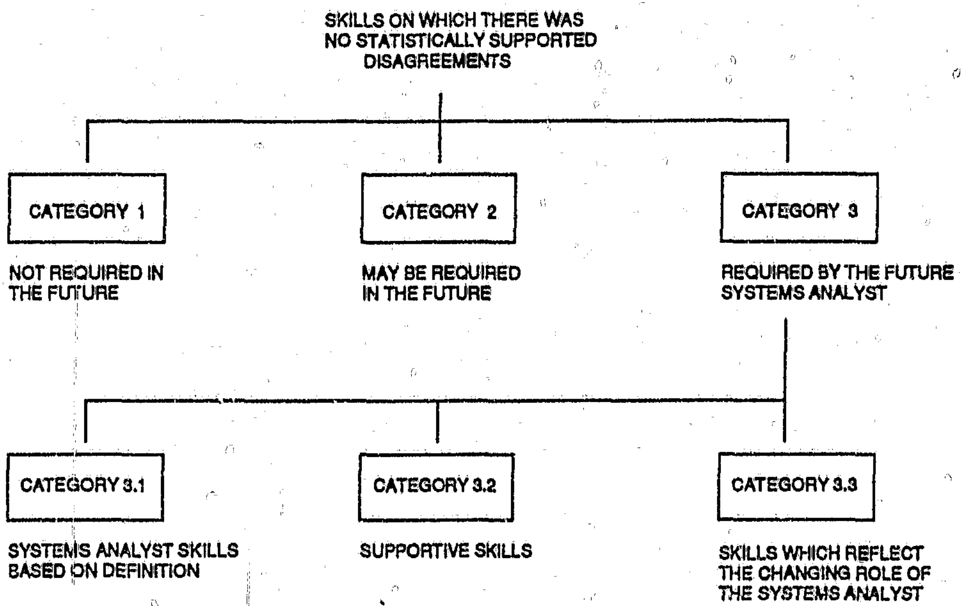

FIGURE 5.10
The categories under which the skills listed in table 5.12 were analyzed

Frequency counts of the respondents' opinions are given in figures 5.11 and 5.12.

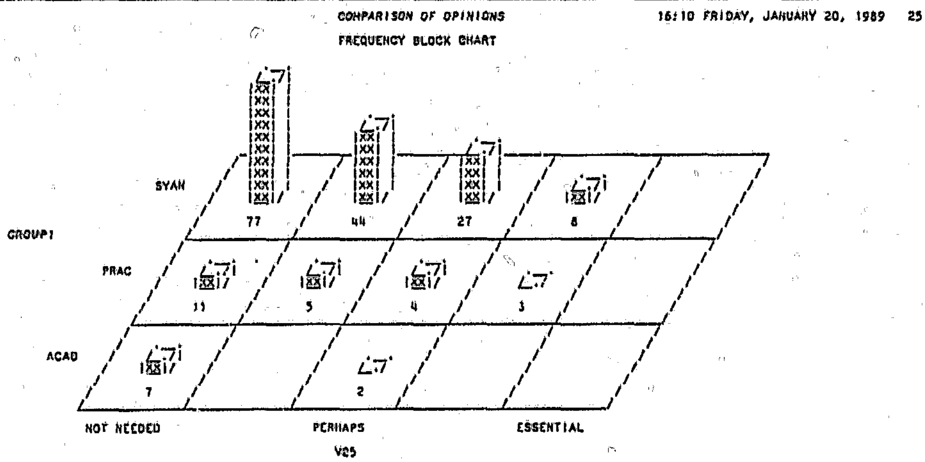

FIGURE 5.11
Importance of 'FORTRAN'
(n=188; median = 1)

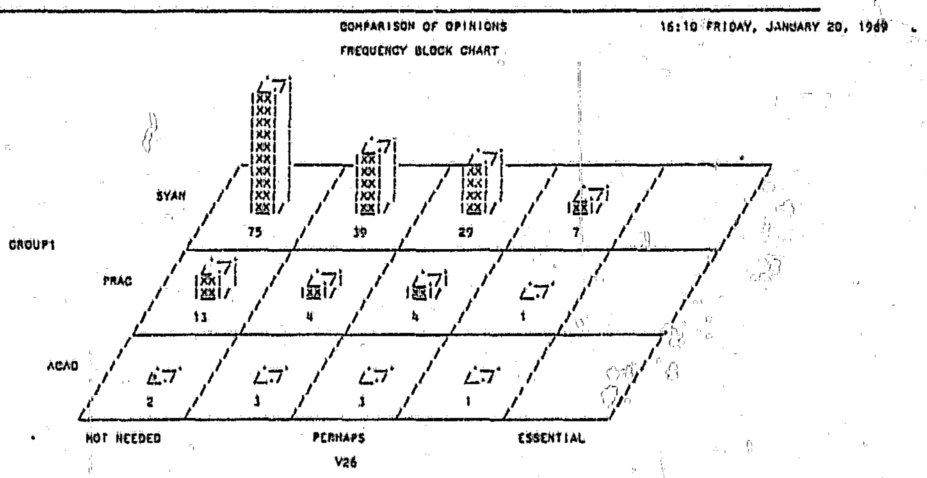

FIGURE 5.12
Importance of 'ADA'
(n=181; median = 2)

5.2.2.2.2 SKILLS WHICH COULD BE REQUIRED BY THE SYSTEMS ANALYST OF THE FUTURE (Category 2)

The exact mix of systems analyst skills required by an individual in the future may vary depending on circumstances. It was expected, therefore, that certain skills would be identified by the questionnaire respondents as 'could be required'. These skills included:

- designing installation configurations
- designing computer networks
- determining telecommunication requirements

Frequency counts of the respondents' opinions are given in figures 5.13, 5.14 and 5.15.

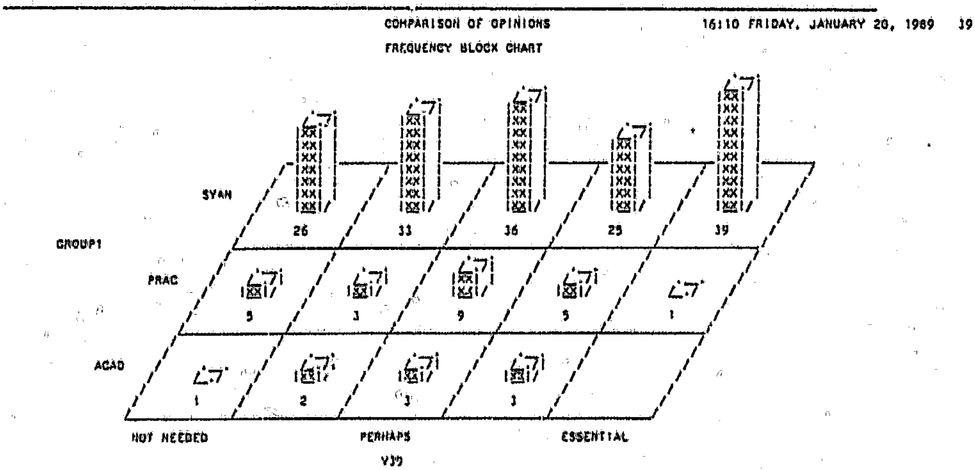

FIGURE 5.13
The importance of 'designing installation configurations'
(n=191; median = 3)

COMPARISON OF OPINIONS 16:10 FRIDAY, JANUARY 20, 1989 40

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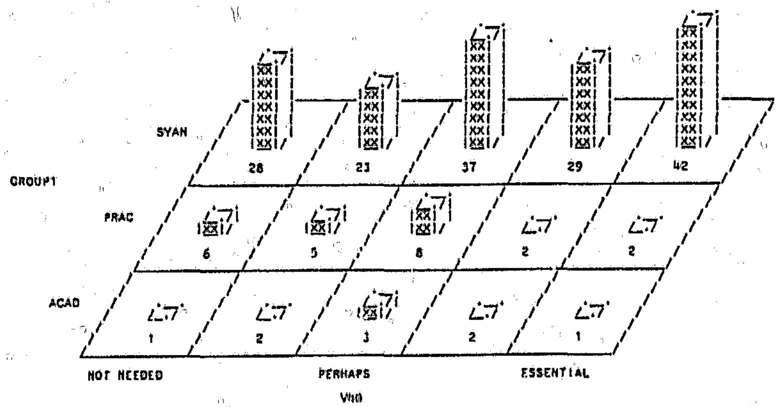

FIGURE 5.14
The importance of 'designing computer networks'
(n=191; median = 3)

COMPARISON OF OPINIONS 16:10 FRIDAY, JANUARY 20, 1989 41

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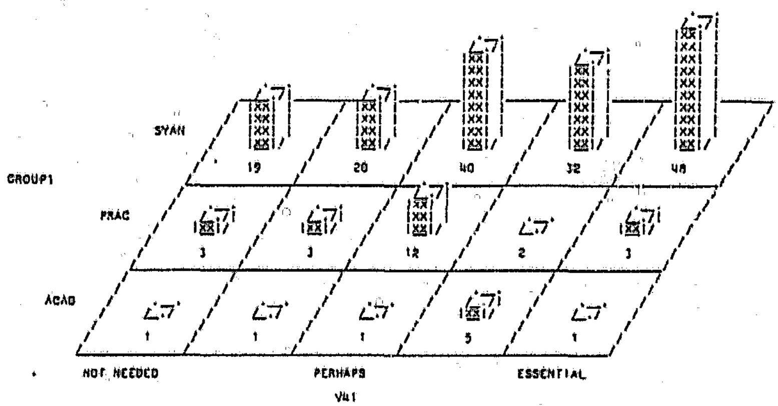

FIGURE 5.15
The importance of 'determining T.P. requirements'
(n=191; median = 3)

5.2.2.2.3 SKILLS FROM THE DEFINITION OF SYSTEMS ANALYSIS WHICH COULD BE EXPECTED TO BE REQUIRED IN THE FUTURE (Category 3.1)

Two groups of skills were identified in this section, the first are analytical skills and the second, skills related to auditing computer based systems.

(i) The skill of evaluating existing procedures was the only analytical skill within this category on which there was no disagreement among the questionnaire respondents (see figure 5.16).

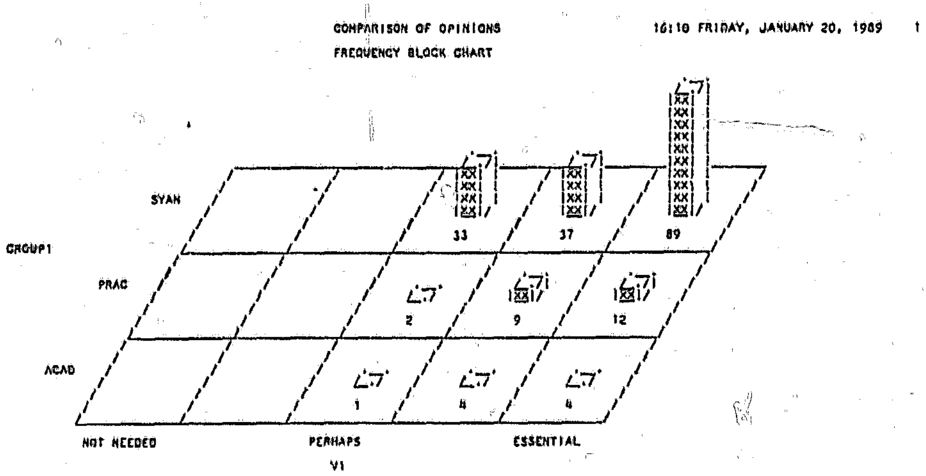

FIGURE 5.16
The importance of 'evaluating existing procedures'
(n=191; median = 5)

(ii) The second group of skills identified support the growing body of opinion (see section 6.3.1.6), Developer Group), which links systems analyst job responsibilities with the auditing of computer-based systems

e.g. determining appropriate system security,

determining appropriate system controls,

building systems which can be audited.

See figures 5.17, 5.18 and 5.19 for frequency counts which show the strength of respondents' opinions on these issues.

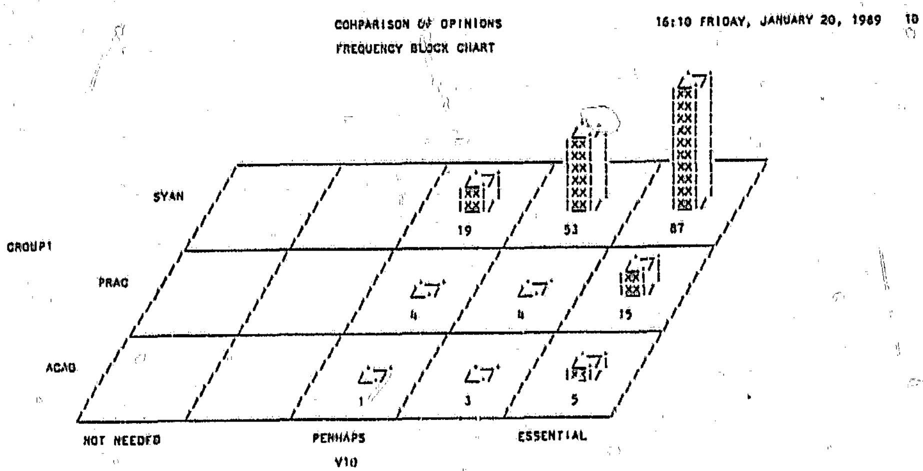

FIGURE 5.17
The importance of 'determining appropriate system security'
(n=191; median = 5)

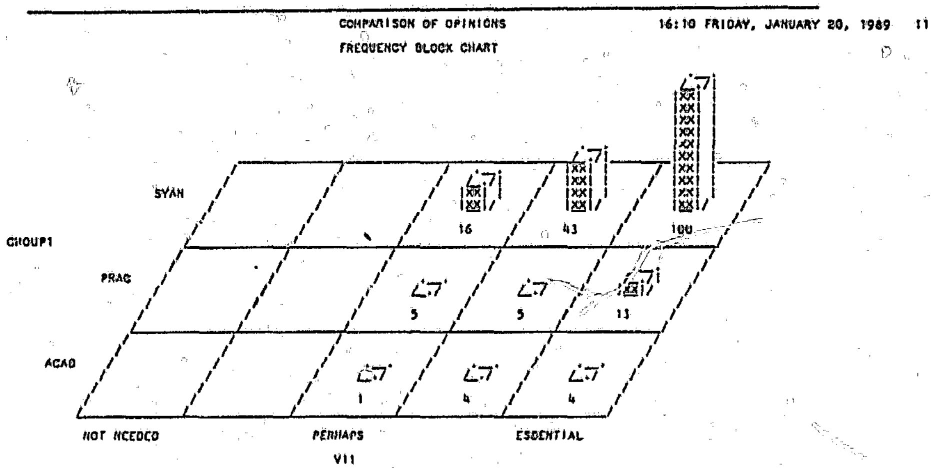

FIGURE 5.18
The importance of 'determining appropriate system controls'
(n=191; median = 5)

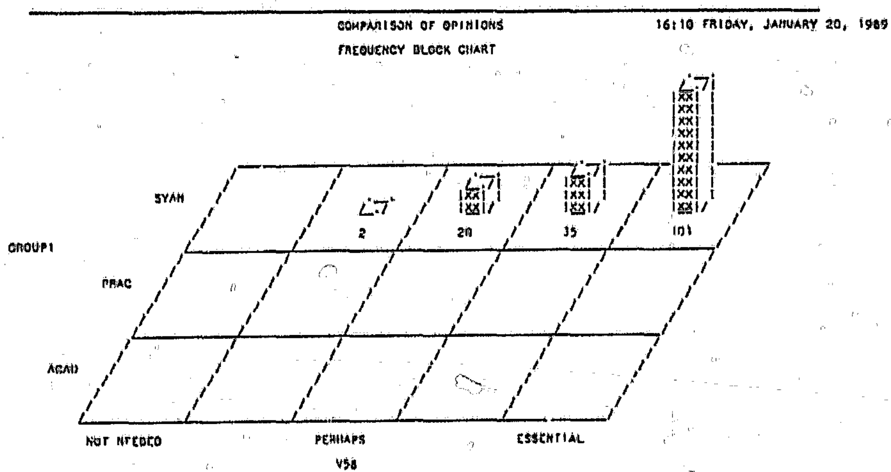

FIGURE 5.19
The importance of 'building systems which can be audited'
(n=159; median = 5)
N.B. This question was added to the questionnaire after the data from the experts were processed.

5.2.2.2.4 SUPPORTIVE SKILLS (Category 3.2)

The skills identified in this section are those which help to enable systems analysts to be more effective at their task. These skills fall into the following groups:

- skills needed to identify users' needs;
- communication skills;
- business skills.

(i) Based on the literature survey (see section 6.3.1.1) it was expected that the systems analyst of the future would be required to have analysis skills
e.g. fact finding,
problem solving,
thinking logically
identifying user/management needs.

Frequency counts of the respondents' opinions are given in figures 5.20, 5.21, 5.22 and 5.23.

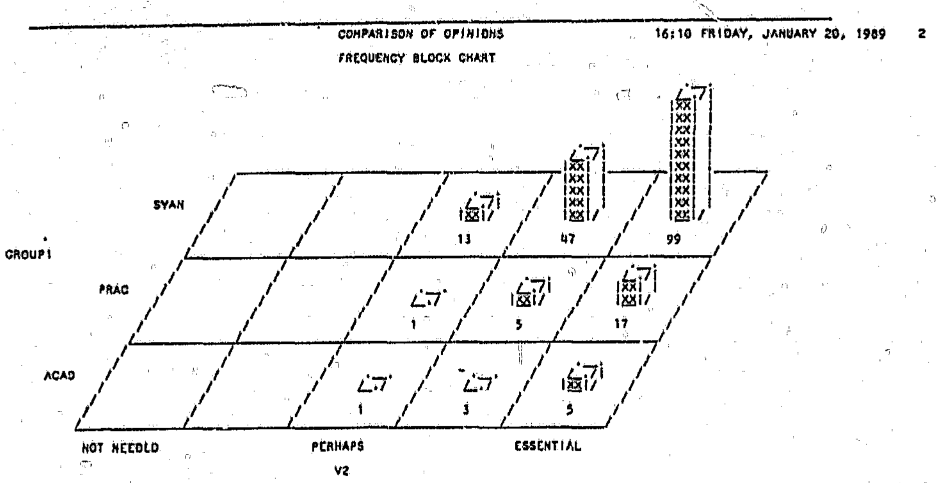

FIGURE 5.20

The importance of 'fact finding'

(n=191; median = 5)

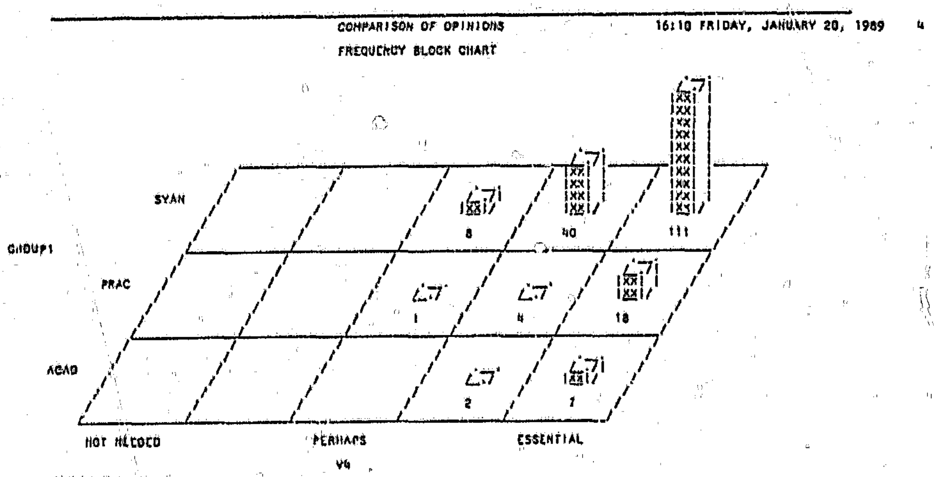

FIGURE 5.21

The importance of 'problem solving'

(n=191; median = 5)

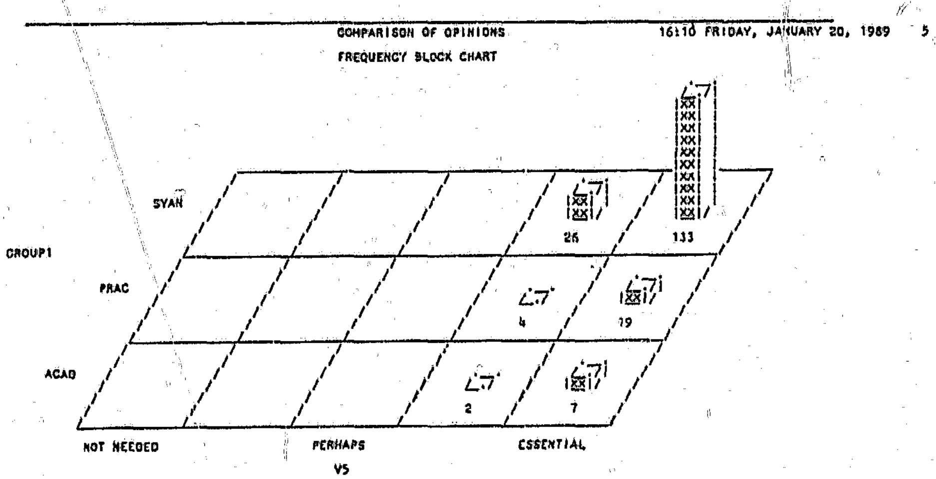

FIGURE 5.22
The importance of 'thinking logically'
(n=191; median = 5)

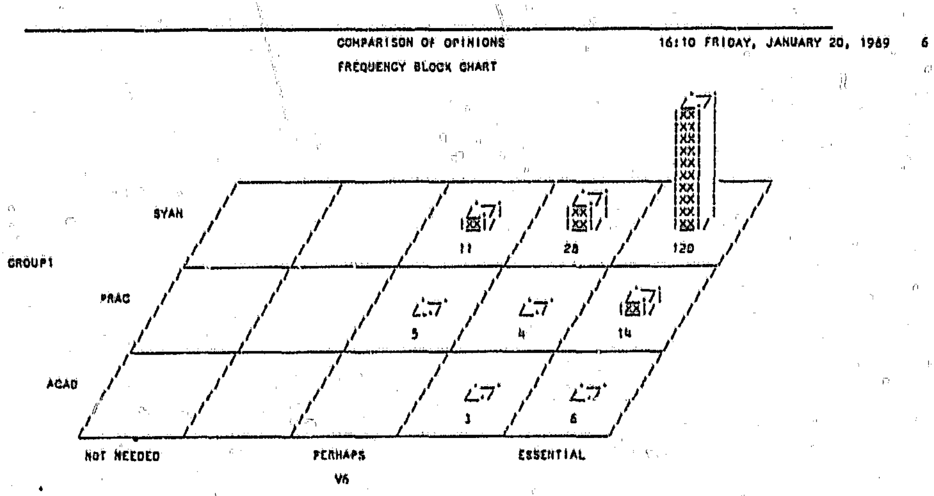

FIGURE 5.23
The importance of 'identifying user/management needs'
(n=191; median = 5)

(ii) It was also expected that the future systems analyst would be required to have communication skills (see section 6.3.1.3)

e.g. interviewing,

verbal communicating,

report writing,

presentation preparing.

Frequency counts of respondents' opinions concerning the importance of these skills to the future systems analyst are given in figures 5.24, 5.25, 5.26 and 5.27.

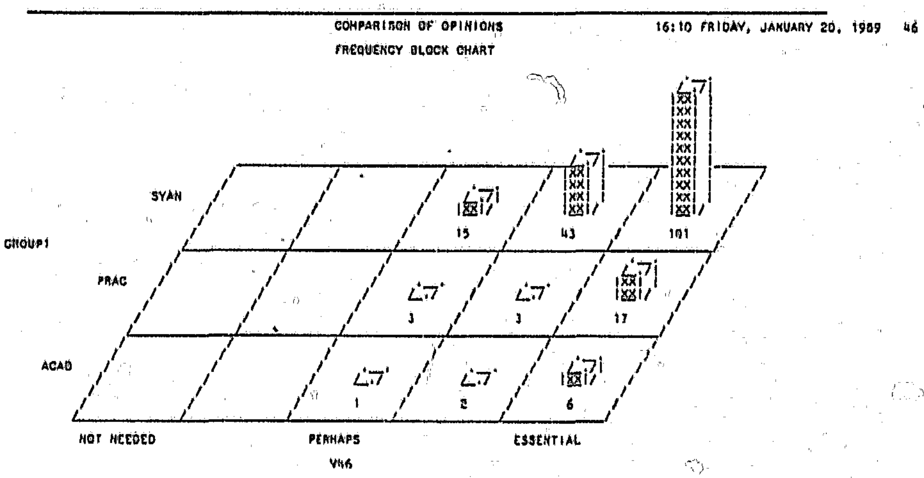

FIGURE 5.24
The importance of 'interviewing'
(n=191; median = 5)

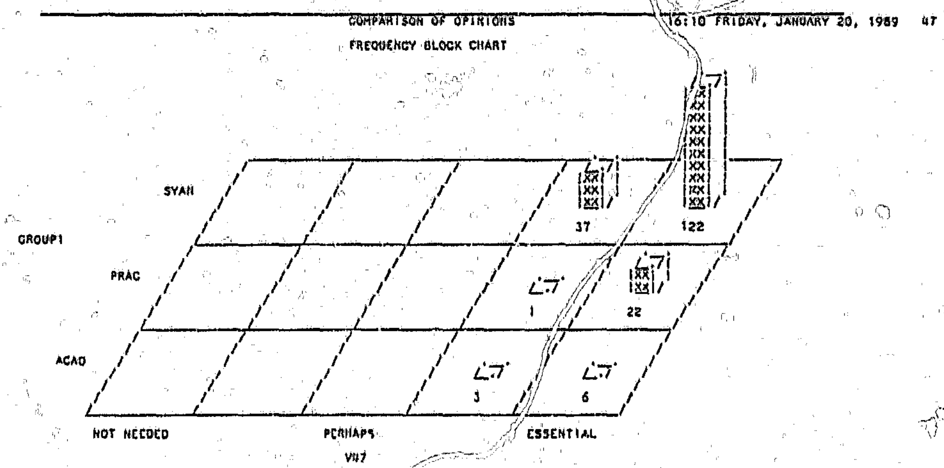

FIGURE 5.25
The importance of 'verbal communicating'
(n=191; median = 5)

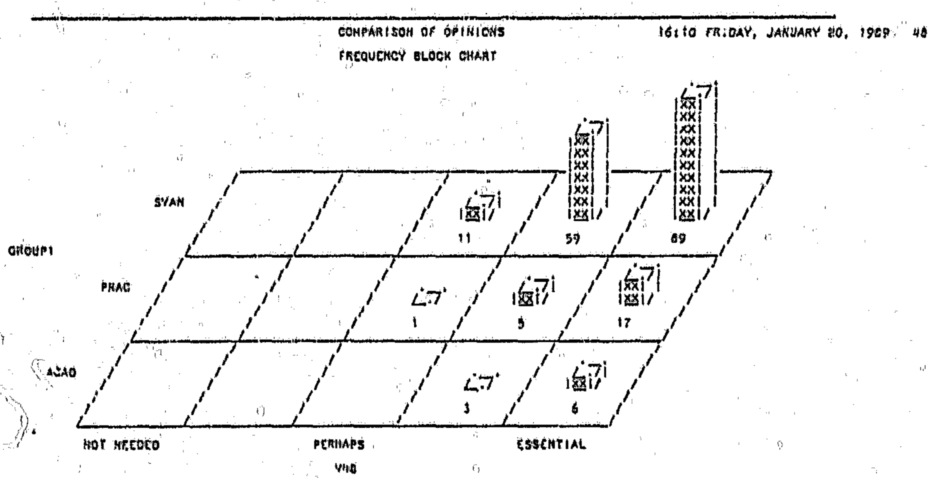

FIGURE 5.26
The importance of 'report writing'
(n=191; median = 5)

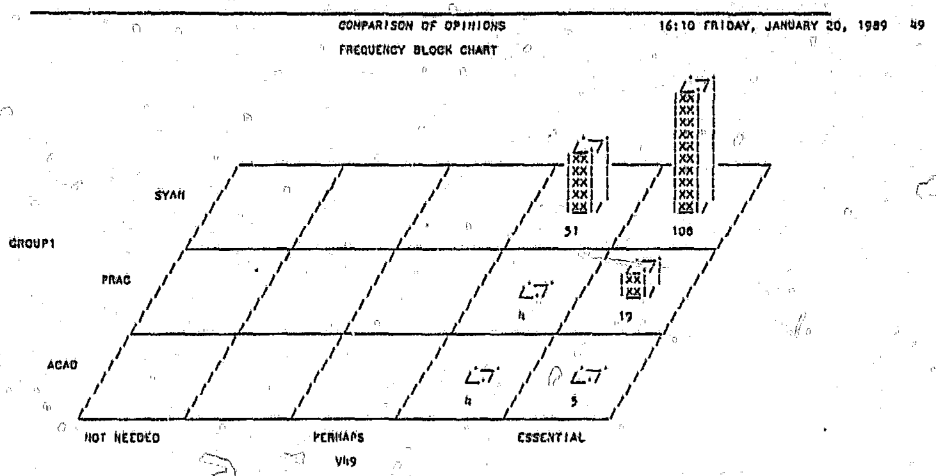

FIGURE 5.27
The importance of 'presentation preparing'
(n=191; median = 5)

(iii) To function effectively as a systems analyst in the future, those employed in this position are expected to have a background which will enable them to relate to the user activity (see section 6.3.1.1). This idea was reflected in the survey results where, to ensure that appropriate systems are implemented, organization and methods skills were regarded as important to the future systems analyst (see figure 5.28).

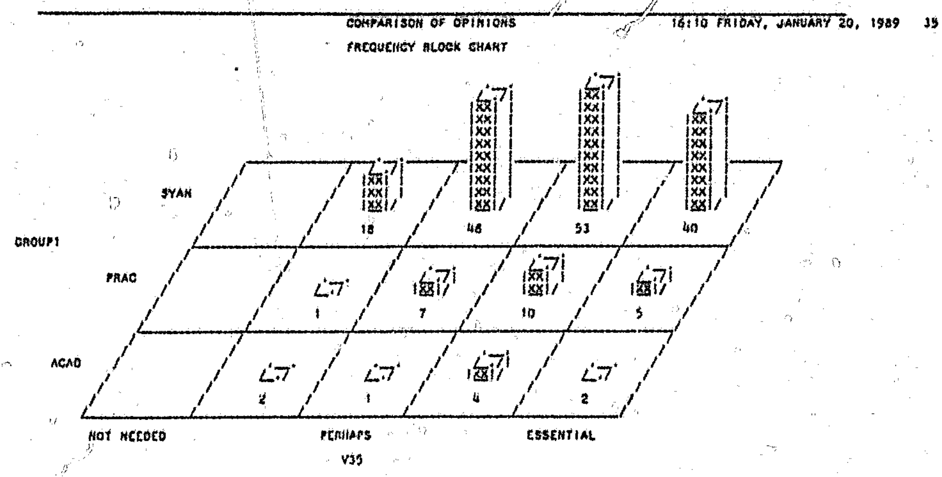

FIGURE 5.28
The importance of 'O and M skills'
(n=191; median = 4)

5.2.2.2.5 SKILL WHICH COULD BE REGARDED AS NECESSARY IN THE FUTURE BECAUSE OF THE CHANGING ROLE OF THE SYSTEMS ANALYST (Category 3.3)

Clear indications were given that the role of the systems analyst is to move away from traditional activities (e.g. as identified in section 5.2.2.2.3 above) to include at least three new areas of responsibility. The first of these areas is a direct involvement in the actual development of application software. This involvement may not require traditional (COBOL) programming skills, but is expected to require skills in:

- determining appropriate development methods,

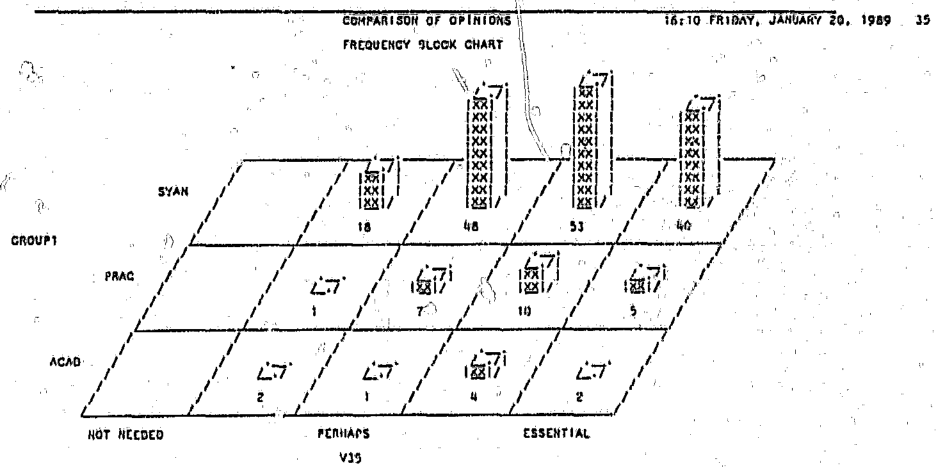

FIGURE 5.28
The importance of 'O and M skills'
(n=191; median = 4)

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- determining appropriate development methods,

- using fourth generation languages,
- using automated systems development methods.

The frequency counts of the opinions of the questionnaire respondents on the importance of these skills are given in figures 5.29, 5.30 and 5.31.

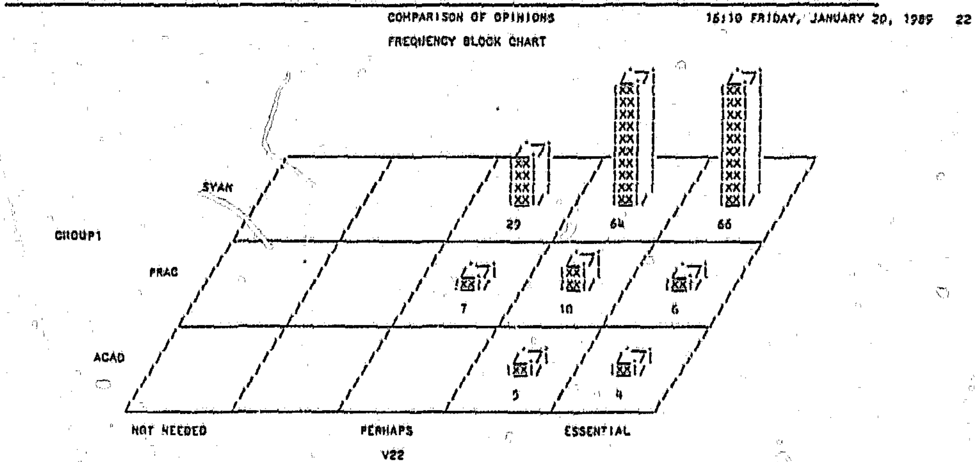

FIGURE 5.29
The importance of 'determining appropriate development method'
(n=191; median = 4)

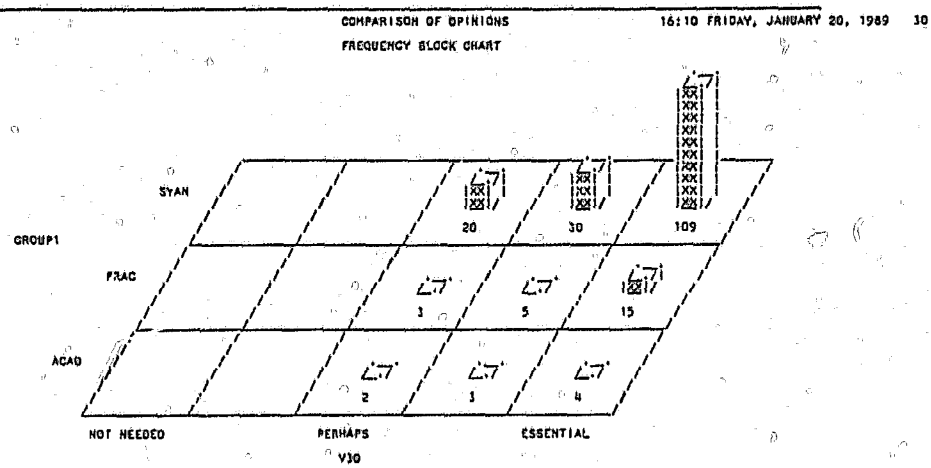

FIGURE 5.30
The importance of 'using fourth generation languages'
(n=191; median = 5)

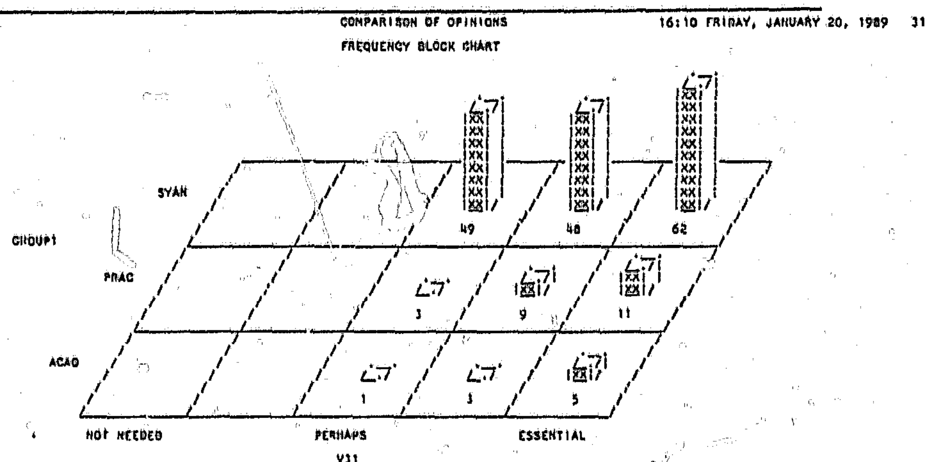

FIGURE 5.31
The importance of 'using automated systems development methods'
(n=191; median = 4)

The second areas where the results of the empirical research suggested that the role of the systems analyst is expected to expand is related to management issues. Those who responded to the questionnaire did not disagree that the future systems analyst will require project management skills e.g. progress monitoring and estimating timescales), and the more general management skills of managing and motivating people. An indication of the strength of these opinions is given in figures 5.32, 5.33 and 5.34.

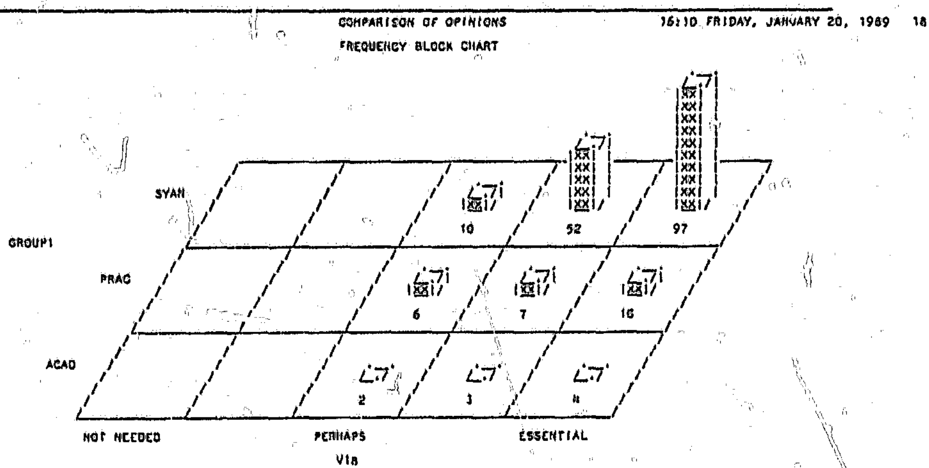

FIGURE 5.32
The importance of 'progress monitoring'
(n=191; median = 5)

COMPARISON OF OPINIONS 16:10 FRIDAY, JANUARY 20, 1989 19

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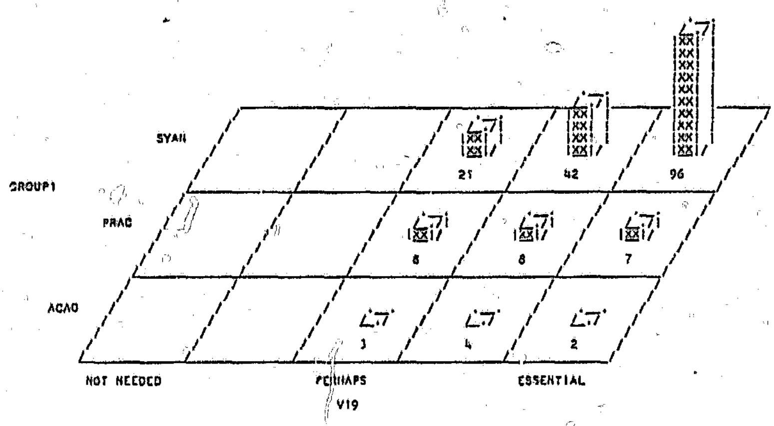

FIGURE 5.33
The importance of 'estimating costs'
(n=191; median = 5)

COMPARISON OF OPINIONS 16:10 FRIDAY, JANUARY 20, 1989 52

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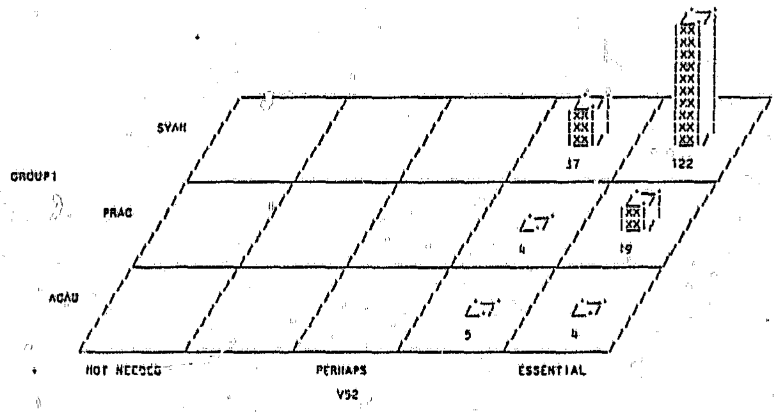

FIGURE 5.34
The importance of 'managing/motivating people'
(n=191; median = 5)

A third area where there was evidence that the role of the systems analyst in the future was expected to expand was into the realm of strategic planning. This skill has been regarded as a separate group because strategic planning must be regarded as a significant step away from usual systems analysts' responsibilities (see section 2.1.1.4). Strengths of opinions from the groups participating in the empirical research are given in figure 5.35.

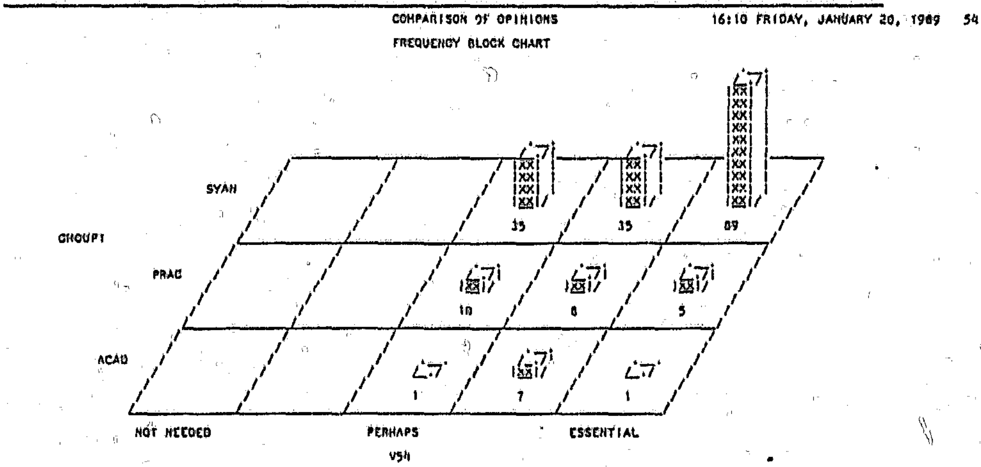

FIGURE 5.35
The importance of 'strategic planning'
(n=191; median = 4)

The final area beyond the traditional role of the systems analyst which could become a future skills requirement is related directly to databases. The opinions of the questionnaire respondents on the importance of the skill of designing logical data models is presented in figure 5.36.

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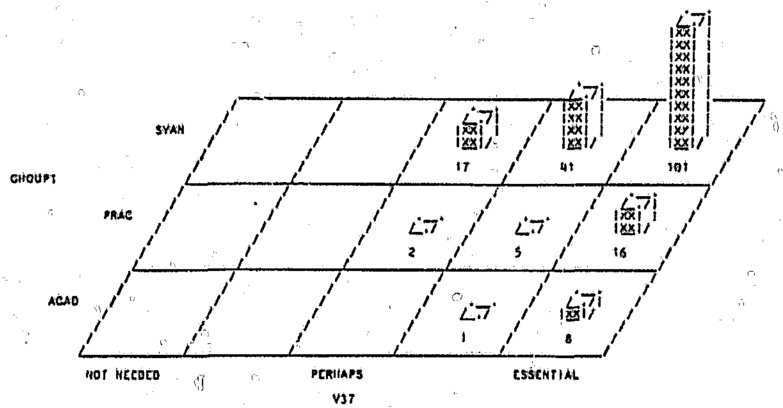

FIGURE 5.36

The importance of 'designing logical data models'
(n=191; median = 5)

5.2.2.2.6 SUMMARY ON THE SKILLS ON WHICH THERE WAS NO DISAGREEMENT

The lack of disagreement on the importance of the skills listed in table 5.12 is significant, not only because of what was included, but also because of what was missing. The skills on which there was no disagreement included analytical skills (e.g. fact finding and logical thinking), development skills (e.g. using fourth generation languages and automated systems development methods) and communication skills (e.g. interviewing and report writing). What created an element of concern for the South African computer industry was that, when these data were compared with the skills identified in the literature survey (see section 6.3), some significant skills were missing (e.g. skills as a change agent, skills in business practices, using prototyping techniques and the whole range of interpersonal relationship and management skills). Although these skills were regarded as important by the sample population as a whole (see section 5.2.2.2), the fact that there was disagreement on their importance suggests a lack of foresight in the South African computer industry.

5.2.2.3 SUMMARY ON COMPARISONS OF RESPONDENTS' OPINIONS

In this section the opinions of the three constituent groups of respondents (expert practitioners, academics and systems analysts) were compared. Although these comparisons showed strong indications of the changing role of the systems analyst (see section 5.2.2.2.4 above) a number of inconsistencies in the areas of disagreement, were identified. For example, it was expected that there would be no disagreement among the respondents on the significance of skills in business practices for the future systems analysts in the light of there being no disagreement that they would have the increasing of business skills as a job responsibility. This survey, therefore, revealed a certain lack of consistency and possibly even preparedness, on the part of the South African computer industry, for the role of the systems analyst in future application systems development (see Crossman (1987) and Crossman (1988)).

5.3 JOB RESPONSIBILITIES/SKILLS MODEL

The job responsibilities/skills model, which will be compared with the roles/skills model in section 7.3.1 and provides input to identifying the skills profile of the systems analyst of the future (section 7.3.2), was built using the empirical data.

5.3.1 FIRST ATTEMPT AT BUILDING THE MODEL

Initially it was envisaged that the inclusion in the next stages of the research of the skills identified as important by the respondents to the questionnaire could be substantiated by following the steps below:

(i) Calculate the median scores for each dimension to both the question relating to future systems analysts job responsibilities (questionnaire section 4) and skills (questionnaire section 5). Detailed descriptive statistics for each dimension is provided in appendix 'K'.

(ii) Identify those dimensions with median scores of 4 or 5 (on the scale 1 = not required to 5 = definitely required) and regard these dimensions as important to the respondents (Freund and Williams, 1977, p.28).

(iii) Place each job responsibility into one of the categories identified in section 5.2.2.

Category 3.1	required by the definition of systems analyst used in the research
Category 3.2	required to support the main systems analysts' responsibilities
Category 3.3	required to cater for the changes in the role of the systems analyst.

(iv) Justify the inclusion of each important skill by establishing links between the dimensions in section 3, 4 and 5 of the questionnaire. (e.g. If prototyping was expected to be one of the methods of building systems in the future, and prototyping systems was regarded as a systems analysts' job responsibility, then the future systems analyst would be expected to possess skills of prototyping and using fourth generation languages).

Unfortunately this simple approach could not be used because, in some cases, these links were not present. (e.g. Job responsibilities were missing in the areas of controlling/auditing application systems, strategic planning and database activities while the respondents indicated that skills in these areas were expected.)

Another procedure, therefore, needed to be followed to establish confidence that these skills were a consistent representation of the opinions of the respondents to the questionnaire.

5.3.2 SECOND ATTEMPT AT BUILDING THE MODEL

The job responsibilities/skills model was built initially using a 'bottom-up' approach. The steps followed are described below, and presented diagrammatically in figure 5.37.

(i) The median scores for each dimension were calculated as described in section 5.3.1 point (i).

(ii) Dimensions with median scores of 4 or 5 were regarded as representing an important opinion (as in section 5.3.1 point (ii)).

(iii) The important dimensions from both sections 4 and 5 of the questionnaire (future job responsibilities and future skills) were regarded as level 1 of the model.

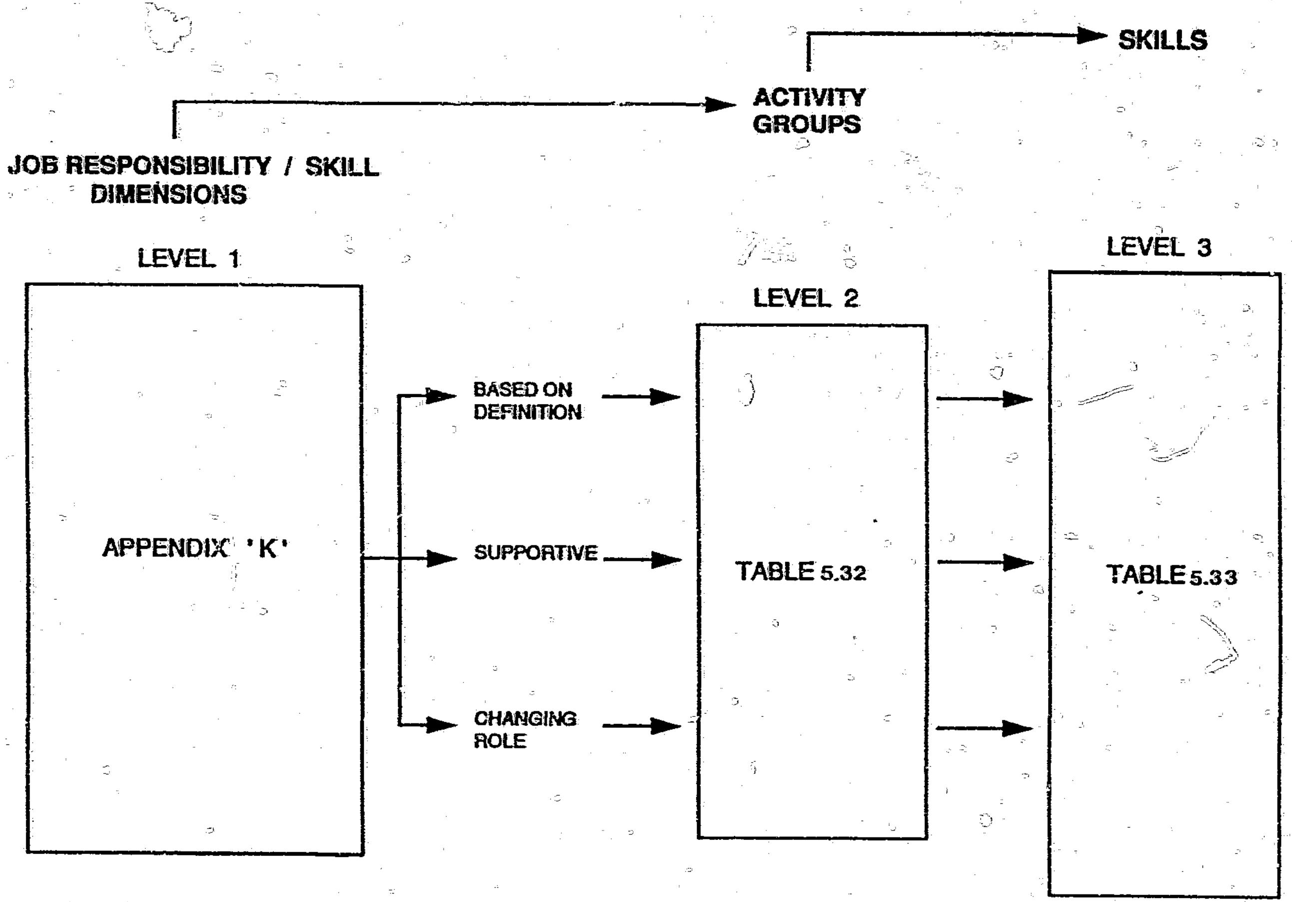

FIGURE 5.37
The job responsibilities/skills model

(iv) The dimensions in level 1 of the model were grouped into clusters (for details see section 5.3.2.1).

(v) Each identifiable cluster was given a name to describe the activities within the group. These descriptive names constituted level 2 of the job responsibilities/skills model. (To promote consistency in the study these activity groups were also divided into the 3 categories defined in section 5.2.2.2).

(vi) All the skills which were identified as necessary to each of the activity groups were regarded as the third level of the model and used as input to later stages of the research (see section 7.3.1 and 7.3.2).

5.3.2.1 ESTABLISHING ACTIVITY GROUPS

The first level of the job responsibilities/skill model contained those dimensions in sections 4 and 5 of the questionnaire which, in the opinions of the respondents, were regarded as important to the future systems analyst (see appendix 'K'). These dimensions were grouped into clusters. This clustering was achieved by applying one of three approaches:

- activity groups were identified by extracting those dimensions with fairly strong Tau-B correlation coefficients and highly significant probablity levels (because of the sample size it was possible to select these groups from only those dimensions with correlation coefficient of greater than ,3000 and a probability level of no greater than ,0001);

- following a lead from the literature;
- a combination of both of the above approaches.

By its nature, this process was interpretive. In the paragraphs below the basic steps which were followed are outlined, and illustrations of the process are given.

Besides enforcing the statistically-based selection identified above, for each dimension the highest ranked Tau-B correlation coefficients were identified. If it appeared that there was meaning in the correlation of two dimensions, those items were regarded as part of an activity group, and the next highest coefficient was inspected. This process continued until an item was identified which was regarded as having a spurious correlation with the base dimension. Once this spurious correlation was identified, no further items were included in that activity group.

The activity group identified in table 5.13 is used to illustrate the process. The base dimension was cost-analyzing systems (C2) and the four highest correlation coefficients were for the skill of cost benefit analyzing (V12), the job responsibility of conducting feasibility studies (C4), the skills of estimating costs (V19) and estimating timescales (20). These correlation coefficients ranged from a high of ,5241 to a low of ,3099. The probability value in each case was either ,0000 or ,0001. The dimension task prioritizing (V53) had the next highest correlation coefficient at ,2977. Not only was the correlation below the limit set, but the item was not regarded as one which belonged to a costing activity. This correlation was therefore regarded as spurious, and no further items were included in that group.

The details of applying the clustering process are given below. On some occasions it was regarded as appropriate to create an activity group from a stand-alone dimension (e.g. see the 'change agent' skill (V7) below), because although no activity group, as such, could be identified, the activity is well documented in the literature.

To provide a consistent approach within the study (see section 5.2.2.2), the resultant activity groups are presented in the three categories of:

- activities based on the definition of systems analyst (section 2.1.1.4);
- activities which support the systems analyst activity;
- activities which suggest a change in the role of the systems analyst.

To facilitate cross-referencing, each dimension referenced is associated with the code-name used in the statistical processes (see appendices 'J' and 'K').

5.3.2.1.1 ACTIVITIES BASED ON DEFINITION OF SYSTEMS ANALYST

The activity groups identified in the section were:

costing activities

formal analysis procedures

information engineering

system feasibility determination

user contact

(NOTE: All the activity groups are presented in alphabetic order to prevent any implied priority.)

(i) COSTING ACTIVITIES

Using the job responsibility of cost-analyzing systems (C2) as a base, a cluster of related job responsibilities and skills were identified (see table 5.13)

TABLE 5.13
Activities with 'Cost-analyzing systems' as a base

DIMENSIONS	TAU-B	PROB > IRI
Conduct feasibility studies (C4)	,4353	,0001
Cost benefit analyzing (V12)	,5241	,0001
Estimating costs (V19)	,3186	,0000
Estimating timescales (V20)	,3099	,0000

(ii) FORMAL ANALYSIS PROCEDURES

In spite of the envisaged changes in the role of the systems analyst (see Martin, 1982 p.10) the questionnaire respondents indicated that traditional systems analysis procedures would still be required in the future.

With the job responsibility of using formal analysis procedures (C1) as a base, significant correlations were identified between a small group of other job responsibilities and skills (see table 5.14).

TABLE 5.14

Activities with 'Using formal analysis procedures' as a base

DIMENSIONS	TAU-B	PROB > IRI
Formally document user needs (C5)	,4584	,0001
Produce detailed specifications (C6)	,3928	,0001
Using structured analysis methods (V9)	,5392	,0001

(iii) INFORMATION ENGINEERING

There was no strong link apparent between the job responsibility of using formal procedures to determine information requirements (C9) and any other variable. This job responsibility was, therefore, regarded as a cluster on its own, although it was expected it would be part of the formal analysis procedure cluster above.

(iv) SYSTEM FEASIBILITY DETERMINATION

Determining the feasibility of a proposed system is regarded as a significant systems analyst activity (Pressman, 1982, p.36). A small group of associated job responsibilities and skills were identified using conducting feasibility studies (C4) as a base (see table 5.15).

TABLE 5.15

Activities using 'Conducting feasibility studies' as a base

DIMENSIONS	TAU-B	PROB > IRI
Cost-analyze systems (C2)	,4354	,0001
Formally document user needs (C5)	,3712	,0000
Cost-benefit analyzing (V12)	,3702	,0000

(v) USER CONTACT

The objective of all the systems analysts' activities is to ensure that systems are installed which meet users' needs (see section 2.1.1.4). It was therefore expected that the questionnaire respondents would regard contact with the users as central to systems analysts' activities.

One aspect of this contact was perceived to include the need to train users (C33), and acting as a consultant (C34) or the skill of teaching (V50). This cluster was identified with training users (C33) as a base (see table 5.16).

TABLE 5.16

Activities using 'Training users' a base

DIMENSIONS	TAU-B	PROB > IRI
Acting as a consultant (C34)	,3528	,0000
Identifying user functions (V3)	,3131	,0000
Teaching (V50)	,3096	,0000

A second sub-division of user contact was the obvious requirement for the skill of identifying users' needs (V6). Using this skill as a base, the cluster in table 5.17 was identified in the empirical data.

TABLE 5.17
Activities with 'Identifying users' needs' as a base

DIMENSIONS	TAU-B	PROB > IRI
Identifying user function (V3)	,4968	,0001
Implementing office procedures (V34)	,3687	,0000
Implementing system procedures (V33)	,3430	,0000
Determining specific users' information needs (V38)	,3318	,0000

The third cluster of interlinked dimensions in this group was associated with the need for the systems analyst to increase business skills (C30). The strength of this interlinking is provided in table 5.18 below.

TABLE 5.18
Activities using 'Increase business skills' as a base

DIMENSIONS	TAU-B	PROB > IRI
Work in user department	,3512	,0000
Skills in user practices	,3442	,0000

5.3.2.1.2 SUPPORTIVE ACTIVITIES

The activity groups in this section are those which enable the systems analyst to function effectively. They include:

business skills

change agent skills

communication skills

decision making skills

fact finding skill

inter-personal relationship skills

keeping abreast of technology

problem solving skills

teaching skills

(The activity groups are presented in alphabetic order.)

(i) BUSINESS SKILLS

Inconsistencies in the questionnaire respondents' opinions on the need for systems analysts to develop business skills has been noted (see section 5.2.2.1). In spite of these inconsistencies, however, some links between associated job responsibilities and skills could be identified by basing the cluster on the skill of implementing office procedures (V34) (see table 5.19).

TABLE 5.19
Activities using 'Implementing office procedures' as a base

DIMENSIONS	TAU-B	PROB > IRI
Introducing new structures in user department (V32)	,6189	,0001
Organization and methods skills (V35)	,4902	,0001
Implementing system procedures (V33)	,4590	,0001
Identifying user functions (V3)	,4127	,0001

(ii) CHANGE AGENT SKILLS

The role of the systems analyst is closely linked to change (e.g. Lee, 1981, p.43, Davis and Olson, 1985, p.349 and 594, and Feeney and Sladek, 1977, p.85). Although, in the opinion of the questionnaire respondents, this skill (V7) was not correlated strongly with any other identified through the empirical research, the questionnaire respondents regarded it as important to the future systems analyst.

(iii) COMMUNICATION SKILLS

The role of the systems analyst as a communicator is well documented (e.g. Capron, 1986, p.53, Lee, 1981, p.49 and Gore and Stubbe, 1983, p.46). In the opinion of the questionnaire respondents, this group of skills could not be linked directly to a particular job responsibility. It was possible, however, to identify a cluster of strongly inter-related skills in this category based on verbal communicating (V47) (see table 5.20).

TABLE 5.20
Activities using 'Verbal communicating' as a base

DIMENSIONS	TAU-B	PROB > IRI
Interviewing (V46)	,5482	,0001
Presentation preparing (V49)	,4681	,0001
Report writing (V48)	,4676	,0001
Dealing with people (V44)	,4517	,0001

(iv) DECISION MAKING SKILLS

The importance of decision making skills (V55) to the systems analyst is demonstrated by the large number of dimensions with which this skill is correlated (see table 5,21).

TABLE 5,21
Activities using 'Decision making' as a base

DIMENSIONS	TAU-B	PROB > IRI
Reviewing performance (V56)	,6072	,0001
Task prioritizing (V53)	,5883	,0001
Strategic planning (V54)	,5558	,0001
Project controlling (V16)	,5346	,0001
Project planning (V15)	,4552	,0001
Scheduling (V17)	,4457	,0001

(v) FACT FINDING SKILLS

The gathering of information is the method used by the systems analyst to identify user needs and proposed systems' characteristics (Lee, 1981, p.103). The cluster of dimensions based on this skill (V2) show its importance to the questionnaire respondents (see table 5.22).

TABLE 5.22
Activities using 'Information gathering' as a base

DIMENSIONS	TAU-B	PROB > IRI
Evaluate existing procedures (V1)	,4581	,0001
Identifying user function (V3)	,4429	,0001
Problem solving (V4)	,3106	,0000

(vi) INTER-PERSONAL RELATIONSHIP SKILLS

It is widely recognized that inter-personal relationship skills are as significant as technical skills to the systems analyst (see section 6.3.1.12). This view is supported by the opinions of the questionnaire respondents. Using the skill of working in and through a project team (V43) as a base, the cluster in table 5.23 was identified.

TABLE 5.23
Activities using 'Working in an through a project team' as a base

DIMENSIONS	TAU-B	PROB > IRI
Dealing with people (V44)	,6926	,0001
Managing/motivating people (V52)	,5627	,0001
Being diplomatic (V45)	,5541	,0001
Reviewing performance (V56)	,4013	,0000

(vii) KEEPING ABREAST OF TECHNOLOGY

In the opinion of the questionnaire respondents the future systems analysts will have the responsibility to keep abreast of technology (C35) to ensure they can perform functions such as revising development method standards (C18; TAU-B, 3456; PROB > IRI ,0000). It was surprising, however, that there were not stronger correlations between this responsibility and the other technical activities (e.g. building whole system (CI5)) included as future systems analysts' responsibilities.

(viii) Problem solving is a central systems analyst activity (Byrkett and Uckan, 1985, p.45). A small cluster of skills based on problem solving (V4) was identified in the empirical data (see table 5.24).

TABLE 5.24
Activities using 'Problem solving' as a base

DIMENSIONS	TAU-B	PROB > IRI
Thinking logically (V5)	,6299	,0001
Problem solving (C8)	,3452	,0000

(ix) TEACHING SKILLS

To help train the users to make effective use of any new system is regarded as a systems analysts' responsibility (Martin, 1982, p.335). The respondents to the questionnaire supported this view. The cluster of dimensions in table 5.25 was identified, based on the skill of teaching (V50).

TABLE 5.25
Activities using 'Teaching' as a base

DIMENSIONS	TAU-B	PROB > IRI
Presentation preparing (V49)	,4485	,0001
Selling ideas (V51)	,3779	,0000
Verbal communicating (V47)	,3654	,0000

5.3.2.1.3 ACTIVITIES WHICH REFLECT CHANGES IN THE ROLE OF THE SYSTEMS ANALYST

The activity groups identified from level 1 of the model which indicate that the responsibilities of the systems analyst are changing, were:

acquiring systems

audit and control activities

database responsibilities

designing systems

identifying appropriate development method

management

strategic planning activities.

(The activity groups are presented in alphabetic order.)

(i) ACQUIRING SYSTEMS

One of the more dramatic changes envisaged in the future role of the systems analysts is that they will not only be involved in the analysis and design of computer-based systems, but will have a responsibility for the building of systems. This was evident in the empirical data and from the literature survey (see section 6.3.1.6). The important dimensions identified in the data (see section 5.3 point (ii)) were linked to form a number of sub-divisions in this cluster.

(a) GENERATING SYSTEMS

The links identified in this sub-division were between the job responsibility of generating systems (C12), the skill of using automated systems development methods (V31; Tau-B ,3153; Prob > lRl ,0000) and the job responsibility of tuning generated systems (C16; Tau-B, ,3506; PROB > lRl ,0000). The tuning of generated systems (C16) correlated significantly with integrating new and old systems (C17; Tau-B ,3658; Prob > lRl ,0000).

(b) PROTOTYPING SYSTEMS

An obvious link existed between the job responsibility of prototyping systems (C14) and the skill of using prototyping techniques (V29; Tau-B ,5690; Prob > lRl ,001). A much weaker link was identified between using prototyping techniques (V29) and using fourth generation languages (V30; Tau-B ,1674; Prob > lRl ,0101).

(c) INSTALLING APPLICATION PACKAGES

A strongly linked cluster was identified in the empirical data between both job responsibilities and skills associated with the systems analysts' use of application packages. Based on the expected responsibility of selecting packages (C26), the correlations in table 5.26 were found in the empirical data.

TABLE 5.26
Activities using 'Selecting packages' as a base

DIMENSIONS	TAU-B	PROB > IRI
Implement packages (C27)	,7411	,0001
Customize packages (C28)	,5101	,0001
Evaluate packages (V27)	,6053	,0001
Implement packages (V28)	,5225	,0001

(ii) AUDIT AND CONTROL ACTIVITIES

There is some evidence in the literature (e.g. Pope, 1979, p.22) which suggests that the systems analyst is expected to be involved in the audit of computer-based systems. This cluster of skills, which has no job responsibility base, is grouped around the skill of building systems which can be audited (V58) (see table 5.27)

TABLE 5.27

Activities using 'Building systems which can be audited' as a base

SKILL	TAU-B	PROB > IRI
Determining appropriate system controls (V11)	,3871	,0000
Auditing computer systems (V57)	,3831	,0000
Implementing system procedures (V33)	,3562	,0000

(iii) DATABASE RESPONSIBILITIES

Managing data and databases as a systems analyst responsibility was identified in the literature (see section 6.3.1.5). Support for these ideas was identified in the empirical data. Designing logical data models and specifying users' information requirements were seen as future systems analysts' responsibilities in the larger context of strategic planning. The correlations in table 5.28 are based on the skill of determining corporate data requirements (V36), and identify this skill cluster.

TABLE 5.28

Activities using 'Determining corporate data requirements' as a base

DIMENSION	TAU-B	PROB > IRI
Designing logical data models (V37)	,4776	,0001
Determining specific user's information needs (V38)	,4325	,0001
Building competitive positions (V14)	,3204	,0000

(iv) DESIGNING SYSTEMS

Later, from the literature survey, it will be established that the systems analyst will be expected to perform a large number of activities in the systems design cluster (see section 6.3.1.20). By linking the activities identified in the empirical data to the job responsibility of designing systems (C11), (see table 5.29) a hint that the role of the systems analyst is expected to broaden, was identified.

TABLE 5.29
Activities using 'Designing systems' as a base

DIMENSION SKILL	TAU-B	PROB > IRI
Use formal analysis procedures (C1)	,3755	,0000
Generate systems (C12)	,3626	,0000
Identify appropriate develop method (C10)	,3495	,0000

(v) MANAGEMENT

(a) PROJECT MANAGEMENT

The job responsibilities and skills linked in this large cluster (see table 5.31) are based on the job responsibility of monitoring systems development (C20).

TABLE 5.30

Activities using 'Monitoring systems development' as a base

DIMENSION	TAU-B	PROB > IRI
Control systems develop. (C21)	,7651	,0001
Plan systems develop. (C19)	,6842	,0001
Evaluate systems develop. (C22)	,6163	,0001
Report on systems develop. (C23)	,5488	,0001
Evaluate performance of systems developers (C24)	,4771	,0001
Conduct post-implementation evaluations (C25)	,4180	,0001
Project controlling (V16)	,4158	,0001
Decision making (V55)	,4087	,0001
Estimating timescales (V20)	,3913	,0000
Scheduling (V17)	,3806	,0000
Reviewing performance (V56)	,3717	,0000
Progress monitoring (V18)	,3692	,0000
Project planning (V15)	,3483	,0000

(b) MANAGEMENT IN GENERAL

The skills linked in table 5.32 are presented from the base of the skill of managing/motivating people (V52).

TABLE 5.31
Activities using 'Managing/motivating people' as a base

DIMENSION	TAU-B	PROB > IRI
Working in/through a project team (V43)	,5627	,0001
Task prioritizing (V53)	,4459	,0001
Dealing with people (V44)	,4453	,0001
Reviewing performance (V56)	,4304	,0001

(vi) STRATEGIC PLANNING ACTIVITIES

Although, in the questionnaire, the skill of strategic planning (V54) was included under the management group (see appendix 'G'), because of the prominence this skill is given in the literature (see section 6.3.1.18), it was felt that it should be regarded as a separate cluster. Unfortunately, however, it was not possible to support statistically the identification of a cluster under this heading. This was surprising because the important skills of using information and information systems as competitive weapons (V13) (see McFarlan, 1983; Rackoff et al., 1985) would have been placed in this cluster.

5.3.2.1.4 SUMMARY ON ACTIVITY GROUPS

Using the data of level 1 of the job responsibilities/skills model, a number of activity groups which represent the future systems analyst tasks (as perceived by the respondents), were identified. Although these activity groups were presented in this section within three categories, those categories were combined and listed in table 5.32 as level 2 of the model.

TABLE 5.32

Groups of activities which constituted level 2 of the job responsibilities/skills model

- User contact
- Formal analysis procedures
- Costing activities
- System feasibility testing
- Formal methods of identifying information needs
- Audit and control activities
- Communicating
- Problem solving
- Business practices
- Decision making
- Fact finding
- Interpersonal relationships
- Teaching
- Change agent
- Keeping abreast of technology
- Identifying appropriate development methods
- Systems design
- Acquiring systems
- Management, in general
- Project management
- Strategic planning activities
- Database activities

5.3.2.2 LEVEL THREE OF THE JOB RESPONSIBILITIES/SKILLS MODEL

Each of the skills regarded as important to the respondents of the questionnaire could be placed into at least one of the clusters identified as level 2 of the job responsibilities/skills model. These skills (listed alphabetically in table 5.33) represent, in the opinion of representatives of the South African computer industry, the skills profile of the systems analyst of the future, and constitute level 3 of the model.

5.3.2.3 SUMMARY ON BUILDING THE JOB RESPONSIBILITIES/SKILLS MODEL

The objective of this stage of the research was to identify the skills which, in the opinion of the questionnaire respondents, will be required by the future systems analyst. Because of inconsistencies within the replies from the respondents, identifying these skills could not be done simplistically. An approach was taken, using as a base the median scores of each dimension of both sections 4 and 5 of the questionnaire. This was regarded as level 1 of the model. This base enabled a number of systems analyst activity groups to be identified which confirmed a change in the role of the systems analyst. These activity groups were regarded as the second level of the model. All the skills which were part of these activity groups were those identified as important to the future systems analyst by the questionnaire respondents. These skills, regarded as level 3 of the model, provided clear indication of the skills a sample population of the South African computer industry thought should be expected of the future systems analyst.

TABLE 5.33

Level three of the job responsibilities/skills model

- Acting as a change agent
- Auditing computer systems
- Being diplomatic
- Building competitive positions
- Building systems which can be audited
- Cost-benefit analyzing
- Critical-path analysis
- Dealing with people
- Decision making
- Designing logical data models
- Determining appropriate development methods
- Determining appropriate system controls
- Determining appropriate system security
- Determining corporate data requirements
- Determining specific users' information requirements
- Estimating costs
- Estimating time
- Evaluating application packages
- Evaluating existing procedures
- Fact finding
- Identifying competitive advantages
- Identifying user function
- Identifying user/manager needs
- Implementing application packages
- Implementing new structures in user departments
- Implementing office procedures
- Implementing system procedures
- Interviewing
- Managing/motivating people
- Organization and method skills
- Problem solving
- Progress monitoring

(CONT)

TABLE 5.33 (CONT)

Project controlling
Project planning
Presentation preparing
Report writing
Reviewing performance
Scheduling
Selling ideas
Skills in business practices
Strategic planning
Task prioritizing
Teaching
Thinking logically
Using automated systems development methods
Using Fourth Generation Languages
Using prototyping techniques
Using structured analysis methods
Verbal communicating
Working in/with a project team

5.4 SUMMARY OF THE CHAPTER

The data collected through surveying representatives of the South African computer industry were processed in two ways:

- firstly, the opinions of the three constituent groups in the sample population (the academic experts, the practitioner experts and the practising systems analyst) were compared and contrasted;
- secondly, the data were used to construct the job responsibilities/skills model which gave a clear indication of what skills the respondents regarded as necessary for the systems analyst of the future.

The skills identified in this section as important, were used as input to other stages of the research. In section 7.3.1 they were compared to the skills identified through the literature survey and in section 7.3.2 they were input to building the skills profile of the future systems analyst.

CHAPTER SIX

THE ROLES/SKILLS MODEL

Once the empirical data had been used to build the job responsibilities/skills model, (see definition in section 2.1.1.3) the next step to identifying the skills required by the systems analyst of the future was taken using a combination of deductive reasoning and literature reviews (see figure 6.1 for a diagrammatic representation of this stage of the research).

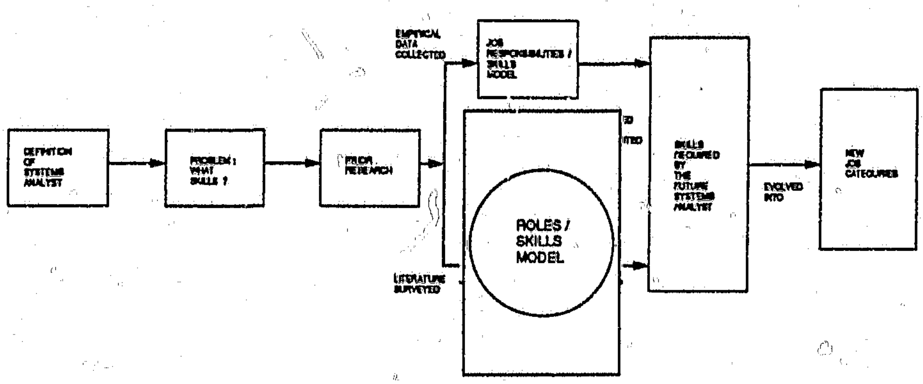

FIGURE 6.1
This stage of the research in context

A model was built which linked the roles future systems analysts are expected to play in their environment, with the skills required to function effectively within these roles. The amount of literature available specifically on the skills required by the systems analyst of the future is limited. Some of the details of the model, therefore, apply directly to the current systems analyst's position, and to the future systems analyst only by deduction.

This model has a basic structure of three levels:

LEVEL ONE - the people and things with which a future system analyst is expected to associate.

LEVEL TWO - the nature of these associations (expressed in terms of the roles the systems analyst will be expected to perform).

LEVEL THREE - the skills which will be required in order to function effectively within these roles.

Figure 6.2 is a presentation of the inter-relationship between these levels and the intermediate links which were established to construct the model.

6.1 LEVEL ONE

The first level of the model was established by identifying the people, tasks, structures, cultures and technology with which the systems analysts are expected to interact while performing their function (Davis and Olson, 1984, p.355).

6.1.1 SYSTEMS ANALYST'S ASSOCIATIONS

The following items were identified (either directly in the literature or by deduction and inference) as those with which a systems analyst will have an association.

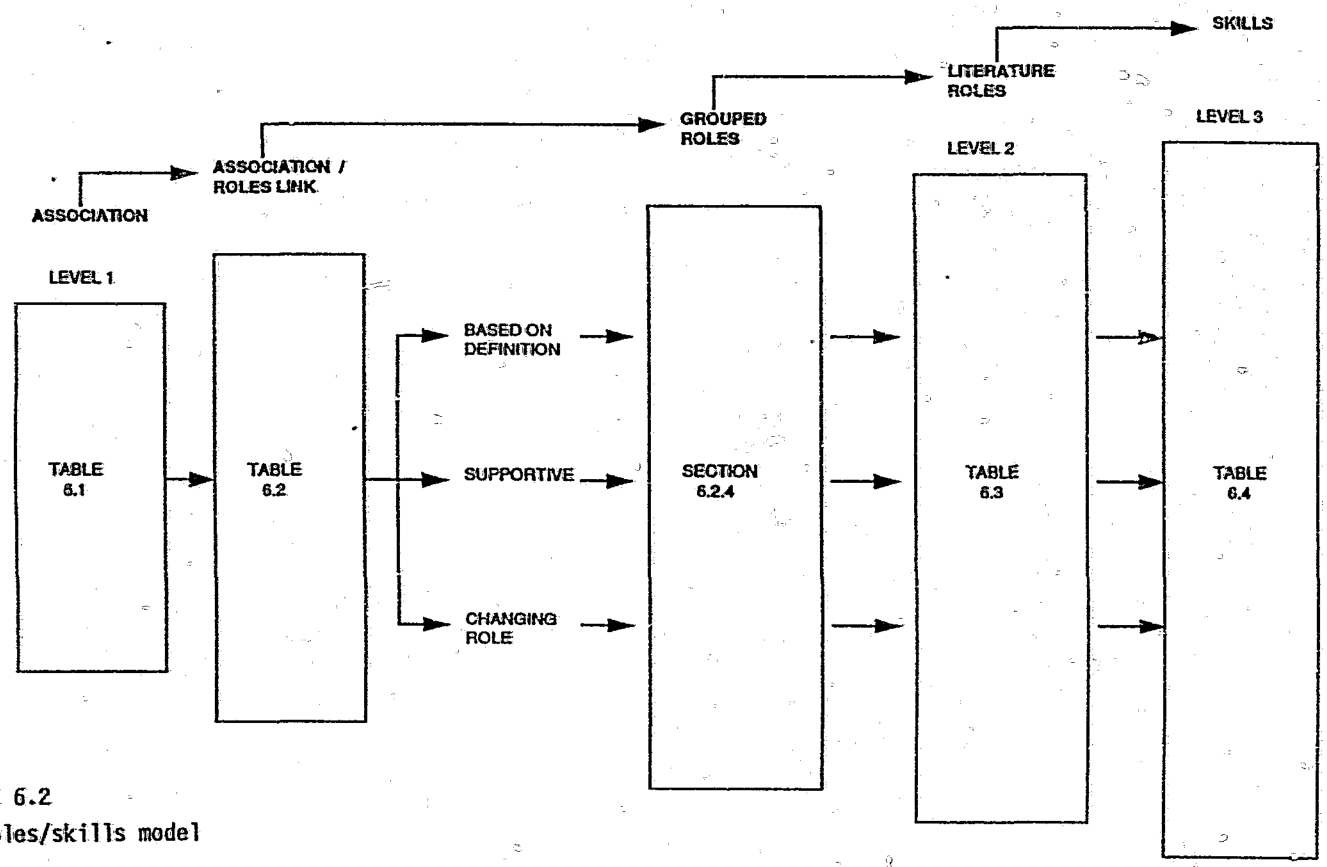

FIGURE 6.2
The roles/skills model

(i) The company by which the systems analyst is employed

The association individuals have with the company which employs them is documented in literature which is not specifically related to systems analysis.

It is deduced that all employees, including systems analysts, will be influenced by a company's goals, objectives and culture (Drucker, 1977, p.135; Elkins, 1980, p.107; Allen, 1969, p.117).

(ii) Users (managers and workers)

There are a large number of references in the literature identifying the systems analyst's association with the user at both management and worker levels (e.g. Wetherbe, 1979, pp.88-93; Bower et al., 1983, p.123; Ostle, 1985, pp.56-58; Capron, 1986, pp.36-37; Spock, 1985, p.114; Martin, 1982, p.331; Jenkins, 1986, p.30).

(iii) I.S. Department

Again there is a large pool of source material describing the relationships of systems analysts within the I.S. Department. Examples of these references will be grouped together for clarity.

I.S. Manager/Management team/Project leader

(Spock, 1985, p.114; Allen, 1969, p.117; Elkins, 1980, p.107).

Project/Project team/Subordinates

(Capron, 1986, p.39; Bowen, 1981, p.121; Allen, 1969, pp.23-30; Keen, 1981, pp.183-284; Harold, 1983, p.105; Jackson, 1986, p.248).

Peers

(Gore and Stubbe, 1983, p.45; Newman and Rosenberg, 1985, p.398; Bower et al., 1985, p.121).

System being developed

(Clarke and Prins, 1986, p.32; Davis W S, 1983, p.397; Lee, 1978, p.49; Jackson, 1986, p.248; Roe, 1984, p.39; McLeod and Forkner, 1982, p.307; Capron, 1986, pp.36-37).

Systems analyst task

(Ostle, 1985, p.36; Jeffery and Lawrence, 1984, p.107; Thierauf, 1986, pp.643-645; Davis and Olson, 1985, p.458; Bower et al., 1985, p.121; Harold, 1983, p.105; Leeson, 1981, p.55; Davis D L, 1983, p.17).

Other technical colleagues

By deduction, the systems analyst must communicate and co-operate with other members of the I.S. department who may contribute, directly or indirectly, to the development of the project.

(iv) Vendors

To benefit from advances in technology, the systems analyst will require some association with the suppliers of equipment, development tools and software. This need is referred to occasionally in the literature (e.g. Harold, 1983, p.105; Bartol et al., 1988, p.33; Thierauf, 1986, pp.570-597; Capron, 1986, p.343; Gore and Stubbe, 1983, p.422).

(v) The I.S. Industry

It is sometimes claimed that people involved in application software development are more loyal to their own industry than to the company which employs them (e.g. Ginzberg and Baroudi, 1988, p. 587; Koenig, 1982, p.218; Bartol et al., 1986; Davis and Olson, 1985, p.646). Any changes in their future role are not likely to isolate systems analysts completely from this influence.

(vi) The Technology

Personnel involved in application software development will be unlikely to have an association with computer-based technology other than as a user and an evaluator of the technology (Bartol et al., 1986, p.32; Harold, 1983, p.105).

6.1.2 SUMMARY OF ASSOCIATIONS

The associations a systems analyst is expected to have in the future are summarized in table 6.1. This is regarded as the first level of the roles/skills model.

6.2 LEVEL TWO

The second level of the model was built by determining the nature of the associations systems analysts are expected to have with their environment. This was done by identifying in the literature - or by

TABLE 6.1

Level one of the roles/skills model

- The Company (employer)
  - Company goals and objectives
  - Company culture
  - Users
    - Managers
    - Workers
  - I.S. Department
    - Manager/Management team
    - Project/Project team
      - Leader
      - Peers
      - Subordinates
      - System being developed
    - Systems analyst task
    - Other technical colleagues
      - Programmers/Designers
      - Operators
      - Network/Communications controllers
      - I.S. engineer/Database administrator
      - QA staff
- Vendors
  - Equipment
  - Development tools
  - Software
- The I.S. industry (the so-called 'profession')
- The Technology

deduction from indicators in the literature - the roles which the systems analyst is required to fill in order to function within the level one associations (see Meissner, 1986, p.7).

6.2.1 INITIAL LIST OF ROLES

No example was found in the literature of linking the future systems analysts' association with their environment (see section 6.1) with the roles they will be expected to fill to be effective within each association. To establish these links in the model required cycles of deduction both from the detailed level up, and from the higher levels of the model down into more detail.

A literature search revealed a list of nearly 100 roles which the systems analyst of the future will be expected to fill. It was felt that if this list of roles could be placed into a hierarchy, which in turn could be linked to the associations which the future systems analyst will have, then the possibility of any important factors being overlooked would be minimized.

6.2.2 ROLES LINKED DIRECTLY TO ASSOCIATIONS

The upper levels of the hierarchy was established by deduction. Each of the items in the systems analysts' environment was analyzed to attempt to deduce the role the systems analyst must play to be effective within that association (see table 6.1). These roles were later grouped and linked to the roles identified in the literature.

(i) The Company and the User

As a member of staff, the systems analyst will be required to fill the role of subordinate and learner. The relationship with the user, however, will demand that the systems analyst cover a range of roles from strategic planner, analyst, systems designer, prototyper, developer and implementor to change agent, consultant, instructor and possibly even project manager, communicator and interpersonal facilitator (see table 6.2).

(ii) The I.S. Department

The future systems analysts will fill the role of a subordinate to the management of the I.S. Department and the leadership of any project team with which they may be involved. To their peers the systems analysts will play the role of learner and interpersonal facilitator while to their subordinates, they could fill the roles of project manager or consultant.

A number of the roles already mentioned will be filled by the systems analysts in their association with the system being developed. Again these cover a broad spectrum from strategic planner, analyst, systems designer, data base designer, prototyper, developer and implementor to estimator, project manager, change agent and consultant to perhaps even quality assurer.

To other technical personnel in the I.S. department the systems analyst could fill the roles of communicator, consultant or user (see table 6.2).

(iii) The Vendors

The roles which the future systems analysts will fill in relation to the vendors to the computer industry will include communicator (of requirements), and learner and implementor (of new technology and approaches) (see table 6.2).

(iv) The I.S. Industry

The systems analysts of the future will also communicate requirements (and perhaps also experiences) to the I.S. industry, but in this relationship they will again fill the roles of learner and subordinate (see table 6.2).

(v) The Technology

The systems analyst will learn to keep abreast of the technology, but will obviously also play the role of a user of the technology (see table 6.2).

6.2.3 GROUPING OF THE ROLES

Both models built in this study had the same underlying structure. In this section the roles identified through the systems analysts' associations (table 6.1), are grouped into the same categories as those used for the job responsibilities in the empirical model (section 5.2.2.2). Using this some basic framework ensured thoroughness in the contrasting and combining of the two models in section 7.3.1.

NOTE: To avoid any implied priority, all roles are listed alphabetically.

TABLE 6.2

Linking of future systems analysts' roles to their environment

ENVIRONMENT	ROLE
COMPANY	Learner
USER (Manager, Worker)	Subordinate
	Analyst
	Change agent
	Communicator
	Consultant
	Developer
	Implementor
	Instructor
	Interpersonal facilitator
	Project manager
	Prototyper
	Strategic planner
	System designer
	Worker

ENVIRONMENT	ROLE
I.S. DEPARTMENT	
Manager/Management team	Subordinate
Project/Project team	Strategic planner
Team leader	Subordinate
Peers	Interpersonal facilitator
	Learner
Subordinates	Consultant
	Project manager
System being developed	Analyst
	Change agent
	Consultant
	Data base designer
	Developer
	Estimator
	Implementor
	Project manager

(CONT)

TABLE 6.2 (CONT)

ENVIRONMENT	ROLE
	Prototyper
	Quality assurer
	Strategic planner
	Systems designer
Systems analyst task	ALL ROLES
Other technical personnel	Communicator
	Consultant
	User
VENDORS	Communicator
	Implementor
	Learner
	Strategic planner
THE I.S. INDUSTRY	Communicator
	Learner
	Subordinate
THE TECHNOLOGY	User

6.2.3.1 ROLES REQUIRED BY DEFINITION

The roles (from table 6.1) which are required of the systems analyst according to the definition in section 2.1.1.4 are:

analyst role

estimator

quality assurer (evaluator).

6.2.3.2 SUPPORTIVE ROLES

Roles in the second group are those activities which provide the support which enables the systems analysts to perform their tasks effectively. The roles in this group are:

change agent

communicator

fact finder

instructor

interpersonal facilitator

learner

numerator

subordinate

user (of technology).

6.2.3.3 ROLES INDICATING CHANGE

In the context of this research, the most important group of roles is that which reflects the changes in the systems analysts' task. Roles in this group include:

consultant

data base designer

developer of systems

generalist

implementor of systems

project manager

strategic planner

systems designer.

6.2.3.4 LINKING THESE ROLES TO THOSE IDENTIFIED IN THE LITERATURE

Significantly more roles than those listed in these three groups were identified in the literature (see section 6.2.4.1 to 6.2.4.3). Although it led to some overlapping and redundancy, the roles identified in the literature were grouped into these three categories. This linking technique was used to minimize the possibility of overlooking significant roles (and, therefore, not identifying the skills associated with the roles).

6.2.4 A ROLES HIERARCHY

To ensure that no skills were overlooked in the roles/skills model, all the roles identified through the literature survey were built into a roles hierarchy. The highest level of the hierarchy was the roles identified in table 6.2, and grouped into the three categories identified in section 6.2.3. This process is presented graphically in figure 6.2.

6.2.4.1 ROLES FROM THE DEFINITION OF SYSTEMS ANALYST

The roles in this group are directly linked to the definition of systems analyst in section 2.1.1.4.

6.2.4.1.1 ANALYST ROLE

The analyst role was perceived to be a composite role comprising, firstly, of those roles which must be performed to function as an analyst. These include:

- benefit identifier (Harold, 1983, p.105)
- cost justifier (Martin, 1986, p.336)
- estimator (Harold, 1983, p.105)
- fact finder (Lucas, 1982, p.301)
- needs identifier (McLeod, 1983, p.545)

problem recognizer (Wetherbe, 1979, p.86)

task analyzer (Bahl and Hunt, 1984, p.130)

reviewer (Ostle, 1985, p.160)

specifier (Dickson and Wetherbe, 1985, p.341).

Secondly, to be able to perform these analysis activities effectively, the systems analyst could be expected also to fill the following roles:

business associate (Lee, 1981, p.49)

decision maker (Wetherbe, 1979, p.100)

methodology expert (Capron, 1986, p.100)

problem solver (Vitalari and Dickson, 1983, p.946)

task performer (Thierauf, 1986, p.6)

technical assessor (Canning, 1984b, p.4)

technician (McLeod and Forkner, 1982, p.308).

A third group of analyst roles was identified. This group has not been included here because, although it is closely associated with the traditional analyst activity of needs identifier, the method of identifying these needs is through prototyping the requirements (Boar, 1986, p.28). Because this role is one of the changes in this systems analysts' associations with the user, details are included as a new category in section 6.2.4.3.7.

6.2.4.1.2 ESTIMATOR ROLE

One of the systems analysts' basic responsibilities includes estimating. Within this role, the systems analyst will be required to act as:

cost estimator (Davis W S, 1983, p.188)

forecaster (Bowman et al., 1983, p.15)

numerator (Byrkett and Uckan, 1985, p.45)

time estimator (Pressman, 1982, p.59).

6.2.4.1.3 QUALITY ASSURER/EVALUATOR ROLE

At the Q.A. Conference in Chicago in 1982 it was suggested that one of the roles of the systems analyst is that of a quality assurer (Q.A. Conference, 1982, p.341). To perform effectively within this specialist role, the systems analyst will be required to be an:

evaluator (Elkins, 1980, p.385)

reviewer (Ostle, 1985, p.160).

6.2.4.2 ROLES WHICH SUPPORT THE SYSTEMS ANALYSTS' ACTIVITIES

These groups of roles are based on the supportive roles required for the individual to function as a systems analyst.

6.2.4.2.1 CHANGE AGENT ROLE

From the many references in the literature to this activity, the following supportive roles were identified:

advisor/mentor (Barr and Kochen, 1984, p.175)

catalyst (McLeod, 1983, p.545)

confronter (Capron, 1986, p.36)

enforcer (Ostle, 1985, p.57)

innovator (Dickson and Wetherbe, 1985, p.399)

persuader (Capron, 1986, p.36).

To be able to perform these roles, the change agent needs further to be a:

forecaster (Bowman et al., 1983, p.15)

influencer (Ostle, 1985, p.57)

initiator (Ostle, 1985, p.57)

politician (Koenig, 1982, p.218)

seller (of ideas) (FitzGerald et al., 1981, p.236)

technical assessor (Canning, 1984b, p.4).

6.2.4.2.2 COMMUNICATOR ROLE

The supportive roles in this group have been identified as those which cover the whole spectrum of communication:

communicator (Davis D L, 1983, p.15)

documentor/writer (Capron, 1986, p.54)

interviewer (Capron, 1986, p.100)

presenter/speaker (Semprevivo, 1982, p.69).

To be able to function effectively in these roles, the communicator also needs to be a:

diplomat (Harold, 1983, p.120)

listener (Nylen et al., 1967, p.119)

negotiator (Jeffery and Lawrence, 1984, p.107).

6.2.4.2.3 FACT FINDER ROLE

To perform the role of a fact finder, the systems analyst will need to function within the following roles:

communicator (Davis D L, 1983, p.15)

observer (Capron, 1986, p.100)

problem recognizer (Wetherbe, 1979, p.86)
reviewer (Ostle, 1985, p.160)
diplomat (Harold, 1983, p.120).

6.2.4.2.4 INSTRUCTOR ROLE

A number of sources indicated that the function of the systems analyst should include the roles of:

educator (Martin, 1981, p.335)
instructor (Cox and Snyder, 1983, p.247)
seller (FitzGerald et al., 1981, p.236)
teacher (Martin, 1982, p.335)
trainer (Jenkins, 1986, p.30).

6.2.4.2.5 INTERPERSONAL FACILITATOR ROLE

One group of roles identified in the literature possessed a strong interpersonal flavour (Bower et al., 1989, p.121). These roles included:

arbitrator/mediator (Harold, 1983, p.102)
co-operator (Spock, 1985, p.114)
diplomat (Harold, 1983, p.120)
enabler/helper (Martin, 1982, p.332)
encourager (Martin, 1982, p.334)
facilitator (Rivard and Huff, 1985, p.90)
motivator (Drucker, 1977, p.55)
participant (Newman and Rosenberg, 1985, p.404)
politician (Koenig, 1982, p.218)

supporter (Thomsett, 1980, p.43)

team member (Semprevivo, 1982, p.66).

6.2.4.2.6 LEARNER ROLE

Certain literature references strongly suggest that the systems analyst will not be effective without filling the role of a learner (Davis W S, 1983, p.44). These references include:

acceptor (Allen, 1969, p.110)

listener (Nylen et al., 1967, p.119)

observer (Capron, 1986, p.36)

understander (Leeson, 1981, p.53).

6.2.4.2.7 NUMERATOR ROLE

A group of roles which the systems analyst is expected to fill requires mathematical and statistical competencies. These roles include:

analytical modeller (Harold, 1983, p.17)

mathematical modeller (Byrkett and Uckan, 1985, p.45)

mathematician (Byrkett and Uckan, 1985, p.45)

statistician (Jenkins, 1986, p.32).

6.2.4.2.8 SUBORDINATE ROLE

The employees of any organization will tend to be productive (and successful) within the organization if they function effectively as subordinates. From the literature survey the following supportive roles were identified as being appropriate for the systems analyst:

acceptor (Allen, 1959, p.110)

co-operator (Spock, 1985, p.114)

learner (Davis W S, 1983, p.44)

participant (Newman and Rosenberg, 1985, p.404)

supporter (Thomsett, 1980, p.43)

task performer (Thierauf, 1986, p.6).

6.2.4.2.9 USER (OF TECHNOLOGY) ROLE

To be able to benefit from advances in technology which assists in the building of computer-based application systems, the systems analyst may be required to function within the roles of:

acceptor (Allen, 1969, p.110)

buyer (Harold, 1983, p.105)

learner (Davis W S, 1983, p.44)

technical assessor (Canning, 1984b, p.4)

tools expert (Thierauf, 1986, p.643)

understander (Leeson, 1981, p.53).

6.2.4.3 ROLES WHICH INDICATE A CHANGE IN THE SYSTEMS ANALYSTS' TASK

These groups of roles indicate a shift from the definition of systems analyst (see section 2.1.1.4).

6.2.4.3.1 CONSULTANT ROLE

To function as a consultant, the future systems analyst will be required to fill the following roles:

advisor/mentor (Barr and Kochen, 1984, p.175)

buyer (Harold, 1983, p.105)

change agent (Feeney and Sladek, 1977, p.85)

co-ordinator (Capron, 1986, p.38)

encourager (Martin, 1982, p.334)

evaluator (Elkins, 1980, p.385)

forecaster (Bowman et al., 1983, p.15)

instructor (Cox and Snyder, 1985, p.247)

system building facilitator (Rivard and Huff, 1985, p.90)

technical assessor (Canning, 1984b, p.4).

To be able to function in these roles, the future systems analyst may need to fill the following additional roles:

business associate (Lee, 1981, p.49)

seller (of ideas) (FitzGerald et al., 1981, p.236)

task performer (Thierauf, 1986, p.6)

tools expert (Thierauf, 1986, p.643).

6.2.4.3.2 DATABASE DESIGNER ROLE

This is one of the more technical activities which the systems analyst of the future is expected to perform. The roles which will need to be filled are:

data element identifier (Dickson and Wetherbe, 1985, p.210)

logical data modeller (Martin, 1982, p.576)

methodology expert (Capron, 1986, p.236)

task performer (Thierauf, 1986, p.6)

tools expert (Thierauf, 1986, p.643).

6.2.4.3.3 DEVELOPER ROLE

To perform the tasks of a developer (as opposed to performing only the analytical step of system's implementation) requires the systems analyst to perform the following roles:

estimator (Harold, 1983, p.105)

methodology expert (Capron, 1986, p.236)

programmer (fourth generation) (Davis and Olson, 1985, p.426)

programmer (third generation) (Greenwood et al., 1986, p.12)

reviewer (Ostle, 1985, p.160)

specialist (Martin, 1982, p.160)

technical assessor (Canning, 1984b, p.4)

technician (McLeod and Forkner, 1982, p.3098)

tools expert (Thierauf, 1986, p.643)

user of technology (McLeod and Forkner, 1982, p.308).

The non-technical roles which support these technical activities include:

reconciler (Lee, 1981, p.49)

task performer (Thierauf, 1986, p.6).

6.2.4.3.4 GENERALIST ROLE

The emphasis of some authors (e.g. Clarke and Prins, 1986, p.32 and Benbasat et al., 1980, p.31) is that generalist skills are perceived to be more useful for the future systems analyst than specialist skills. This perception appeared to be in direct contrast with other writers (e.g. Martin, 1982, p.337 and Thierauf, 1986, p.102) who claim that more specialization is needed in the task of the systems analyst (see section

7.5.2.1 where this issue is resolved).

6.2.4.3.5 IMPLEMENTOR ROLE

As an implementor of new systems the future systems analyst will be required to fill the roles of:

buyer (Harold, 1983, p.105)

change agent (Feeney and Sladek, 1977, p.85)

converter of user procedures (Keen, 1981, p.225)

co-ordinator (Capron, 1986, p.38)

estimator (Harold, 1983, p.105)

evaluator (Elkins, 1980, p.385)

file creator (Crocker, 1984, p.36)

systems tester (Crocker, 1984, p.36)

test data designer (Crocker, 1984, p.36)

tools expert (Thierauf, 1986, p.643).

To be able to support these technical activities, the implementor must also function in the roles of:

forecaster (Bowman, 1983, p.15)

organizer (Keen, 1981, p.214)

seller (FitzGerald et al., 1981, p.236)

task performer (Thierauf, 1986, p.6)

technical assessor (Canning, 1984b, p.4)

technician (McLeod and Forkner, 1982, p.308).

6.2.4.3.6 PROJECT MANAGER ROLE

A number of sources in the literature suggested that the future systems analysts will be expected to manage application software development projects. To achieve this, they will require to function within the roles of:

advisor/mentor (Barr and Kochen, 1984, p.175)
appraiser (Allen, 196[illegible], p.205)
controller (Keen, 1981, p.261)
co-ordinator (Capron, 1986, p.38)
delegator (Allen, 1969, p.107)
estimator (Harold, 1983, p.105)
evaluator (Elkins, 1980, p.385)
leader (Canning, 1984b, p.4)
motivator (Crocker, 1977, p.55)
organizer (Keen, 1981, p.214)
project planner (Keen, 1981, p.188)
scheduler (Harold, 1983, p.105)
task performer (Thierauf, 1986, p.6).

6.2.4.3.7 PROTOTYPER ROLE

This new role is an extension of the analyst role (section 6.2.4.1.1). One of the methods which a systems analyst may use to determine user requirements is the technique of prototyping (Boar, 1986, p.28). To perform effectively within this role, the systems analyst will be required to be an:

analyst (Gore and Stubbe, 1983, p.45)
implementor (McFarlan, 1983, p.8)
programmer (fourth generation)(Davis and Olson, 1985, p.426)

specialist (Martin, 1982, p.337)

systems designer (Capron, 1986, p.39).

It is envisaged that the following supporting roles will also be required:

reconciler (Lee, 1981, p.49)

technician (McLeod and Forkner, 1982, p.308)

tools expert (Thierauf, 1986, p.643).

6.2.4.3.8 STRATEGIC PLANNER ROLE

Another specialist role identified in the literature was a systems analyst as a strategic planner (Davis and Olson, 1985, p.444). To function within this role the systems analyst will need to be a:

business associate (Lee, 1981, p.49)

communicator (Davis D L, 1983, p.15)

estimator (Harold, 1983, p.105)

forecaster (Bowen et al., 1983, p.15)

numerator (Byrkett and Uckan, 1985, p.45)

task performer (Thierauf, 1986, p.6).

6.2.4.3.9 SYSTEMS DESIGNER ROLE

It is interesting that the role of the systems analyst is considered to include the function of the physical design of the system (e.g. Davis and Olson, 1984, p.577). This suggests (a point expanded upon later - see section 7.4.2) that the title 'systems analyst' does not describe adequately the tasks performed by a person working in this position. Further support is given to this argument by writers who suggest that the future systems analyst will function within roles such as:

conceptual designer (Capron, 1986, p.142)

configuration designer (Jenkins, 1986, p.30)

data base designer (Davenport, 1980, p.506)

procedure designer (Davis and Olson, 1985, p.587)

specifier (Dickson and Wetherbe, 1985, p.341).

To be able to support these functions the systems analyst may also be required to fill the following roles:

decision maker (Wetherbe, 1979, p.100)

estimator (Harold, 1983, p.120)

reviewer (Ostle, 1985, p.160)

task performer (Thierauf, 1986, p.6)

technical assessor (Canning, 1984b, p.4)

technician (McLeod and Forkner, 1982, p.308)

tools expert (Thierauf, 1986, p.308).

6.2.5 SUMMARY ON ROLES

The systems analyst roles identified in the literature, and grouped into the hierarchy described in section 6.2.4, were known to contain overlapping ideas and, in some places, duplication. Part of the redundancy was that some of the roles were only complete if they included other roles (e.g. consultant, developer, project manager) while other roles could be presented in their primary form (e.g. advisor, catalyst, innovator). Because the reason for building this model was to identify systems analyst skills, (not systems analyst roles), the second level of the roles/skills model was identified by combining each of the groups identified in section 6.2.4. These groups of roles are presented in table 6.3 in alphabetic order (again to prevent any implied priorities in the presentation).

6.3 LEVEL THREE

The third level of the roles/skills model was also identified directly from the literature. These skills were regarded as necessary for the system analyst to function effectively within the roles identified as the second level of the model (table 6.3). To ensure that the probability of any necessary skills being overlooked was unlikely, the roles and the skills were directly linked.

TABLE 6.3
Level Two of the Roles/Skills Model

GROUP 1 ANALYST	GROUP 2 CHANGE AGENT
Benefit identifier	Advisor
Business associate	Catalyst
Communicator	Communicator
Cost justifier	Confronter
Decision maker	Enforcer
Estimator	Forecaster
Fact finder	Influencer
Interpersonal facilitator	Initiator
Learner	Innovator
Methodology expert	Interpersonal facilitator
Needs identifier	Persuader
Numerator	Politician
Problem recognizer	Seller
Problem solver	Technical assessor
Reviewer	
Specifier	

TABLE 6.3 (CONT)

Task analyzer
Task performer
Technical assessor
Technician

GROUP 3 COMMUNICATOR
Diplomat
Documentor/Writer
Interpersonal facilitator
Interviewer
Listener
Negotiator
Presenter/Speaker

GROUP 4 CONSULTANT
Advisor/Mentor
Business associate
Buyer
Change agent
Communicator
Co-ordinator
Encourager
Evaluator
Forecaster
Instructor
Seller
Systems building facilitator
Technical assessor
Task performer
Tools expert

GROUP 5 DATA BASE DESIGNER
Communicator
Data element identifier
Logical data modeller
Methodology expert
Numerator
Task performer
Tools expert

GROUP 6 DEVELOPER (see also PROTOTYPER)
Communicator
Estimator
Methodology expert
Programmer (fourth generation)
Programmer (third generation)
Reconciler
Reviewer
Specialist
Task performer
Technical assessor
Technician
Tools expert
User

GROUP 7 ESTIMATOR
Cost estimator
Forecaster
Numerator
Time estimator

(CONT)

TABLE 6.3 (CONT)

GROUP 8 FACT FINDER
- Communicator
- Diplomat
- Interpersonal facilitator
- Learner
- Observer
- Problem recognizer
- Reviewer

GROUP 9 GENERALIST

GROUP 10 IMPLEMENTOR
- Buyer
- Change agent
- Communicator
- Converter of user procedures
- Co-ordinator
- Estimator
- Evaluator
- File creator
- Forecaster
- Instructor
- Interpersonal facilitator
- Organizer
- Seller
- Systems tester
- Task performer
- Technical assessor
- Technician
- Test data designer
- Tools expert

GROUP 11 INSTRUCTOR
- Communicator
- Educator
- Interpersonal facilitator
- Seller
- Teacher
- Trainer

GROUP 12 INTERPERSONAL FACILITATOR
- Arbitrator/Mediator
- Communicator
- Co-operator
- Diplomat
- Enabler/Helper
- Encourager
- Facilitator
- Learner
- Motivator
- Participant
- Politician
- Supporter
- Team member

GROUP 13 LEARNER
- Acceptor
- Communicator
- Interpersonal facilitator
- Listener
- Observer
- Understander

(CONT)

TABLE 6.3 (CONT)

GROUP 14 NUMERATOR
- Analytical modeller
- Mathematical modeller
- Mathematician
- Statistician

GROUP 15 PROJECT MANAGER
- Advisor/Mentor
- Appraiser
- Communicator
- Controller
- Co-ordinator
- Delegator
- Estimator
- Evaluator
- Interpersonal facilitator
- Leader
- Motivator
- Organizer
- Project planner
- Scheduler
- Task performer

GROUP 16 PROTOTYPER
- Analyst
- Implementor
- Instructor
- Programmer (fourth generation)
- Reconciler
- Specialist
- Systems designer
- Technician
- Tools expert

GROUP 17 QUALITY ASSURER
- Evaluator
- Reviewer
- Specialist

GROUP 18 STRATEGIC PLANNER
- Business associate
- Communicator
- Estimator
- Forecaster
- Numerator
- Task performer

GROUP 19 SUBORDINATE
- Acceptor
- Co-operator
- Interpersonal Facilitator
- Learner
- Participant
- Supporter
- Task performer

(CONT)

TABLE 6.3 (CONT)

GROUP 20 SYSTEMS DESIGNER	GROUP 21 USER
Change agent	Acceptor
Communicator	Buyer
Conceptual designer	Learner
Configuration designer	Technical assessor
Data base designer	Tools expert
Decision maker	Understander
Estimator	
Numerator	
Physical designer	
Procedure designer	
Reviewer	
Specifier	
Task performer	
Technical assessor	
Technician	
Tools expert	
User	

6.3.1 LINKING ROLES AND SKILLS

The following steps were taken to link the two levels of the model:

- the alphabetic order of the roles identified in section 6.2.4 was retained;
- to minimize duplication, the linking of roles and skills was done cumulatively (if a skill had already been identified as necessary within a group, it was not referenced again within that group);
- also to avoid unnecessary duplication, roles which were treated as a group were specifically excluded from other groups;
- for the sake of brevity, only one literature reference per skill was noted;

- again the skills were listed alphabetically to avoid any unintended priorities.

6.3.1.1 ANALYST GROUP (see section 6.2.4.1.1)

ROLES INCLUDED: Analyst, Benefit identifier, Business associate, Cost justifier, Decision maker, Methodology expert, Needs identifier, Problem recognizer, Problem solver, Reviewer, Specifier, Task analyzer, Technical assessor, Technician

ROLES EXCLUDED: Estimator, Fact finder, Task performer

ROLES/SKILLS LINK:

To function as an analyst, the following skills are perceived to be necessary:

analyzing (Gore and Stubbe, 1983, p.46)
analyzing business problems (Mumford, 1985, p.97)
analyzing data flows (Harold, 1983, p.105)
deductive reasoning (Croisdale, 1975, p.35)
evaluating existing procedures (FitzGerald et al., 1981, p.112)
evaluating information (Grindlay, 1981, p.15)
fact finding (Wetherbe, 1979, p.97)
identifying user needs/requirements (McLeod, 1983, p.545)
mediating (Capron, 1986, p.39)
problem identifying (Wetherbe, 1979, p.88)
problem solving (Vitalari and Dickson, 1983, p.946)
skill: business (general) (Lee, 1981, p.49)
skill: business training (Chen, 1985, p.39)

skill: database/data dictionary (Navathe and Kerschberg, 1986, p.21)

skill: user department/functional area (Alavi, 1985, p.176)

task analyzing (Bahl and Hunt, 1984, p.130)

thinking logically (McLeod and Forkner, 1982, p.308)

using methodologies (e.g. structured analysis)(Yourdon, 1986, p.134)

viewing any situation as a system (Nunamaker et al., 1982, p.785.

To function within the role of a benefit identifier, some of the skills already mentioned (e.g. fact finding, skill: user department/ functional area) will be required by the future systems analyst. Other skills identified include:

forecasting business trends (Canning, 1984b, p.1)

risk analyzing (Jackson, 1986, p.92)

skill: I.S. technology (Davis D, 1983, p.17)

using information competitively (Canning, 1984b, p.2)

using technology (McLeod and Forkner, 1982, p.343).

The skills required to be a business associate which have already been noted include general business acumen, skills in business training and skills in the functional area into which the computer-based system is to be installed. Two further specific skills were noted:

skill: accounting/finance/economics (Vitalari, 1985, p.222)

skill: organization and methods (Lee, 1981, p.49).

The role of cost justifier (which will include skills in general business trends and the use of I.S. technology) is mentioned specifically in the literature (Martin, 1986, p.336).

Many of the roles to be filled by the future systems analyst (e.g. systems designer, implementor, evaluator) require the skill of decision making. Obviously, this skill is also required within this analyst group of roles (Wetherbe, 1979, p.100).

To ensure that the analysis activities are not approached purely subjectively, the future systems analyst will require skills in the use of current analytical methodologies (Yourdon, 1986, p.134).

Skills required for the roles of needs identifier and problem recognizer have already been noted (e.g. identifying user requirements), as have the need for skills in problem identification and problem solving.

Although the role of reviewer could be perceived as an after-the-event responsibility to ensure that the installed system is meeting the users' requirements, there is another dimension which could be added to this role. This dimension would include the responsibilities of ensuring that systems which are requested are feasible, and that appropriate development approaches are taken. Skills required for this role include:

identifying appropriate approach (Sumner, 1986, p.205)

determining system feasibility (Lee, 1981, pp.83-92).

There is a suggestion in the literature that the future systems analyst will fill the role of a specifier and consequently require skills which include:

prototyping (Boar, 1986, p.25)

setting objectives (FitzGerald et al., 1981, p.236)

system specifying (Dickson and Wetherbe, 1985, p.341)

The task analyzing skills required for the role of task analyzer was mentioned as a skill required for the analysis role above.

The technical roles of the future systems analyst (e.g. technical assessor and technician) will require skills which include:

keeping abreast of technology (Ostle, 1985, p.37)

skill: technical (McLeod and Forkner, 1982, p.308)

using technology (McLeod and Forkner, 1982, p.343).

One further point is noted in this section. Contrary to the ideas expressed above, at least one literature reference (Cox and Snyder, 1985, p.248) suggested that the future systems analyst need not be an expert in the functioning of the user department. Further examples of such differences of opinion are given in table 6.5.

6.3.1.2 CHANGE AGENT GROUP (see section 6.2.4.2.1)

ROLES INCLUDED: Advisor, Catalyst, Confronter, Enforcer, Forecaster, Influencer, Initiator, Innovator, Persuader, Politician, Seller, Technical assessor.

ROLES/SKILLS LINK:

The role of the systems analyst as a change agent demands a group of skills which are tightly linked to the roles identified above.

The role of advisor/mentor will require the skills of:

giving advice and support (Barr and Kochen, 1984, p.175)

selling ideas/persuading/gaining acceptance (Capron, 1986, pp.36 and 37)

thinking logically (McLeod and Forkner, 1982, p.308).

The role of catalyst who introduces change into the user function (McLeod, 1983, p.545), will require the skills of:

influencing (Ostle, 1985, p.57)

initiating/integrating (Ostle, 1985, p.57)

innovating (Dickson and Wetherbe, 1985, p.399)

introducing change (Feeney and Sladek, 1977, p.85)

negotiating (Jeffery and Lawrence, 1984, p.107).

To introduce change it may be necessary to act as a confronter and an enforcer. The skills required to operate within these roles are identified as:

confronting (Capron, 1986, pp.36 and 37)

enforcing (Ostle, 1985, p.57)

imposing (Capron, 1986, pp.36 and 37)

skill: being politically aware (Davis and Olson, 1985, p.458).

Resistance to change is a common problem faced by those who implement computer-based systems (Lee, 1981, pp.43-47). The change agent, therefore, needs to be able to display various forecasting skills, including identifying the impact of change (Capron, 1986, p.36).

Because of this resistance to change, the change agent needs skills at:

coping with resentment (Newman and Rosenberg, 1985, p.397)

skill: relating to people (Newman and Rosenberg, 1985, p.397).

The skills required for the next grouping of roles (influencer, initiator, innovator, persuader, politician and seller) have been identified above.

The final dimension to the change agent's role is technical. The skills required for this role include:

keeping abreast of technology (Canning, 1984b, p.4)

technical assessing (Canning, 1984b, p.4).

6.3.1.3 COMMUNICATOR GROUP (see section 6.2.4.2.2)

ROLES INCLUDED: Communicator, Diplomat, Documentor/Writer, Interviewer, Listener, Negotiator, Presenter/Speaker

ROLES/SKILLS LINK:

The expected communication roles are those related to verbal (oral) and written communication. The skills required for these roles include:

documenting (Capron, 1986, p.54)

interviewing (Lucas, 1982, p.301)

listening (Nylen et al., 1967, p.119)

negotiating (Jeffery and Lawrence, 1984, p.107)

preparing presentations (Capron, 1986, p.65)

record keeping/note taking (McLeod and Forkner, 1982, p.308)

report writing (Lee, 1981, p.53)

selling ideas (FitzGerald et al., 1981, p.236)

specifying (e.g. requirements)(Dickson and Wetherbe, 1985, p.341)

teaching (Martin, 1982, p.335)

using body language (Davis and Olson, 1985, p.259)

using charting techniques/graphics (Gore and Stubbe, 1983, pp.104-125).

Other skills which assist in being effective in the role of a communicator include:

being politically aware (Davis and Olson, 1985, p.458)
identifying receivers 'frame' (Bostron et al., 1983, p.2)
skill: understanding people (Bower et al., 1985, p.121)
thinking logically (McLeod and Forkner, 1982, p.308).

6.3.1.4 CONSULTANT GROUP (see section 6.2.4.3.1)

ROLES INCLUDED: Advisor/Mentor, Business associate, Buyer, Co-ordinator, Encourager, Evaluator, Forecaster, Seller, Systems building facilitator, Technical assessor, Tools expert

ROLES EXCLUDED: Change agent, Instructor

ROLES/SKILLS LINK:

As can be anticipated, many of the roles in which the consultant must function will overlap with those of the analyst and the change agent (e.g. advisor/mentor, business associate, encourager, forecaster, innovator, seller, technical assessor). The skills required for these roles will not be duplicated here (see sections 6.3.1.1 and 6.3.1.3 above).

As a buyer of computer equipment and systems, the consultant will require skills at:

acquiring/selecting hardware (Thierauf, 1986, p.570)
acquiring/selecting software (Bartol et al., 1986, p.35)
estimating (Harold, 1983, p.105).

To function effectively within the role of a systems building facilitator, the consultant will require skills which could include: