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A Maturity Model of Information Systems Development

by
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Declaration

This research takes as its starting point a difference between the responses to a questionnaire and a revised version of that questionnaire. The original questionnaire (which is shown at Appendix 2) was developed jointly with a then colleague, Dr. Janice Burn, of Hong Kong Polytechnic who was researching a different topic. Section 4 of the original questionnaire was developed mostly by myself but with some input from Dr. Burn. Section 6 of the original questionnaire was solely my work. Most of the other sections were developed mostly by Dr. Burn but with some input from me.

The research which is the subject of this thesis utilises a revised version of this instrument for the purpose of finding suitable case study organisations. The revision and all activities described here following it are solely the work of myself alone.

Various facets of this research have been presented in conference papers and a journal article of which this researcher is the sole author. These are :-

1993. *Prototyping - a Participative Technique for Information Systems Development*. Journal for Computing and Information Technology. Vol. 1. No. 4. Pp 235 - 242.

1993. *The Methodology Dimension of a Maturity Model of Information Systems Development*. Proceedings of the First Conference of the British Computer Society Information Systems Methodologies Specialist Group. eds. Jayaratna N., Paton G. Merali Y, Gregory F. University of Warwick Print Services. 1 -3 September. Pp. 445 - 458.

1996. *Pluralism of Epistemology and the Question of Culture in an Information Systems (IS) Research Project in Hong Kong*. Knowledge & Discourse Conference 96 Abstracts. Hong Kong University. Barron C. & Bruce N. eds. 18th -21st June. P 182.

Summary

This thesis describes interpretative idcographic research using differences from a longitudinal questionnaire poll of the Information Systems (IS) development community of Hong Kong to identify those practitioners' organisations which are quickly adapting to changes in their environments. A maturity model of IS development practice, which is the main contribution of this research, was derived from the IS development literature. A number of case studies of the quickly adapting organisations in Hong Kong have been carried out with the intention of verifying the construct and utility of this model.

The model examines an organisation's IS development practice through a number of dimensions. The dimensions are formed into the acronym AMMUS. The first such dimension is the degree of **automation** in the practice. Next is the sophistication of the **methodologies** deployed by the practitioners discerned from the rigour of application of the methodology, the form of the sequence in which stages of the development process may be visited and the paradigms on which the methodology is based. Another dimension of the model is the concern of the practitioners for **measuring** the quality and effectiveness of their work. **User involvement** is the next dimension and the way in which this is practised is arranged in a sequence. Finally, the **scope** of the problems normally tackled and the stages of the problem solving process are posited as useful dimensions for assessing the practice.

The model has been found to be resilient and useful. It has been discovered that the use of certain of the dimensions of the model must be tempered with knowledge of additional factors. However, the model is found to be a useful tool for indicating to IS development management where their attentions are most likely to yield significant benefits.

List of Abbreviations

3GLs	Third Generation Languages
4GLs	Fourth Generation Languages
ACM	Association of Computer Manufacturers
AMMUS	Automation, Methodology, Metrics, User involvement, Scope
BPR	Business Process Redesign
CASE	Computer Assisted System Engineering
CCTA	the United Kingdom's Central Computing and Telecommunications Agency
CHEK	The Chekiang First Commercial Bank
CSC	A Computer Services Company
DBMS	Data Base Management System
HACTL	Hong Kong Air Cargo Terminals Ltd.
HKCC	The Hong Kong Country Club
HKCS	The Hong Kong Computing Society
HMSO	Her Majesty's Stationery Office
ICIS	The International Conference on Information Systems
IEEE	The Institute of Electrical & Electronic Engineers
IFIP	The International Federation of Information Processors
IS	Information Systems
Meth.	Methodology (s) - <i>only used in tables & illustrations</i>
MIS	Management Information Systems
MISRC	MIS Research Centre
NCC	National Computing Centre
PSL	Problem Statement Language
RHKJC	The Royal Hong Kong Jockey Club
SEI	Software Engineering Institute
SHANCOM	The Shanghai Commercial Bank
WP	Working Paper

Abstract

This research, which was carried out in Hong Kong, concerns the problems of organisational Information Systems (IS) development. It is not concerned with the problems tackled by IS developers on behalf of client organisations. Rather it is concerned with the problems that they face as IS developers going about their practice. It concerns the environment and structures of their practice rather than the problems they solve through their practice. This is ideographic research, seeking to identify exemplary practice and to identify conditions under which such practice may be replicated in other situations.

From the literature review and the researcher's previous contact with IS developers in Hong Kong a disjunction between theory and practice was believed to exist. The aim of improving the understanding of IS development practice to reduce this disjunction was identified and the following objectives were formulated:-

- a. to discover how change in IS development practice is managed in Hong Kong;
- b. to discover whether such change as occurs follows the maturity and other models found in the Western literature;
- c. to formulate a maturity model of IS development practice;

and

d. to partially instantiate the maturity model developed here with reference to practice in Hong Kong.

The epistemology has been pluralistic firstly using a pair of questionnaires longitudinally to identify “fast adapters” and “conservatives” amongst the IS development community in Hong Kong. This was followed by the use of interpretative methods looking in a holistic way at the practice amongst the six most “fast adapting” organisations in IS development terms.

Prior to this interpretative, case study building phase, an analysis of the literature of IS development yielded a maturity model of IS development. This maturity model of IS development is proffered as the main contribution of the research. It is an over-arching theory. It consists of a number of dimensions on which IS developers may locate positions of their organisation’s IS development practice. As such it serves both a predictive and an auditing function. It serves to show IS developers where they may go from their current location on the model and on which dimensions of the model attention may bring greatest payoff.

The model is shown to emerge from the IS development literature; the research largely consists of an attempt to substantiate the model amongst IS development practitioners in Hong Kong. Although overwhelming evidence of the veracity of the model has not been found almost all of the dimensions of the model have been found to resonate amongst IS development practitioners and their managers in Hong Kong. Subsidiary contributions from the research are found in a deepening of the understanding of the IS development practitioner and the various dimensions in which the practitioner is located. These dimensions (encapsulated in the acronym AMMUS)

are Automation of practice, Methodology (rigour of application, sequence of visiting stages and paradigms), Metrics and quality concerns, User involvement and Scope (of problem boundary, life-cycle stages). From the cases explored it is possible to order the dimensions of the model in terms of their usefulness to the development managers consulted. For most dimensions this strengthens their claim to inclusion in the model but in one case (Metrics) it suggests exclusion from the model. It is suggested, bearing in mind the experience of other maturity models in IS, that the importance of specific dimensions may change over time - new dimensions emerging and existing dimensions losing importance. The research also achieved substantiation of some change during the period of the research of the tools and techniques used by IS development practitioners in Hong Kong. These concerned changes in processor deployment, file structures, development language and the effect of recognition of organisational learning on maturity in Nolan's (1979) terms.

The importance of the research is established with reference to a well-known series of ongoing Delphi studies of the concerns of IS managers spanning 10 years and 3 continents. Also, survey studies of the IS literature have been accessed to show the concerns of academics in the area. It is shown that during that period and in the territories in which these researches were carried out, the concerns embodied in the model promulgated here, have been consistently amongst the uppermost concerns of both academics and managers in IS.

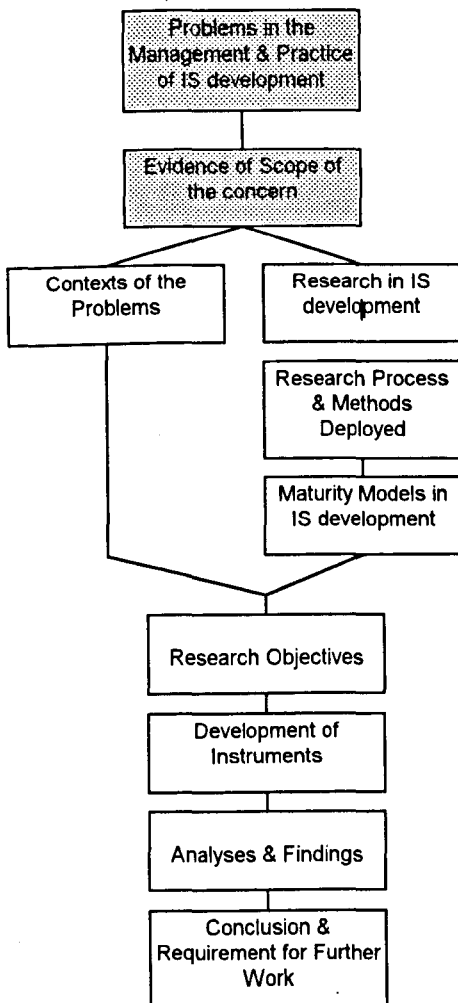
Methods of IS research are examined and the research is located on a well known model of IS research. The philosophy adopted for this research is asserted to be pluralistic and it is shown why this assertion is justified. The research uses longitudinal

and case study methods and the reasons for their selection and use are explained in detail.

A questionnaire that had been used in other research in 1987 was revised and re-issued to those IS development managers who had responded previously. From the differences in response “fast adapters” and “conservatives” were identified. Six from each category were invited to participate in further in-depth research into their IS development practices. Interestingly, only the “fast adapters” consented to this extension of the research activity but all of those consented. With the six “fast adapters” participation, case studies of their IS development context and practice were formed and an attempt was made to place them on the model of IS development maturity promulgated from the literature. From the initial assignments made to all of the dimensions for each organisation summary assignments were sought for each organisation. Linear programming methods were used to minimise the difference between the dimension specific assignments and the organisation assignments by varying the organisation assignments.

Some fit was found between the model and the practice. The dimensions are evaluated according to the number of different positions identified on the dimension amongst the case studies. It is asserted that a dimension where all the positions promulgated on the dimension are found with instances from the cases is more useful than a dimension where most cases are assigned a particular point. Finally, recommendations for further research are made.

Chapter One - Synopsis



Chapter One outlines the problems that are the concern of this research. IS Development management is faced with a turbulent situation in many aspects of their roles. The problem owners are specifically identified as Information Systems developers and Information Systems Development managers. Briefly four problems are identified. Firstly there is the degree to which the problem owners understand the role that IS can play in transforming the way in which business is enacted. Secondly there is the quality of the IS development process. Human resource

problems in IS development and the acceptance of automation in the development process give rise to the third and fourth problem areas. These concerns of the research are differentiated from other problems of the same population. In this chapter evidence is brought from a growing body of longitudinal research that the concerns addressed by this research have persisted for sometime. Whilst these concerns are not the most pressing to the population polled it is shown that they are persistent and growing in importance.

1. Problems of IS Development

1.1 Introduction

At a recent international conference Niels Björn-Anderson and Angèle Cavaye (1993) referred to the post-modern chaos faced by Information Systems (IS) developers, the organisations they serve and the users of the artefacts they create, i.e., Information Systems consisting of people, software and hardware. Referring to themselves as Information Systems professionals they went on to assert that:

“Our business function is perhaps even more ripe for a BPR (Business Process Re-engineer) than any other business function, since our basic tools and technology are changing faster than anywhere else in the organisation. We need to re-engineer our own function to meet the new tasks.”

(ibid., Page 26, my parentheses)

In the most general terms this research aims to develop a framework useful for supporting the management of change amongst organisational Information Systems Developers. This framework's own emergence as a maturity model is described in Chapter 7. This development is preceded by a broad description of the contexts, (i.e. research culture, socio-technical setting, ethnic culture and geographic setting) of the research in Chapter 2.

Chapters 3 through 6 concern the methods of the research. Chapter 3 reviews research methods in IS and IS development. Chapter 4 explains the selection of particular methods for this investigation. Chapter 5 develops a categorisation of IS development Philosophies, Approaches, Methods, Tools and Techniques and relates

those to concerns identified by a questionnaire poll in Hong Kong in 1987. Research objectives are refined in Chapter 6 to specific research questions. The model developed in Chapter 7 draws from the insights of the schools identified in Chapter 6 and seeks to stand between the models of Nolan (1979) and Humphrey (1988) described in Chapter 5. These bodies of work, although drawing on extensive consultancy practice in the United States, are largely theoretical. A plan to find evidence of the reflection of the model in the real world, especially amongst IS developers in Hong Kong, was devised. The promulgation of this plan is found in Chapter 7. The findings from the enactment of the plan are presented and analysed in Chapter 8. Finally Chapter 9, as well as indicating directions for further investigation, assesses the veracity of the research, answering the question to what extent the belief in the usefulness of the research stated in the following paragraph is justified.

It is believed that the framework developed in this research can indicate to Information Systems Development managers the position of their current practice in a certain set of dimensions. They will gain a clearer perspective of their practice relative to recommended practice. This should enable them to make clear decisions regarding their opportunities to improve the practice. As Information Systems Development practice is one of the most potent change mechanisms available to managers in modern organisations, this research can be said to concern change amongst the change agents.

1.2 The concern of the research

Since the development of the first electronic computers continual change has been the norm amongst the practitioners of the development of Information Systems. Couger et al (1982) identify a number of parallel generations. They lament that it is taking about ten years from the advent of new hardware technology to the widespread

use of languages and systems methods capable of fully exploiting the new technology for the benefit of organisations. By the time appropriate language and systems development techniques are in place the next generation of hardware technology has become apparently available. "Apparently available" because without appropriate systems development methods the hardware cannot be viewed as totally "available".

The turbulence of the situation poses risks to the practitioners themselves as well as the organisations and societies they serve. Risk to the practitioners includes the obsolescence of their expertise leading to its uselessness. Further there is also increasing packaging of some of their expertise in such a way that it appears that their skills are commonplace and easily acquired. This latter phenomenon leads to a lowering of the standing of IS developers in the community at large. The turbulence leads organisations to perceive that the development and maintenance of Information Systems are troublesome activities and the reaction may be to attempt to treat Information Systems as a utility best bought from a specialist external agency. The term "outsourcing" has been coined for this practice. Lacity and Hirschheim (1993) have found the metaphor of Information Systems as a utility to be misguided. They state that in several cases of "outsourcing" that they have examined there was failure in delivery of expected lower costs as well as the loss of control of resources crucial to the maintenance of competitive advantage. There is a danger of Information Systems practitioners becoming hapless pawns ill-advised to form any loyalties except to themselves and collectively a perceived profession. Meanwhile organisations are faced with vying paradigms, e.g., structured (De Marco, 1978; Jackson, 1983; Orr, 1977; Ward & Mellor, 1985; Warnier, 1974; Yourdon 1989), object-oriented (Coad & Yourdon, 1990, 1991; Booch, 1986; Rumbaugh et al , 1991; Wirfs-Brock & Johnson, 1990), prototype based (Alavi, 1984; Boehm, 1988; Mayhew & Dearnley, 1987; Tate, 1990; Wilson,

1993a) of Information Systems delivery, leading to perpetual political struggles amongst the competing schools.

Information Systems Development managers are faced with an unprecedented range of opportunities to improve the performance of the development activity (Martin, 1984; McClure, 1989; Lyytinen, 1989; Kumar & Welke, 1992 inter alia). However, at the same time there is evidence of disillusionment of their clients (Joshi, 1992; Hunt, 1993.) Whilst organisations weather the storms of economic cycles there emerges an unstable scenario of ever-changing "de facto standards" in the provision of the core Information Technology. Since the "standards" and shared beliefs at the core are unstable, "standards" in ancillary technology are impossible. Such ancillary technologies include communications protocols, programming paradigms, analysis and design methodologies and approaches to systems integration and business process redesign to name only a few. Meanwhile there is a persistent clamour for more accountability in the performance of Information Systems Development (Necco et al, 1987).

High productivity is promised by the promoters of products such as computer aided software or systems engineering (CASE) tools, fourth generation languages (4GLs) and database management systems (DBMS). Maturing analysis and design methods promise an improvement in the likelihood of the right system being delivered, at the right time to the right client. Emerging paradigms such as object-orientation and client/server processing appear to promise some amelioration of the long-standing complaints of user management together with new and better ways of organising the custody and delivery of information in organisations. This may be achieved through enabling higher levels of end-user computing and simplification of the development

process. Some development management, occasionally spurred by user managers, habitually pick up these developments in isolation proffering them as panaceas to organisational ills. Some end-users react by taking responsibility for devising their solutions for themselves, using un-tailored micro-based packages, easy to use interfaces and even visual programming adding to the complexity of an already heavily confused situation and the furthering of the disrepute of the "professional" developer. In such confusion some user management and indeed some practitioners (Clark, 1992) cynically dismiss these as the latest in a long line of over-sold fads. Meanwhile others claim (e.g. Keen, 1981; Martin, 1984; McClure, 1989; Galliers, 1993) that the emphasis of development can and should be moved from that of building software to that of integrating Information Systems components into organisational information infrastructures.

If Information Systems developers are to be recognised as professionals they must move their practices out of the initial euphoric stage that society allows new technologies. If true professional standing is to be achieved and maintained it would seem necessary for practitioners to:

- develop and proffer a coherent set of theories justifying claims to expertise;
- render their processes open to inspection and acceptable to their fellow professionals as well as stake-holders in the enterprise and society at large.

Whilst many of these issues will have an impact on the present and future role of the IS developer, means are required for placing new developments, and the opportunities and threats such developments pose, in perspective. This research proffers the concept that many of these developments are inter-related and that there may be

precedence contingencies amongst them. A suitable framework assists IS management to identify directions and feasibility of mooted change.

1.3 Important Strands in Information Systems Development Research

For more than the last decade a number of researchers have attempted to identify the most important issues in Information Systems management (Dickson et al, 1984; Hartog & Herbert, 1986; Brancheau & Wetherbe, 1987; Farhoomand, 1987; Parker & Idundun, 1988; Watson, 1989; Grover & Sabherwal, 1989; Broadbent et al, 1992; Teng & Galletta, 1990; Niederman et al, 1991; Clark, 1992; Grover & Goslar, 1993; Galliers et al 1994.) This body of research represents one of only a few instances of longitudinal study in the Information Systems area. However, it would appear that the longitudinal aspect has not arisen from any grand design. On the contrary it could be asserted that the research stream has gathered its own momentum.

This “meta-research” into the most important research issues in IS takes place in three countries, primarily Australia (Watson, 1989; Broadbent et al, 1992), the United Kingdom (Parker & Idundun, 1988; Galliers et al, 1994) and the United States (Clark, 1992; Brancheau & Wetherbe, 1987; Dickson et al, 1984; Grover & Goslar, 1993; Grover & Sabherwal, 1989; Hartog & Herbert, 1986; Niederman et al, 1991; Teng & Galletta, 1990.) There are three distinct approaches in the work. Grover & Sabherwal (1989) analysed the total research contents of careful selections of published journals. Clark (1992) has executed structured interviews with Information Systems executives in 30 significant companies but the majority of the research was initiated in the early 1980s with a Delphi study reported by Dickson et al (1984). Because of the Delphi format of the study, the practice of later researchers of using previous work or concurrent work in other territories as their starting points and the roughly consistent

naming of issues found in this now considerable body of work, it is possible to trace the history of specific issues and compare and contrast their importance amongst the respondents in the United States (the origin point and where most of the studies have been done), Australia and the United Kingdom.

The recurring theme from these researches is that the linking of development effort to the concerns of organisational management is a more important focus than merely the efficiency of the information processing. The concern goes beyond simply selecting and resourcing the application areas deemed to be most effective in supporting the organisation. Calls for the development of information architectures and infrastructures reflect the reality that new information and communications technology enable businesses to operate in completely different ways. This goes further than the traditional centralisation/ decentralisation issues into the mode of governance and ownership of the development establishments.

However, whilst the concerns outlined above may have been the most prominent we can also find amongst the data gathered in these researches a persistent concern for the issues addressed in this research. In order to get a clear picture four of the issues, pertinent to this research but recurring in the work described above, were identified. Figure 1 gives a view of these four issues taken from the questionnaire work.

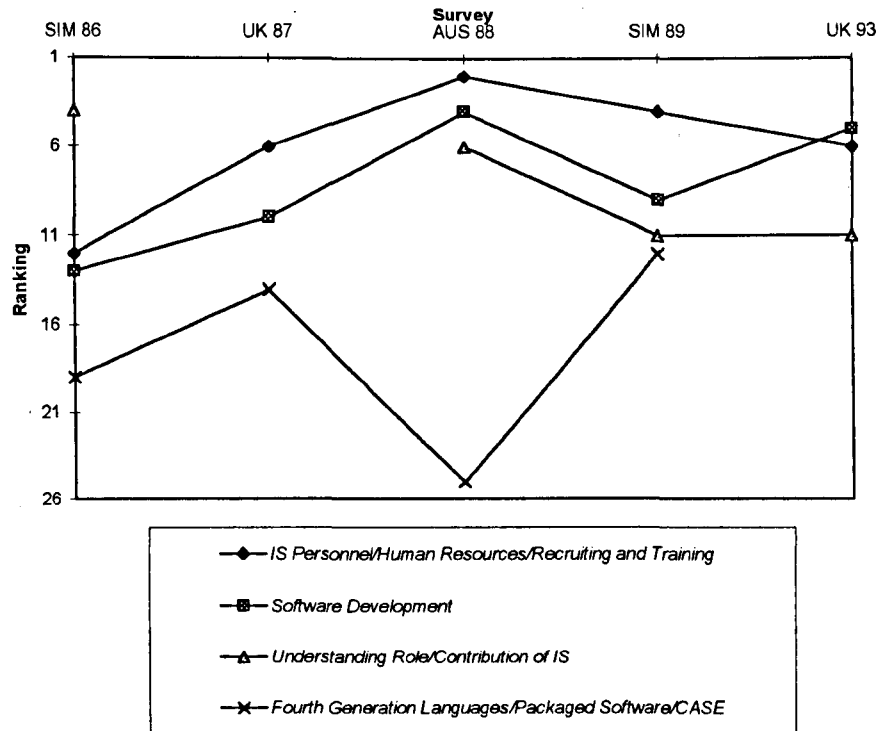


Figure 1.1 Criticality of selected Issues according to IS Managers (note SIM 86 from Brancheau & Wetherbe p27; UK 87 from Parker & Idundun p35; AUS 88 from Watson p126; SIM 89 from Niederman et al p 479; UK 93 from Galliers et al p227)

This is not a pure view in that the incidence of the issues “Fourth Generation Languages”, “Packaged Software” and “CASE” have been combined into a single issue. Consequently, where more than one of them has appeared in a survey result the highest position has been reflected here. This is justified by the reasoning that these issues are reflections of the Information Systems managers’ desire for automated devices to act as a panacea to the problems they face. Similarly the issues variously named IS Personnel / Human Resources and Recruiting and Training have been combined since they are held to pertain to closely related areas. The earliest surveys are not included in figure 1 and it should be read taking care to note that it gives a comparison between three geographically disjoint communities of Information Systems managers at around the same period of time (the late 1980s and early 1990s).

It is reasonable to assert that the Information Systems management community in Hong Kong (where the current research is geographically located) has strong associations with all of these territories. Evidence of this comes from the high percentages of practitioners who seek their education in these countries (Australia, North America and the UK) and the fact that tertiary level courses in Hong Kong educational institutions frequently utilise pedagogical models developed in these territories. It is often said that Hong Kong is a place where East meets West but it might also be said that Hong Kong is a place where the mores of the United Kingdom meet those of the United States. Australia's contribution to Information Systems Development in Hong Kong is evidenced by the fact that two very large organisations (Cathay Pacific Airways and the Royal Hong Kong Jockey Club) have sited Information Systems Development groups in Australia. This action may be a staff retention strategy in the run-up to the change of sovereignty of the territory in 1997 and is believed to be practised by some other large development houses.

The strong communion which Hong Kong practices with these territories lends support to the relevance of these results to the importance of the current research. This is because the current research has been carried out amongst the Hong Kong Information Systems Development community. In Hong Kong a number of countries are frequently referred to as "the advanced countries." These are Australia, Canada, the West European countries and the United States of America. In fact it is claimed that the current research is amongst an internationally minded group of professionals who look to these communities for stimulus and professional communion. For this reason it is not asserted that results of this research are generalizable only to limited spheres such as newly industrialising economies or developing countries, rather that the results are of interest and relevance to all communities of Information Systems developers. In chapter

two the Hong Kong Information Systems Development community is tested against a model (Lu & Farrell, 1990) of the developing/ developed country spectrum. It is found that in only one dimension of this model, (management practices) can the Hong Kong Information Systems Development community be said to display the characteristics attributed to developing countries. It is therefore contended that this research may be generalizable in many respects to practice in advanced countries but is possibly most generalizable to newly industrialising countries whose management practices derive to some extent from a similar cultural base.

Figure 1 also shows a temporal contrast of the situations in the United States during the period from 1986 to 1989 and another temporal contrast of the situations in the United Kingdom in 1987 and 1993. We can further see from figure 1 that the “dream of automation” (concern about CASE, Fourth Generation Languages or Packaged Software) is not the most pressing concern of Information Systems managers. It is not reported in any of its forms by Galliers et al (1994) as being amongst the top 14 concerns of either Information Systems managers or non-Information Systems managers or what either group expects to be concerned about in five years’ time. However, American respondents in 1989 ranked “planning and using CASE technology” as having only eleven more critical issues. The Australian survey of 1988 reported concern about packaged software only as 25th. In the UK in 1987 concern about Fourth Generation Languages was the 14th concern of Information Systems managers, whilst in 1986 in the United States, packaged software was ranked 19th. There are two ways to interpret these responses. It may be that IS development management are relatively happy with the tools and packages currently available or it may be that there is not a widespread dream of automation amongst them.

Understanding the role of Information Systems is of concern to this research in that if senior general management do not value the role of Information Systems then the Information Systems department will be viewed as a commodity that may be bought in or sold without adversely affecting the company to any great extent. There will be little leeway for alternative modes of operation - the bottom line dictating operations because of lack of appreciation of the affective role that quality systems can play. Because of their affective influence on the organisation Information Systems can certainly not be evaluated in this mechanistic way. IS play a key role in enabling the organisation to understand itself and its environments. If IS management is inappropriately placed in the lower levels of the organisation then IS may be faced with infeasible demands or the refusal to fund projects other than those directly having an impact on the bottom line. These considerations are tied up with the use of IT for competitive advantage which was placed sixth in the 1993 UK survey and eighth in the 1989 US survey.

The concern to understand the role of IS in the organisation was not ranked by the earlier study in the United Kingdom. However, in the preceding study in the United States it was highly placed (4th) by Information Systems managers in which study general managers also placed it highly (5th). Latterly it was highly placed (6th) in the Australian study of 1988 and just missed the top 10 (being placed 11th) in both the American study of 1989 and the UK study of 1993. Whilst not being amongst the most pressing issues Information Systems managers can be said to believe it is an issue deserving attention.

Since issues concerning personnel and training do not appear with consistent expression in all the surveys considered here, for the purposes of this review, they were considered to belong to the same stream. Hence, where Information Systems personnel

or human resources or recruiting and training appear in the responses, the highest response given for any one of these three is plotted on figure 1. Some geographical specificity becomes apparent on this view. The Australian survey rates human resources second and Watson states:

“Australian managers are having greater difficulty in solving IS human resources problems; with apparently the shortage of appropriately skilled IS personnel a relatively greater problem in Australia than in the US”.

(1989; p124)

Watson attributes this to “inherent rigidities” in the Australian educational system. Given the relationship of systems of Hong Kong education to others in the Commonwealth, if these “rigidities” are the root of the problem they are as likely to pertain as much in Hong Kong as in Australia. Added to that, in Hong Kong there is the 1997 factor that has proved a major headache throughout the 1980s for Hong Kong employers of skilled professionals. There is a constant to-ing and fro-ing of young professionals seeking to establish residence status in the territories (Australia, Canada and the United States) talked of as “countries of settlement”.

It may be seen from figure 1 that of the issues pertinent to this research “Software Development” has consistently appeared amongst the top 20 issues. Further, in the most recent surveys it has appeared in the top 10. Its highest placing has been as the third most concerning in the United Kingdom by non-IS managers and fifth most concerning by IS managers in 1993, whereas it was placed tenth in 1987. Similarly its importance is growing in the perceptions of the Information Systems managers in the United States, who ranked it as number thirteen in 1986 and perceive it as the ninth most critical issue in the survey of 1989. It was the fourth most concerning issue in the

survey of Australian Information Systems Managers in 1988. It is reasonable to infer that it is a persistent concern.

Concern waned somewhat, especially in the United States in the early to mid-nineteen-eighties but it can be seen that the concern is growing again. It may have been that the period of lessening concern was characterised by a number of factors. These are identified as:

1. rapid growth in end-user computing;
2. the promise of easier to implement systems through Fourth Generation Languages;
3. the promise of Computer Assisted System or Software Engineering workbenches (i.e. CASE workbenches);
4. the belief that many systems were easily available in packaged software; and
5. the promise of easier to use database management systems.

As these promises have not been fully delivered and the problems of integration have become more and more apparent, the concern for Software Development, has returned.

Singularly alone amongst the surveys Galliers et al (1994) sought to discover not only the importance of the issues but also whether they were problematic. Galliers et al (ibid.) use the term "criticality" to describe the interception of perception of both attributes. In their survey both Information Systems and non-Information Systems managers found software development to be both important and problematic.

As stated above, Clark's (1992) approach was different. Taking a behavioural research approach he developed a structured interview instrument from the literature

(Huff & Munro, 1985; Iivari, 1986 inter alia) and carried out in-depth interviews with Information Systems Managers in 30 selected companies in the south-eastern United States. Clark states that the selection was based on a desire to obtain a balance between size (based on revenue or assets), profitability, number of employees, industry type and geographical setting. The relevance of Clark's findings to the current research is that in two of the areas he investigated, he recognises the need for well developed specifications but notes the paucity of such amongst the organisations sampled. These areas were, the make versus buy approach to systems acquisition (Iivari, 1986) and the Application Development Process.

Clark defines a "research agenda" as a number of questions including:

"Is the technology operating domain of an organisation determined by the simultaneous interaction of the management strategy (leading, lagging, mixed), technology model (need pull, demand push) and competitive environment (stable, turbulent)? What are the operating domain characteristics?"

(Clark, 1992, p 72)

This question area is addressed in the current research for the Hong Kong organisations sampled. The research also addresses, for Hong Kong, Clark's concern as to whether effective ways of commissioning, maintaining and evaluating complex organisational information infrastructures are being pursued.

Another approach to ranking important themes is to examine literature reflecting activities of researchers in the discipline. Farhoomand (1987) analysed the content of certain major journals in the Management Information Systems field (*MIS Quarterly*; *Information & Management*; *Systems, Objectives and Solutions*) and the

Information Systems papers in three other major publications (*Communications of the ACM; Management Science and the Harvard Business Review*.) Grouping his results into periods 1977 to 1979, 1980 to 1982 and 1983 to 1985 he found that the design of Database Management Systems, Systems and Software in all three periods were the most frequently reported research areas. Grover and Saberwal (1989) carrying out a similar study using *MIS Quarterly, Information and Management and the Proceedings of the International Conference on Information Systems* over the decade 1977 to 1986 found Information Systems Development to be the seventh most highly researched topic. A more recent study (Teng & Galletta, 1990) carried out through a questionnaire completed by 397 MIS faculty members in the United States ranked Systems Development as the fifth most researched area.

Clearly, Information Systems Development is not viewed, either by Information Systems management or Management Information Systems researchers as the most pressing area requiring research. However, it can be described as a significant persistent concern, well worthy of attention especially because there are a number of choices available to IS development management that will have an impact on the ability of the organisation to flexibly respond to changing market scenarios. For instance if IS problems and opportunities are consistently viewed in Departmental terms many opportunities will never be perceived. If IS staff are consistently regulated by rigid constructs they will not develop any understanding of these constructs enabling them to relax and develop them as appropriate. If IS constructs are only viewed through one or two limited models, such as the data-flow model or the entity-relationship model, they are more likely to proceed towards implementation with costly flaws.

1.4 Summary

This Chapter opened by explaining the layout of the thesis. It went on to set the scene of the research as the practice of new professions taking on the role of enabling the effective use of new technologies in modern organisations. This scene has been shown to be turbulent. The turbulence is generated by a number of factors including:

1. the emergence of successive waves of technology;
2. the complexity of the technology itself;
3. the requirements of user management to gain competitive advantage through the effective deployment of the technology;
and
4. conflicting paradigms underlying the skills these professionals bring to the scene.

A thread of the literature addressing concerns of both user management and IS researchers has been analysed as a longitudinal research activity. This analysis shows that there is persistent and widespread concern in four areas of interest. These are identified as:

- a. the quality of systems development;
- b. the selection and management of expensive systems development automating tools (e.g. CASE, DBMS);
- c. the understanding by general management of the role of IS;
and
- d. the management of human resources in IS.

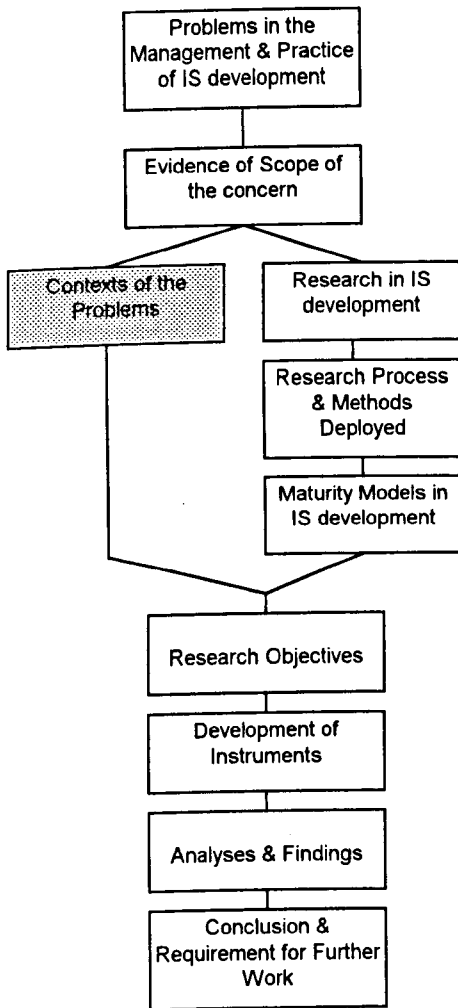
It is posited that IS development management would benefit from the availability of a model addressing at least some of the issues implied by the concerns

identified above. Such a model might consist of a set of dimensions on which IS development management might plot the position of their organisation's IS development practice. This research sets out to discover which dimensions would be most usable by and useful to IS developers and their managers for navigating the aforesaid turbulence. Candidate dimensions are drawn from the IS development literature and an attempt is made to verify their usability and usefulness in a number of organisations in Hong Kong where IS are developed.

The importance of the research has been established by reference to the "meta - research" which has been analysed both longitudinally through time and cross-culturally. This analysis has informed the projection of the areas of usefulness of the results of the research which is asserted to go beyond IS development practice in Newly Industrialising Countries. It is posited that the results of the research are likely to be of interest to all IS developers particularly for those in Confucian based emerging economies but also to IS developers in the "advanced" countries since Hong Kong is displaying so many pertinent characteristics of an "advanced" country.

The next chapter examines three significant contexts in which this research was carried out. These are context of the current state of research in IS, the geographical/cultural context and the socio-technical context.

Chapter Two - Synopsis



Having established the general areas of concern of the research Chapter 2 locates the research within three significant contexts. Firstly a well known model of processes in IS and their environments is used to locate the research in the overall field of IS research. Secondly, the geographical and cultural context is portrayed and thirdly the socio-technical context is explained.

Since the research was carried out in turbulent times in all of these contexts this Chapter outlines pertinent elements of these contexts so that the findings (which appear in Chapter 8) may be accurately interpreted.

2. Contexts of the Research

2.1 Context relative to Information Systems Research

Ives et al (1980) provide a framework for research in Information Systems.

This research is situated wholly within the shaded border-less boxes shown in Figure 2.1 below.

The external environment

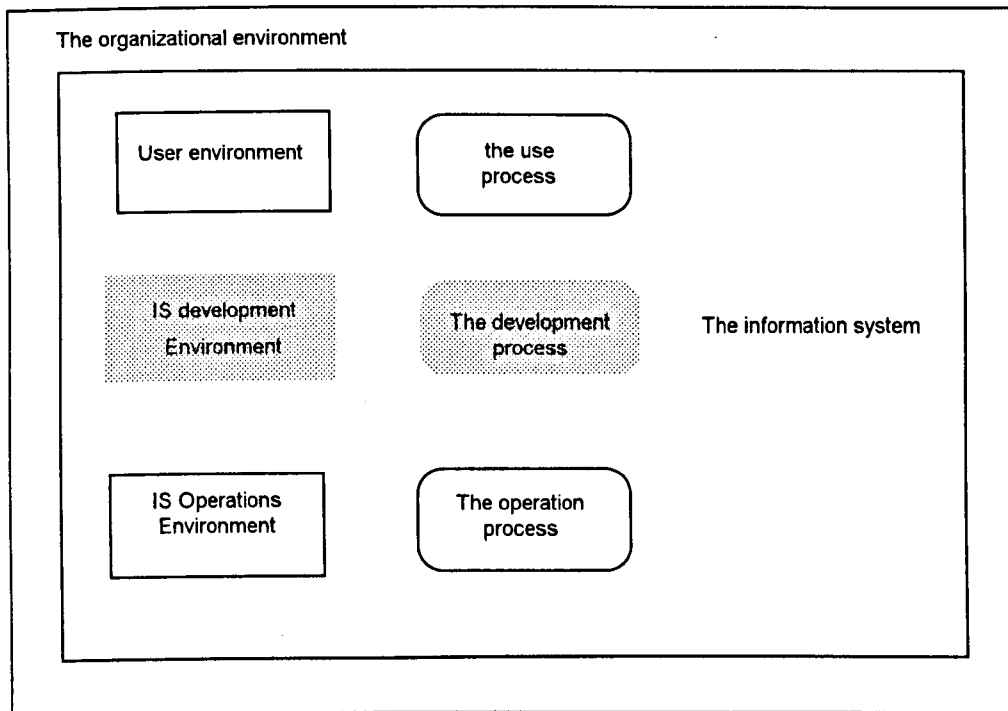


Figure 2.1 Positioning of the research within Ives et al Model of Environments of Information Systems research

The research takes place wholly within the IS development environment and concerns the IS development process. In Chapter 3 Visala's (1991) use of this model to recommend research approaches in IS is tested against the current research and the feasibility and utility of candidate research methods are evaluated.

IS is an emerging discipline taking reference from older disciplines which are ontologically diverse. This poses the problem of careful epistemology construction for those intending to embark on research in IS. The location of the research in this dimension is indicated at this point as it is developed further in 3.2.

2.2 Geographical and Cultural Context

This research was carried out in Hong Kong for no reason other than that for more than a decade prior to the commencement of the research this researcher had been involved in the Information Systems Development community in Hong Kong. The research is being published in the United Kingdom since the cultural background of the researcher was mostly acquired in the United Kingdom. However, this was followed by over ten years prior to the commencement of the research, as an active participant in a Hong Kong organisation. Whilst this organisation was to a large extent a replication of similar organisations in the United Kingdom, a Polytechnic, the researcher observed over a number of years that actors' behaviour in this organisation was conditioned to a great extent by two factors. These were their community of origin and whether their tertiary education followed a British model or an American model. This led to there being four main "factions" or systems of response and collaboration to issues arising for the organisation. Certain cultural characteristics observed, are supported in the psychology literature (Bond, 1986). The most pervasive of those are the collectivist/individualist dichotomy - persons from Confucian dominated backgrounds are more likely to concern themselves and adopt strategies aimed at preserving harmony whereas those from a Judeo-Christian background are more likely to pursue individualistic goals competitively.

The researcher believes that the organisations participating in the research will also display characteristics obtained from a mix of personnel (and their cultures best differentiated as Judeo/Christian based or Confucian based). Not all organisations will have the same mix as that of the organisation employing the researcher. Indeed most organisations are likely to have a tendency to one or more of the classes identified by the researcher. An awareness of these differences will be helpful in gaining sustained access to organisations and in illuminating their practice. Secondly, the researcher believes that his own cultural background is modified somewhat enabling him to gain access to organisations where both western and Chinese behaviours are enacted.

There are a number of relevant cross-cultural studies reported in the Information Systems literature (Tricker, 1988; Lu & Farrell, 1990; Ping & Grimshaw, 1992.) Lu & Farrell maintain that they do not treat the concept of developed/developing country as a dichotomy but that

“a wide spectrum of countries is assumed under the label of developing countries”.

Although they include Hong Kong in one of the lists of developing countries they mention, it is illuminating to test Hong Kong against the

“six major differences”

they identify between developing countries and developed countries in relation to Information Systems Development.

Taking those in the sequence identified by Lu & Farrell, “Economic and Social Conditions” is considered first. Lu & Farrell maintain that

“within developing countries, wage levels and general commodity prices are lower than those in developed countries”.

During the research, in 1994, the average per capita income in Hong Kong surpassed that of the United Kingdom. It is difficult to compare directly “general commodity” prices as the basket of commodities considered “general” by the average household in Hong Kong would, for cultural reasons, consist of a different mix of commodities than that in the UK. Comparisons of consumer prices may be somewhat illusory. The item of expenditure most differentiating households in the United Kingdom and Hong Kong is the amount spent on rental or purchase of dwelling space. In most cases households in Hong Kong are faced with expenditure several times greater than in the United Kingdom for reasonably comfortable accommodation.

Lu & Farrell go on to assert that the cost of acquiring “most computer components” divided by the cost of hiring in developing countries (excepting Korea and Taiwan) is 10 to 50 times higher than in some Developed countries. Since the cost of hiring is greater in Hong Kong than in the UK and since the costs of systems components are broadly comparable we can assert that, by this criterion, Hong Kong is not a developing country relative to the United Kingdom. However, Lu & Farrell go on to describe the predominant organisation type, “small family owned businesses”, found in developing countries. Here a factor tending to place Hong Kong amongst developing countries rings true except that some family controlled Hong Kong businesses are major

concerns in International terms, e.g., the Wharf group of companies, Jardine Mathieson, Cheung Kong Holdings etceteras.

Next they turn their attention to “National Infrastructure conditions” citing poor telecommunications, poor transportation, unreliable power supplies and high levels of dust. Of these, only high levels of dust, brought about by frequent temperature inversion conditions, aggressive demolition and rebuilding programs and somewhat more lax factory emission regulation, compare badly with the situation in the United Kingdom. This research shows quite clearly (see Chapter 8) that in 1987 there was a widespread use of on-line and distributed systems and that by 1994 these were mostly evolving to network based systems. Highly placed officials of the Peoples Republic of China have remarked on the high quality of the telecommunications infrastructure of Hong Kong and many business houses regard Hong Kong as a world class financial and business centre. The city is reliably served by two power generating companies whose outages compare favourably with those of any city in the world.

Lu & Farrell suggest that educational conditions are also an indication of developing country status. They state that in developing countries

“Training of application-oriented systems analysts is sometimes unheard of...”

Until recently the Hong Kong Polytechnic had been running a Higher Diploma in Systems Analysis since 1977. At least two Universities mount Masters Courses in Information Systems. It is unlikely that any under-graduate at any of the Universities does not take a unit in computer literacy albeit under some other title. Whilst there may be a shortage of available computing personnel this is more likely an effect of the

proclivity for “countries of settlement”, which are often regarded as developed countries, to offer more easy access to their citizenship for persons with computing qualifications. This indicates that these shortages exist in these developed countries also.

Some of the case studies analysed in Chapter 8 concern organisations which develop and maintain world-beating systems in terms of size, complexity and efficiency (Appendices 1.2 & 1.4 refer). It can not be Hong Kong which Lu & Farrell have in mind when they say

“many developing countries also lack experience in developing large-scale information systems.”

Under the heading “Political and Legal” conditions Lu & Farrell discuss regimes practising

“varying degrees of nationalisation of economic resources and entities.”

It is inconceivable that Hong Kong, with its much vaunted “laissez-faire” policies was in mind at the time of writing. They go on to mention the priority many developing countries place on full employment. Whilst it is true that Hong Kong has been characterised by widespread labour shortages, during the period of the research, this has been a by-product of the “laissez-faire” policy rather than an explicit government policy.

Next the concept of “cultural conditions” is introduced. Lu & Farrell bring forward the concept that

“many IS activities are group activities and involve human interactions; they are greatly impacted by cultural differences.”

This is not in dispute. However, from the perceptions of Bond & Hwang (1986) it is possible to conclude that cultures based on Confucian principles are at an advantage in their ability to co-operate. Whether they are at a disadvantage in moderating inappropriate leadership is a separate question but it has to be owned that the processes of co-operation *per se* are more thoroughly supported in Confucian based cultures than in others. As part of the cultural encumbrance of developing countries the non-alphabetic language problem is brought forward. Again Hong Kong stands apart from the other countries listed in that, whilst most users would prefer to use a computer interface displaying traditional Chinese ideograms, very few users are inept at handling an alphabet based interface. It may be true that Hong Kong Chinese make more grammatical and spelling errors in constructing business letters in English than say Singaporeans or Filipinos. However, this is not the level of skill required to handle most computer interfaces and the argument does not hold as well as it might in Korea or Thailand. Similarly the argument that some cultures are more tolerant of errors than others does not hold since most Hong Kong people are quick to point out and correct the errors of their peers and underlings. An exception to this is the case of the use of the tongue of the colonising power. The phrase meaning “You have done something wrong” is amongst the first picked up by anyone learning Cantonese in Hong Kong through an osmosis-like process.

Finally Lu & Farrell cite Yavas et al's (1985) table of Profiles of Management practices. This is replicated below in Figure 2.1 and extended using the data collected in the 1987 survey to give specific information regarding Hong Kong computer using organisations.

The emergent scenario is one of poor conformity to the "developing country" concept except in the area of management practices. Here also, however, it can be seen from Figure 2.2, that at least in the field of the management of IS development (from which the respondents to the 1987 questionnaire came) the Hong Kong managers followed practices more similar to those found in developed countries than those found in developing countries. Hong Kong is often cited as one of the "four tigers" of dynamic newly industrialising growth. All the "tigers" are Confucian based societies and many of the features of a Confucian society are found amongst the management practices cited below. It is suggested that where in Figure 2.2 similarity between the practices of developing countries and practices found in Hong Kong the influence of Confucius is also found.

Management Practices	Developed Countries	Hong Kong (1987 survey)	Developing Countries
Planning Horizon	Long Range	Medium to Short	Medium to Short
Policy Making	Formally Stated	Ad hoc basis	Ad hoc basis
Activities grouping	mostly on customers	mostly on product or function	mostly on product or function
Number of Departments	Five to Seven	Four	Two to Three
Use of specialised staff	Extensive	Extensive	Some
Use of Service Department	Considerable	Considerable	Very little
Authority Definition	Clear	Clear but not formal	Unclear
Degree of decentralisation	High	Low	Low
Leadership style	Consultative	Autocratic or paternalistic	Autocratic or paternalistic
Manpower policies	Formally stated	Enunciated	Not stated

Figure 2.2 Profiles of Management Practice (adapted and extended from Lu and Farrell, citing Yavas et al)

As a result of the above analysis it is clear that the belief that Hong Kong is a developing country or a Newly Industrialising Country is overly simplistic. An assertion that the findings of the research are particularly pertinent for other developing countries or Newly Industrialising Countries would therefore be poorly grounded.

A number of issues arise from the cultural background of the actors in the organisations studied vis-à-vis that of the researcher. It is reasonable to maintain that the findings of this research will find most applicability in societies closest to Hong Kong, that is newly industrialising countries with Confucian backgrounds. However, the findings of the research may justifiably be claimed to be of interest to a wider audience. This is because Hong Kong is more than a newly industrialising society and like Singapore, has an economic mix showing features of post-industrialism. The

audience referred to includes organisations developing information systems in any community but especially those in emerging economies with Confucian based cultures.

During the period in which the data was gathered and the organisations studied Hong Kong was in the “run-up to 1997”. Historically this has been a unique period. For the first time a de-colonisation would take place through which sovereignty would be transferred to another sovereign state. This contrasts with all other British de-colonisations where sovereignty was vested in a state wholly comprising the local populace. A major event in the medium future was known to the community many of whom viewed it with trepidation. The effect on the professional classes was perhaps greater than on any other segment of the population. The poor and unskilled seemed to adopt a stoic stance that there was little they could do and anyway they did not believe that the imminent changes would necessarily bring negative changes to their circumstances. The very rich corporation owning classes seemed to move in two directions at once. They increased their investments and standing in China. Frequently this was through large charitable donations in their ancestral communities. However, it was also often in sound joint investments taking advantage of the favourable development conditions in the Special Economic Zones, such as neighbouring Shenzhen and Wuhai. At the same time they increased their investment activities in other countries of opportunity such as Canada and Australia. High cost Hong Kong may frequently have lost out in this scenario.

The educated middle classes might have been thought to have been in a state of near or actual panic (Dunn, 1989). From about 1982 a significant proportion of the technically competent population sought to obtain passports in other countries.

(Kirkbride et al, 1989(a) & (b); Ho, 1995) Computing professionals are amongst the most affected group.

“Private sector losses so far have evidently been much greater than those in the public sector (FEER, 18 June 1987: 22,23) cited financial operations and computer business as most seriously affected.”

(Emmons 1988, p57.)

Largely the seeking of a foreign passport was seen as an insurance strategy. Since the employment opportunities were not particularly good in the “countries of settlement” during the period in which the research was carried out, many people returned to the colony having obtained their “insurance” (Tang, 1989). Political pressure was such that the colonising power, fearing destabilisation amongst the educated classes, granted 50,000 passports to heads of households who could show that their academic qualifications and experience were valuable to the community (United Kingdom Government, 1990). Particular preference was given to those who could claim management experience. It should be noted that one of the case study organisations (see Appendix 1.4) and the local airline both set up Information Systems Development centres in countries of settlement. It was hoped that this strategy would help them to retain staff who were eager to obtain a passport for “insurance.”

2.3 Socio-technical Context

The socio-technical context of this research is the interaction of IS developers with the technology which they are more used to “imposing” on others. The period during which the research took place was also turbulent in technical and socio-technical

terms. The market was faced with the availability of inexpensive, fast and powerful microprocessors and there was a persistent decline in the cost of computing power due to persistent improvement in Microprocessor technology. The numbers of organisations implementing Local Area Networks (LANs) increased greatly. Fourth Generation Languages (4GLs) found increasing usage. Computer Aided Systems/Software Engineering (CASE) tools and Database Management Systems (DBMS) became more readily available and Outsourcing, Business Process Redesign and globalisation became topics of interest to senior organisational management (Davenport & Short, 1990; Karimi & Konsynski, 1991; Martin, 1984; McLure, 1989; Lacity & Hirschheim, 1993). One might have thought that as a result the Information Systems Developer would be under some threat. The effects of such a threat will be weighed in respect of the environments both cultural and temporal.

Avison and Fitzgerald (1988) give a succinct description of the development of roles summarised in the diagram below.

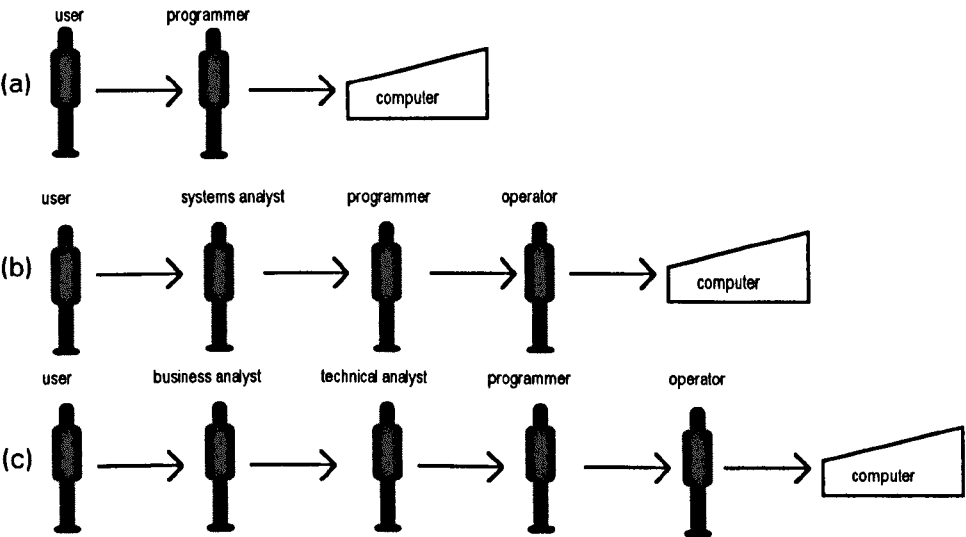


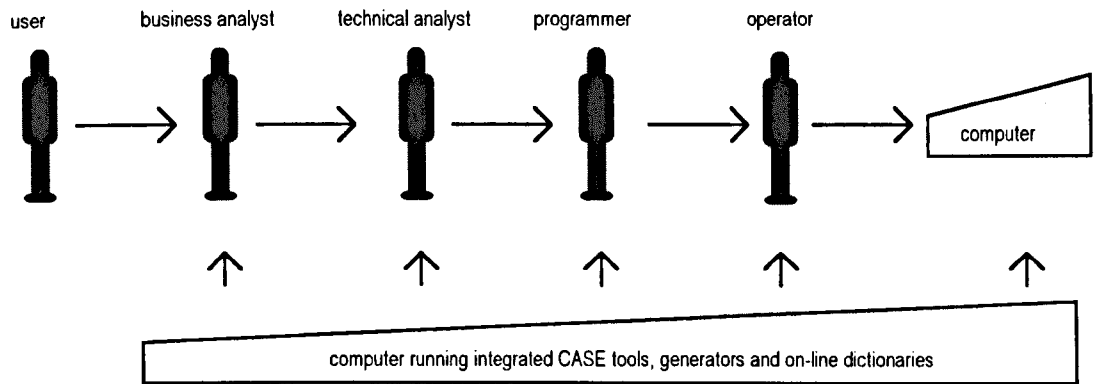
Fig 2.3 Changing roles of people in Data Processing adapted from Avisson and Fitzgerald (1988)

Broadly the scenarios a, b and c represent the situations in the United Kingdom during the decades the 1960s, 1970s and 1980s respectively. During the 1980s a number of authors (Martin, 1984; McClure, 1989) suggested that the changes taking place in

computing technology would have an impact on the roles in Information Systems

Development. These predictions are represented by the diagrams at figure 2.4 below.

CASE Scenario suggested by McLure



End user computing Scenario suggested by Martin

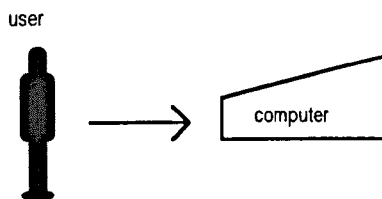


Figure 2.4 Scenarios predicted for the late 1980s and 1990s

Together with these predicted scenarios there was a prediction of wider acceptance of the various movements and trends as mentioned in 1.3 above. There was continuing task specialisation of personnel engaged in developing and maintaining IS in organisations but the phenomenon of “End User Computing” had emerged. This had been enabled largely by the availability of two quite diverse kinds of product. Some end-users were able to interact with some of the facilities of layered products often consisting of an easy-to-use human computer interface (usually a 4GL), an integrated corporate database management system (usually an RDBMS), and a layer of products supporting networking. Others were utilising easy to use, but sophisticated packages frequently in a stand-alone environment. This movement spawned a new set of specialist

staff adept at supporting end-users both technically and as guides through documentation associated with the more complex packages.

The history clearly shows growing role diversity in the IS development context. Superficially, the emergence of end-user computing appeared as an anti-systems movement and a threat to professional developers. However, given the proclivity of organisations to ever wider and more complex support, systems concepts are re-capturing ground briefly lost and IS is finding a pervasive role requiring pervasive professional support.

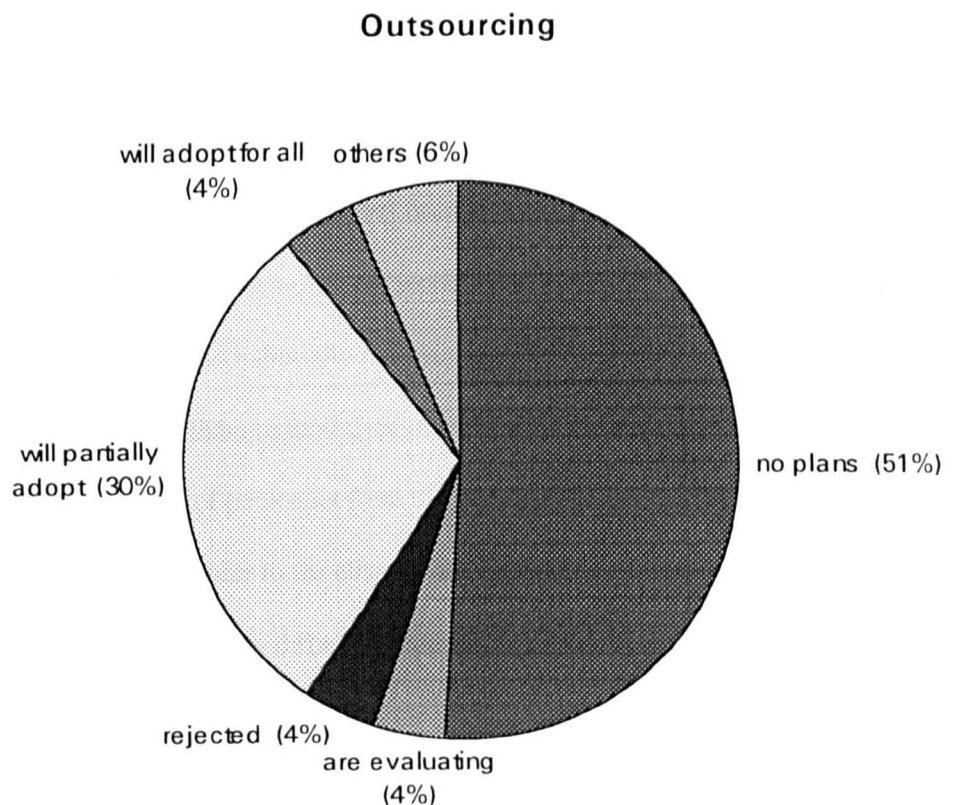


Figure 2.5 Attitudes of Hong Kong IS Managers to Outsourcing

As is shown in Chapter 8 the Information Technology revolution took place in Hong Kong in the sense of a change in the topography of information processing in organisations. There was also widespread and rapid adoption of microprocessor enabled artefacts such as facsimile and mobile telephones. However, in Hong Kong this was not

accompanied to the same extent as in the West by the movement of organisations to concentrate on core competencies, divestment of the IS function into specialist organisations (i.e. outsourcing) and downsizing. Figure 2.5 shows the response of the IS managers in 1993 to prompts regarding possible attitudes to outsourcing. Whilst approximately one third of the respondents assert that they will adopt outsourcing the ratio of those planning to adopt for all systems is only approximately one in seven. More than half stated they had no plans regarding outsourcing whilst a small number were evaluating the concept and an equal number had rejected it. This contrasts markedly with research carried out in the United Kingdom (Willcocks & Fitzgerald, 1994;p 282) where it was found that 51% of the United Kingdom organisations surveyed outsourced some or all of their IT activities and 29% of the UK respondents had considered outsourcing and rejected it. The difference might be explained in terms of a lag, the benefits of outsourcing not having been fully appreciated in Hong Kong yet. Such an explanation fails to recognise the world awareness of Senior IT management in Hong Kong who habitually maintain awareness of trends in the United States and Europe but relate them to their own environment. An alternative explanation would be that the divestment of personnel from the organisation accompanying the outsourcing concepts runs counter to the ethos of East Asian organisations. Whitley (1992) identifies four major factors differentiating East Asian organisations from those of the West. These are strong homogeneity in the particular nation states, the reproduction of particular family authority relations and respect for established hierarchies (using the term 'post -Confucian' for this particular factor), weakly developed legal systems, and stronger legitimisation of position and authority through educational certification.

Similar arguments may be brought for the low uptake of global approaches to IS development. Many Hong Kong organisations operate on a global scale in the sense that they service world-wide markets. The major bank and several of the large family dominated organisations may be viewed as Hong Kong based multi-nationals. A number of federations of joint ventures and foreign based multi-nationals keep their East Asian Head Offices in Hong Kong. Hong Kong has been taking a global view for a considerable time so the new wave of globalisation enabled by the developments in database and communications technology did not have the radical impact that was promoted in the West (Karimi & Konsynski, 1991; Earl & Feeny, 1996).

Some Hong Kong organisations develop systems in a global context, e.g. the Hong Kong & Shanghai Banking Corporation maintains global networks and software developed in Hong Kong, as well as other centres, that may run on machines physically located in North America, Europe, the Middle East as well as the Far East. The Royal Hong Kong Jockey Club develops software which is sold in such widely diversified communities as Sweden and Malaysia. The uptake of a global approach to IS development in Hong Kong, however, is slower than it appears to have been recently in some western countries and for different reasons. Whilst some Western organisations have sought the advantage of low costs available by sourcing computer code from the Indian sub-continent, as is noted in 2.2 two Hong Kong organisations are using as a global approach to staff retention, enabling key staff to gain “insurance” passports by siting some of their development centres in “countries of settlement”. A few organisations are developing systems specifications in Hong Kong for coding in the Indian sub-continent and the Peoples Republic of China but the practice is not widespread.

In the wider organisational context Hong Kong, as with the other “little tigers” was not hit so badly by the economic downturn of the early nineties as Western Nations and Japan. The “leaner, flatter organisation” (Drucker, 1988) is not so appealing when there is a wide differential between the remuneration of professional /management personnel and their support staff. The obliteration concept promoted by Hammer (1990) was viewed as a Western concept distasteful to the Asian view of the organisation as an extension of the family. There is little evidence that “Hong” (the local term for family centred organisations which are federations of smaller organisations) were moving to “tunnels of process” from “chimneys of function” (Earl, 1996).

In view of these differences between Hong Kong and the communities from which much of the literature is derived it is pertinent to wonder whether the findings of this research are only relevant to Hong Kong. It is asserted that the findings are relevant to a wider audience because of the characteristics of the practitioners amongst whom the research was carried out. Whilst these people practice in organisations whose leadership and governance is distinctly Asian their education, development and practice is mainly derived from the west. The model derived concerns the practice of IS developers rather than their organisational context. For this reason it is believed that the findings are equally valid in the communities from which the practice is largely guided. Of course there is an intention to substantiate this claim with further research in the United Kingdom.

2.4 Reflections

It is asserted that all three of these contexts were turbulent during and before the period of the research. The context of research in IS is turbulent because the discipline is unsettled. It is not well-established that IS is an independent discipline clearly separate from Computer Science or Management Science *inter alia*. Whether

candidate disciplines go through an “S” shaped maturity curve the final plateau of which is characterised by well recognised research methods would provide an interesting future research field. Researchers in mature disciplines have the luxury of working from relatively frozen ontologies with well defined epistemologies recognised as most appropriate to their investigation. It is doubtful that IS has yet reached the steep part of an “S” curve since there is much debate as to appropriate ontology and epistemology (Fitzgerald et al, 1985; Cash & Lawrence, 1989; Klein & Hirschheim, 1991).

The turbulence in the “run up to 1997” is self-evident. Its relevance to this research has been explained above. A number of relevant cross-cultural studies have been identified and an arguments has been presented to show that Hong Kong can not easily be classified in a particular grouping of countries. An argument has been made that Hong Kong is in many dimensions not typical of the group of countries identified as “developing” or “newly industrialising”. The facets that Hong Kong managers share with managers in these countries (medium to short planning horizons, ad hoc policy making, activities focusing mostly on product or function, low decentralisation and autocratic or paternalistic leadership) give support to some theses of why the organisational changes recently witnessed in the West have not yet had much uptake in Hong Kong. Viewing the study, therefore, from a geographical/economic basis tends to suggest that it is not interesting to the developing world and it is also not interesting to the developed world. It is asserted that the study should be viewed as the construction of a model for viewing the practice of a group of practitioners who practice in a situation which contains characteristics of both the developing world and the developed world. Further, it is maintained that those practitioners seriously, habitually and determinedly seek education and guidance from best practice in the developed world and that they

habitually adopt good practice from the West when it is appropriate. Indeed a number of the managers polled and interviewed were expatriates recruited from Western countries. Still more were local managers educated partly at least in Western countries. The question arises as to whether the study and model is only of interest to practitioners in Hong Kong. It is asserted that it is not because the model examines constructs and their use in Hong Kong developed in the West. It may be that those constructs may not be the constructs of most imminent interest in the West but neither have they been abandoned in the West so that what the study has to say of them is also applicable in the west.

The turbulence in the socio-technical system has been called the Information Technology (IT) revolution. Largely, the trigger of this revolution is held to be the development of the microprocessor and improvements in communications technology. The effects of this revolution on the emphases in Systems Development are well discussed (Couger et al 1989; Friedman & Cornford, 1989). This research is concerned partially with whether the opportunities of the IT revolution have been realised and adopted in IS development. Whether advances in softer technologies (e.g., Methodologies, Quality, means of involving users in development) are being adopted by practitioners is also a major concern of the research. Chapter 7 reports what was found amongst the most dynamic practitioners in Hong Kong.

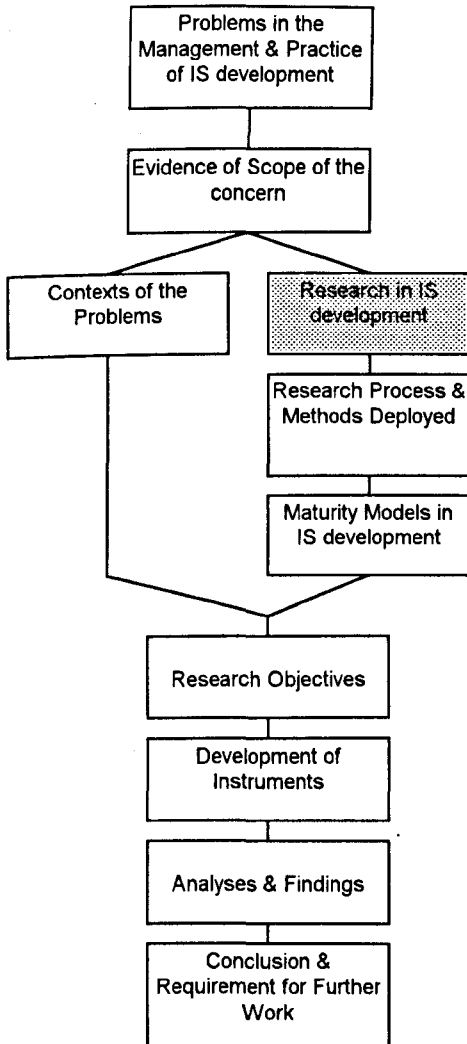
2.5 Summary

This Chapter has outlined pertinent elements of three major contexts of the research. It has identified the location of the research on Ives' (Ives et al,1980) model and hence on Visala's (1991) recommended approaches. Next the geographical context was examined and an argument was made that Hong Kong can not be viewed solely

within the developed or developing set of countries. It is asserted that the contribution of the research pertains to a class of practitioners found in both these contexts and that in their practice they form a world community. The research is limited to their practice and does not concern itself with the effects and affects of their practice on any aspect of the organisations which are the context of the research. However, the next context examined was the socio-technical context and this firstly examined the way that the use of IT has changed the topography of organisations over thirty years. Next the governance of IS developers both in the West and East Asia was viewed through attitudes to outsourcing. It is recognised that the organisations using the services of IS developers can be differentiated depending on whether the practice is taking place in organisations based in the West or the economically dynamically emerging East Asian nations. Differences in the way both these communities have reacted to phenomena such as out-sourcing and globalisation have been elucidated and partially substantiated with reference to similar research in the UK (Willcocks & Fitzgerald, 1994).

The next chapter will develop the IS research context further by considering candidate philosophies, approaches, methods, tools and techniques of research in IS before justifying the methodology taken for this research.

Chapter Three - Synopsis



With the general area of concern and the most pertinent contexts of the research established this chapter surveys the state of research in Information Systems Development. IS's claim to be an academic discipline is evaluated before the relevance of alternative ontological stances are considered. A number of ontological positions are related to the IS research location identified in Chapter 2.

Consideration is given to the term "approach" in IS research before a number of candidate approaches and methods are examined using a well known taxonomy of approaches to IS

research. Certain approaches are found to be justified and the way that their methods are used in this pluralistic approach is explained.

3. Research in Information Systems Development.

3.1 The State of Information Systems Research.

Before considering the research methods used and possible alternatives, this Chapter is broken into a discussion of philosophies, approaches and methods in relation to IS research. This triad is seen as a hierarchy of contexts. An approach is seen as a context for a number of methods and a philosophy is seen as a context for a number of approaches. We shall see that some methods, such as Case Study, may be deployed in more than one approach and from more than one philosophy. In such situations the view is taken that the method is qualified by the approach and philosophy of the researcher.

It is unsurprising that there is a philosophical debate amongst Information Systems Researchers in the 1980s and 1990s. Information Systems as a discipline must trace its origins to the efforts of systems thinkers to apply the power of systems theory to the effective use of powerful computers. More recently, in a widespread sense, this has been extended to include computers integrated with teleprocessing systems. While this “hard” technology has only been available for approximately half a century it has fundamentally transformed itself several times (Couger et al, 1982; Friedman & Cornford, 1989). It is of some concern to both users of the technology and researchers accurately to perceive effective means of deploying the technology. In other words there is a need to perceive accurately opportunities and threats presented by the existence of the technology. Similarly the instability associated with the proclivity of the technology to extend its capabilities every ten years occasioning the declaration of new “generations” poses threats and opportunities. These threats and opportunities are not only posed to those who use the technology, who are challenged to learn new structures

of interaction with the technology each time it changes. These threats and opportunities are also posed to those involved in supporting and extending the technology's use. This latter group will find a constant pressure to rethink and learn revised constructs such as programming paradigms, programming languages and operating systems. They will also find a pressure to re-think the way they interact with the changing and extending user community and the changing technology.

There is a growing school which holds that concerns surrounding the implications of the technology are more pressing than concern to develop the efficiency and utility of the technology itself (Avison & Fitzgerald, 1988; Galliers, 1987; Land & Hirschheim, 1983; Mumford, 1971). This brings the discipline of IS into an ontological arena. It is not disputed that the concerns surrounding the development and extension of the technology, itself, both hardware and software, are valid. However, concerns about bringing the technology into societal use are equally, if not more, valid. Why does this raise ontological questions?

Clearly a positivist stance is appropriate in developing and improving the physical artefacts and those artefacts such as software which, though not physical, are created for the purpose of controlling physical objects. However, it is far from clear that positivism is an appropriate stance for perceiving societal issues at all, and societal issues of Information Systems Development in particular. A succinct historical perspective on the emergence of post-positivism is found in Hirschheim (1985).

Information itself is a troublesome phenomenon to apply positivist methods to. It exists as "information" only when it is informing, instantaneously, and is no longer "information" after its instantaneous existence. From a single source it may find myriad

sinks. It does not conform to scientific laws. Similarly Information Systems are troublesome for positivist examination. For instance the concept of a transaction is a societal construct between two parties. We may observe physical representations of this construct in lines on one or several account reports. We may even hear it represented as bits passing through some telecommunications equipment fitted with auditory feedback but however many times it may be represented it is one single event and is in essence an agreed construct of two sentient beings - and nothing more. Importantly, it is not susceptible to the laws of physics¹ and hence a positivist stance is not simply questionable in understanding many aspects of it, it may also be misleading. The generation of such transactions is, in fact, governed by constructed societal conventions, an understanding of which can be grasped more clearly and rigorously through epistemologies foreign to the positivist stance of "hard" science.

This is to assert the existence of multiple modes of reality. Scientism's regularities can and do empower us to utilise predictable technology. However, when we seek to enquire into the affects (as well as the effects) of the existence and utilisation of such technologies in human society we must seek and interpret other forms of reality. It is the position of this researcher that multiple systems of reality coexist. These may be classified by whether:

1. they occur naturally;
2. are constructed from naturally occurring phenomena;

¹ for instance the laws of physics include the law of conservation of matter, something physical will have finite size but a couple of sentient beings may create as many transactions as please them without regard to this law, only the representations of the transactions are bounded by physical laws - the transactions themselves are not.

3. are constructed by social agreement;

or

4. are the construct of an individual.

Regularities of the first and second kind are most easily perceived and rigorously studied from a positivist stance. Discoveries in the realities of the third kind are most easily perceived and rigorously studied from a realist stance. Realities of the fourth kind may exist on the “reef of Solipsism” (Burrell & Morgan, 1979). Perhaps they are of no interest to anyone except the individual who has constructed them until they are shared with some other sentient being whose acceptance will transform them to realities of the third kind.

To many the divergence from empirical methods of enquiring into any reality is dubious. An extreme assertion takes the form

“(1) every real phenomenon can be measured;

(2) if it can't be measured, it's not real;

(3) if it can be measured, it is real.” Weick (1984)

Unfortunately because empirical methods *may* shed some light in the Social Sciences it is argued that they are more rigorous and therefore more reliable than post-positive methods. Others (e.g. Galliers, 1994) question whether rigour is preserved at the expense of relevance. Although the research plan outlined in Chapter 7 includes a method of data collection (questionnaires used longitudinally) which is often used with those taking a positivist stance, on reflection the stance here was not positivist. This is because by comparing the responses made in 1987 with those made by the same respondents in 1993 individual's constructs were observed for the purpose of perceiving

which individuals displayed evidence of “learning.” There was an assumption that most other significant factors in the respondents’ contexts had not changed. This of course is not, absolutely, the case. However, by carefully selecting the respondent in the situations separated by six years, as good an insight as can be obtained, into the changes in the contexts in which we are interested can be said to have been achieved. Hence, this was a relativist quest. Where positivist evidence was found it was documented and presented but the underlying philosophies most frequently lead this researcher to view the realities examined from a relativist stance. However, the stance is protean. Where evidence can show an apparent positivist regularity it is treated as a current truth in the natural domain, a useful parameter and indicator of *what* is. On the other hand, a relativist stance, more likely to lead to and answer questions of *how* and *why*, is more frequently taken. It is pertinent to note that answers to the *how* question obey different “laws” depending on the system of reality being perceived.

Burrell & Morgan (1979) use the dimensions Subjective /Objective and Radicalism/Regulation to plot into four paradigms modern schools of sociological philosophy. Here we find Social Systems theory and Social Action theory belonging to the objective/regulation paradigm which they label Functionalist sociology. Phenomenology and Hermeneutics are placed in the subjective/regulation quadrant which is labelled the Interpretivist sociology. The two other paradigms - radical humanism and radical structuralism - were not considered for this research. This was because it was known that a high degree of volatile change was inevitable in the geographical and cultural contexts of the research. Given the “foreign” position of the researcher a radical stance would have been as futile as it would be impertinent. The research was concerned to extend theory by asking “what is?” and “how does that work?” A political agenda was not taken to the research.

3.2 Horizon's of Reality in Information Systems

Visala (1991) uses Ives et al's (1980) well known model (see figure 2.1) to construct a matrix, the rows and columns of which are labelled with the contexts, which he calls horizons, from the Ives et al model (ibid.). Visala (1991) inserts in the cells of the matrix recommendations for research approaches from his interpretation of Husserl's (1913) systems of realities (modes of *being*). These are shown in table 3.1 below.

Ontological stance or Mode of <i>being</i>	Research Approach
Instrumentally controllable world of nature and technology	Causal Models (C)
Purposeful Acts	Teleology (T)
World of Meanings, cultures, forms of life	Hermeneutics (H)
Social & Economic Structures	Dynamic Structure models (Y) e.g. cybernetics
Unclassified observations	Statistics (S)
Axiomatic Description Languages	Formal Methods (F)
Conceptual Structures	Phenomenology (P)

Table 3.1 Husserl's Horizons and Research Approach Recommendations - adapted from Visala, 1991

There is an inherent duplication in the matrix generated. The rows are labelled by the same value as the columns so the cells on the top right triangle of the matrix are a mirror image of those on the bottom left, apart from the cells along the diagonal from top left to bottom right. This diagonal line of cells is referred to as the hypotenuse below. Because of the inherent duplication it is adequate to represent this matrix by the triangle given below (table 3.2.) The recommendations are in the form of the single letter taken from the rightmost column of table 3.1. In this triangle of cells, most cells contain recommendations for studying phenomena which are the result of phenomena in

one context interacting with phenomena in the other context. This might be stated as studying the interactions between the phenomena. The cells on the hypotenuse, however, give recommendations for studying phenomena in a single context - that labelled by both the row label and column label.

1. External Environment	PHYS								
2. Organisation Environment	HYT	PHYT							
3. Development Environment	HY	HYT	HF						
4. Development Process	TH	TH	TH*	TH*					
5. User Environment	HTS	HT	HT	H	HCS				
6. Use Process	-	YT	YT	ST	TC*	TC			
7. Operations Environment	Y	Y	YT	T	C	C	F		
8. Operation Process	-	-	-	-	-	TC	C	CF	
9. Information System	H	PTY	T	T	HT	T	C	T	HF
	1	2	3	4	5	6	7	8	9

Figure 3.1 Visala's triangle of recommended research approaches for interacting contexts in IS - adapted from Visala S, 1990

The shaded area of the triangle in figure 3.1 indicates the contexts of the phenomena treated in this research. In Chapter 4 an explanation of the extent to which the approaches suggested were deployed is provided together with a critique of Visala’s recommendations.

These two sections have examined the philosophical approach of the research. At a recent IS conference a debating point was raised in one of the papers:

“To what extent should the underlying philosophy of the research be made clear in Information Systems research.”

(Galliers, 1994)

The preceding survey of possible philosophical stances and their relation to IS research demonstrates that it is essential, whilst there remains no one proper path in research in IS, to elucidate the philosophical underpinning of any research in IS.

3.3 Approaches in IS Research.

In defining a hierarchy of Philosophies, Approaches and Methods of research in Information Systems it is held to be self-evident what the terms Philosophy and Method mean. The term *Approach*, however is used by different writers more closely to one than the other. Visala's (1991) *approach* includes a large part of his philosophy whereas Galliers (1991a) uses the term *approach* to cover several kinds of things including some, but not all, which could be taken as the nomenclature of methods. However, he recognises the similarity and differentiates by stating that his use of the term *approach* is more generic than the term method. I take this to mean that where he has used a label for an approach which might also be the nomenclature for a method he is saying that this method is central to the approach and dominates the approach. One can see how this would be true of methods such as the case study method. Galliers' taxonomy (ibid.) is derived from surveying five bodies of work (van Horn, 1973 cited in Ein-Dor & Segev, 1981; Hamilton et al, 1980; Vogel & Wetherbe, 1984; Galliers, 1985, and Galliers & Land, 1987; and Farhoomand, 1987) which mostly through literature surveys, had attempted to identify the methods being used in IS research. From the notes to the intermediate table it is clear that the need to identify approaches

rather than methods stems from the combining of various methods where they had been differently named by various researchers. It is worthwhile to note that at this stage not all the identified *approaches* are method centred in this, e.g. Longitudinal is a process description, Empirical is a philosophy.

A methodology is held to be the philosophy, approach and methods used by a specific researcher on a specific project. If a researcher or a school of researchers repeatedly use the same methodology then we may say that that methodology is the methodology of that researcher or school. However, in a discipline where it is quite reasonable for a researcher and his school to take a pluralistic path to defining a methodology for specific projects, it is judicious to recognise that the methodology is an attribute of the project and not of the researcher or school. In any case the taxonomy proposed here seeks to avoid the use of the word methodology preferring to use the term method for those activities which are what the researcher does.

It is reasonable to question whether there is a separate kind of thing between the meanings of Visala and Galliers in the context of IS research for which the homonym *Approaches* may be used. It is contended here that the term describes the set of a priori conditions, which the researcher brings to the problem. These a priori conditions would include, ontological stance and global objectives of the researcher amongst others. Whether this is the same as the “alternatives to the practice of scientific research” (i.e. the phenomeno-logical interpretative tradition, the radical-structuralist view and the critical social theory view) identified by Klein & Lyytinen (1985) may be pertinently asked. In the following sections the approaches identified by Galliers (1991a) will be reviewed in relation to the research proposed. Where these approaches are methods centred the method will be the focus of assessment. Where

some other dimension such as process or philosophy is the essence of the approach then that will be assessed in relation to the current project. It will not be surprising to find an intersection of usable approaches since not all the approaches lie in the same dimension.

As stated above, the ontological stance of this research is most frequently relativist. As is pointed out (Hirschheim, 1985) information systems in organisations are essentially social rather than technical phenomena. This is not to deny that much progress has been made by adherence to a positivist stance and that the technological artefacts (both physical and abstract) available to the developer are valuable and remarkable. However, it is to assert that progress in the development of technological artefacts by itself is of limited value. The social reality of bringing technology into the workplace is at least as legitimate a pursuit as the design and development of the technology in the first place. This leads to the researcher's profound belief in the legitimacy of a pluralist epistemology.

3.4 The Epistemology

Galliers' (1991a) revised taxonomy divides approaches broadly into empiricist and interpretivist philosophies. The following will take each of these in turn and assesses why the approach was or was not found to be appropriate for the current project. In the process of assessment the strengths and weaknesses of the approaches are reviewed especially in relation to research in the three contexts identified in Chapter 2.

3.4.1 Laboratory Experiment

In a Social Science research laboratory experiments may be constructed to demonstrate causal relationships between variables. Typically numerous experiments

are repeated of a constructed scenario where the variables, thought to engender the cause of a variance in outcome are manipulated. Results are obtained from which interpretations are made. Persuasive force of any result obtained is the source of the strength of the method. Nonetheless, there are many difficulties with this method. Most pertinent are that in taking the experiment out of the real world, interactions with real world events and influences are specifically excluded. Further, frequently students are used as surrogates for programmers or end-users. Hence it may be reasonably claimed that the results obtained reflect the actions of individuals with less organisationally responsible experience than say, seasoned managers. Yet it is in the realm of management science that these experiments are frequently exercised. Even if the results obtained can easily be generalised to real world situations the results may be strongly or even totally diffused by the factors that have been excluded. As has been stated (Galliers, 1987) variables that are to be ignored are effectively given the value zero which is the value they are least likely to have in reality. Conversely, it is not impossible that irrelevant factors may be introduced through the use of surrogates so that false values are now reified for factors which should be valued at zero.

With respect to the current research it might be possible to devise experiments using students as surrogates to test the veracity of assumptions regarding, for instance, resistance to change. An example such as the frequently heard assertions that programmers used to structured methods experience greater difficulty in adopting object-orientation could be tested using groups of students as surrogates. There would be problems due to the use of surrogates - are young minds freshly trained in one approach not likely to be more adaptable than seasoned professionals? Further such activity raises some ethical questions concerning the use of students as surrogates. Students invest their time and wealth in the expectancy of furthering their own

objectives such as personal development and the acquisition of knowledge. Devising experiments to see whether one path or sequence of learning is more confusing than another is at least a betrayal of the trust necessary between learner and teacher. This researcher would assert that student usage should not go beyond collection of descriptive or opinion data before students should be rewarded with payment for their time or trouble. If such payment is in the form of a valuation, such as a grade, which they have not earned through academic performance then the other students of the institution and society as a whole are being defrauded.

It is questionable whether the Laboratory Experiment approach is always used in an interpretivist fashion. It will be when the causes of actions are being sought but if the objective is to establish some norm and variance then the underlying philosophy is empiricist.

3.4.2 Field Experiments

Field experiments suffer from similar problems to laboratory experiments. It is only possible to study a limited set of variables and those ignored or excluded are presumed to be insignificant. Additionally, there is the problem of finding an organisation willing to be experimented on. It may be that research oriented organisations such as universities may be willing to suffer a limited degree of experimentation. However, the very fact that an organisation is willing to be experimented on sets it apart from the ordinary, raising the question of the veracity of the finding. Replicability is also a major problem as the prospect of finding similar organisations with similar environmental factors, willing to be experimented on, is remote.

Another approach is to set up an organisation for experimentation. This is possible where the researcher's non research skills are in high demand and the market will tolerate novel approaches as a partial price to pay for access to those skills. Such a situation would be a type of halfway house between field research and action research. This approach could be tried for the current project but it is perceived that it would inordinately lengthen the research process. Again the question of replicability in ordinary, i.e. non-contrived, organisations arises.

3.4.3 Surveys

Surveys were used in this research for two purposes. A survey had been executed in 1987. In order to find organisations in which much change had occurred in development practice and conversely organisations where little had changed in this respect, part of the previous survey was replicated. Response was solicited from the incumbents of the same posts as previous respondents. The vehicle was also used to get a wide cross section of views on the directions of information system development and various approaches to change management amongst developers.

Surveys are appropriate vehicles for perceiving popular IS development practices. Responses to questions asking “what is...” can be relied on. Because care has to be taken to avoid ambiguity they are not so reliable in gathering information of why and how things came about where complex networks of possibilities are at play. In other words they are not good vehicles for discovering cause.

Using surveys in the longitudinal manner proposed here also does not give an indication of cause but enables the research to focus on organisations displaying either dynamism or lethargy in the practice of information systems development for deeper

inspection. This satisfies Pettigrew's (1989) call to study extreme cases. Other means, especially Case Study, will be used to explore causal relationships when interesting respondents have been identified through the survey.

3.4.4 Case Study

This is the main method of knowledge substantiation in this research. The candidates were carefully selected from the respondents to both surveys. Whilst response through the questionnaire can be taken as a willingness to co-operate at that level it cannot be assumed that co-operation to a deeper level is available. Therefore candidates were contacted before proceeding further.²

Where co-operation was forthcoming a detailed search of public domain written materials concerning the organisations' development practice was made. Further, searches of materials held within the Polytechnic and Computing Department e.g. MSc in Information Systems dissertations and Bachelor of Arts (Hons) in Computing Studies industrial placement reports.

Eventually a series of interviews was conducted with information systems development personnel and management in the candidate organisations. This method allowed the collection of detailed information concerning views on the causes of change in the organisation and also the values held by the participators. Analogies and

² In one case the original incumbent of the responding task was on-loan to a sister organisation following the acquisition of the organisation under study. The new incumbent of the organisation required a consultancy task as a token payment for co-operation in the research. This was delivered after the case study activity so as not to prejudice the study through the intervention of the researcher.

metaphors, both for the organisation and the information systems development organisation were formulated to be used as a method to elicit and categorise responses. However, since respondents found little resonance between their organisations and the metaphors promulgated these were dropped and a more fluid reliance on analogy adopted. This contrasted with the presentation of the metaphors at a conference in the United Kingdom (Wilson, 1993b) where the metaphors had been well received by attendees most of whom were engaged in IS development education. It is likely that the metaphors chosen were rooted in the ethnic background of the researcher (and that of the conference attendees) rather than that of the respondents.

3.4.5 Theorem Proof

Whilst this method of research is admirable, lending irrefutable force and repeatability in the ontologically positivist spheres of belief it is of limited application in post-positivist terms. It is difficult to see where it might have been applied to the current project.

3.4.6 Simulation and game/role playing

Simulation, game and role-playing were rejected as viable means of research for this project on the same grounds as laboratory and field experiments. The number of variables involved would determine an activity that would become quite unmanageable.

3.4.7 Forecasting and Futures

Although there are two surveys involved in the project their purpose is the longitudinal one of detecting change or lack of change. The populations responding were not anticipated to be large enough to enable the drawing of statistical inferences, a necessary precursor to forecasting. This is a general problem of organisational research

in territories such as Hong Kong where there may be a relatively small incidence of the kind of objects which it is desired to study. However, an interpretation of emerging social forms and behaviour is expected to be the major outcome of the project. For this reason this approach is recognised here to be an interpretivist approach used in the construction of the case studies and models derived from them. If the emphasis had been on statistical forecasting it would have been more appropriate to consider this approach to be an empirical approach.

3.4.8 Subjective/Argumentation

Whilst this might well be questionable as a means of research amongst empiricists it is posited that it is the crux of interpretation and a major element of this project. It is posited that reflection and argument have to take place in any research or it is merely activity. This project had sought to identify meaningful metaphors for constructed objects and causal relationships in the sphere of study. In fact a stage model, which is a kind of metaphor, of Information Systems Development has been postulated. This was not plucked randomly from the imagination but was preceded by analogies, in turn preceded by conjectures. An accurate metaphor, is a sophisticated and powerful affective instrument not to be promulgated lightly.

3.4.9 Action Research

This approach is discounted on the grounds that it is only reasonable to handle one organisation at a time with the approach. The current project necessitated involvement with several organisations in some depth. Further, this approach consciously works towards its postulated outcomes. If meaningful theories are to be evoked a constant willingness to disconfirm the theories must be the stance of the researcher as was the case with this research.

3.4.10 Descriptive/ Interpretation

It is believed that this research has encapsulated the essence of development practice in the organisations studied and developed an overarching theory with which management and personnel in other organisations will identify. Originally a number of metaphors were developed. They were then arranged as a stage theory of development. The strength of this approach is the resilience of the product that may emerge. By repeatedly confronting the actors in the Case Study organisations with affective language portraying their activities their reactions were gauged and the language was adjusted. The weakness is the great risk that dis-confirming evidence will arise. Another weakness highlighted in this research was that since we are dealing with realities in terms of shared experiences and the affectiveness of images of human behaviour there has to be a strong cultural specificity if metaphors are to be used. As explained above in the course of this research the original metaphors were replaced with an explanation of the theory.

This is not to assert that the formulation process from analogy to metaphor to theory is purely rooted in the reports of our interactions with respondents. We started out with a sound foundation in the cumulative reportage from the IS community and research into change processes.

3.5 The Methodology

The methodology of the research therefore, is multiphase interpretative. A partially relevant data set was collected in 1987. The sources of this data were invited to participate in a second collection of the most pertinent items. Data relevant to the categorisation of the places of practice of development, was also collected using the

selected indicators. Metaphors were selected to serve as mechanisms to enable detailed dialogue of the context of development practice. However, these metaphors were not found to be particularly resonant with the case study respondents and were therefore not used further. Whilst the metaphors did not come through strongly it was possible to place the responding organisations on the model and to observe these organisations that have moved most significantly relative to the model as well as organisations that, significantly, have not moved in terms of the model. The methods adopted for these changes is one candidate for further investigation.

Some change process data was collected on the mail responses and a few organisations were selected for deeper investigation aimed at substantiating a number of hypotheses regarding movement through the model. These research methods followed recommendations on longitudinal methods in information systems (Pettigrew, 1989; Vitalari, 1984), theory extension in information systems research (Galliers, 1985; 1991) and case studies (Yin, 1989a & b).

It was found that the complexity of the phenomena under examination, that is the interactions and development of practitioners within organisations in dynamic markets, demands interpretative research because of the large number of factors at play.

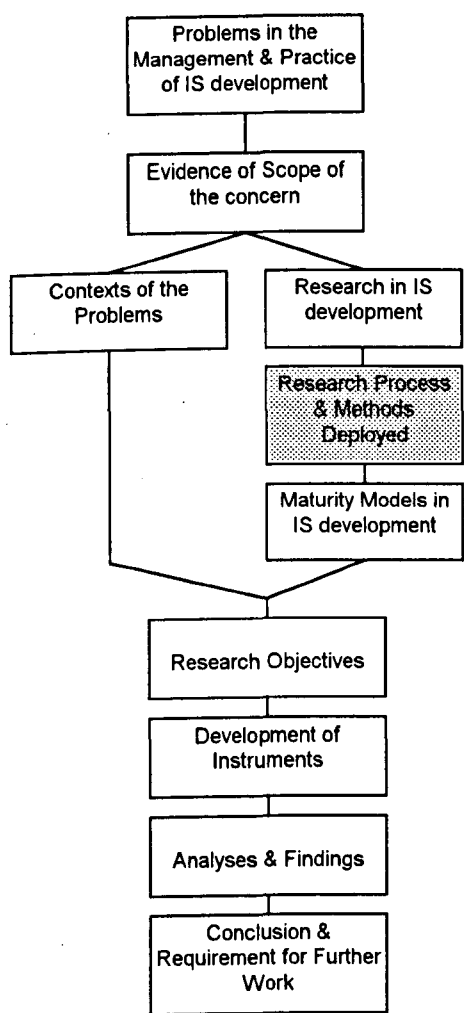
3.6 Summary

This Chapter has surveyed and selected candidate research methods suitable to the area under research indicated in Chapter 1 and the contexts of the research identified in Chapter 2. Alternative ontological positions have been discussed and related to the nature of Information Systems and IS research. The need for a protean perception and understanding of what kinds of questions may be tackled from particular ontological

stances was established. It has been asserted that IS researchers need to explicate their philosophical underpinnings in order for their epistemologies to be seen to be valid.

The need for epistemological pluralism has been described and number of candidate research approaches have been examined. It is noted that there is some difficulty in defining a hierarchy of philosophy, approach, method. Many methods would be moderated if used by enquirers holding different philosophies of reality whereas some methods seem to presuppose a particular philosophy. Whether there is a clearly separable activity, approach, between philosophy and method remains open to discourse, some researchers using the term in a sense close to philosophy and others in a sense close to method. However, the methods to be used in this research were identified and the ways in which they were used outlined. The next chapter examines frameworks of theory development and substantiation with the objective of justifying the particular path of theory development and substantiation taken in this research.

Chapter Four - Synopsis



Previous Chapters having identified concerns, located the research and explained the ontological stance of the researcher this Chapter explains the epistemology. Firstly, alternative paths to theory building and extension are considered and a well known generalised model of the research process is extended by the addition of phase names.

Next this extended model is used to show how the particular methods of this research (i.e. longitudinal comparison of surveys and, case study development) were selected before they are explained in detail.

4. Research Process & Methods Deployed.

4.1 Alternative paths to Theory Development and Extension

Exhorting researchers to take eclectic approaches to theory building and extension Galliers (1991a) recommends some alternative paths to theory building and extension. He gives two particular examples of research processes to illustrate how various approaches may be deployed in theory building and extension in IS. Care is taken to state that these examples (adapted at figure 4.1) are not prescriptive and are intended as guidance. Figure 4.1 shows an interpretation of Galliers' (ibid.) process models which explicates the purposes for which the various activities are performed. Activities of the research process have been variously labelled Exploratory, Reificatory and Confirmatory in this interpretation. This is thought to be useful as it shows that activities such as Case Study development are used by researchers for different purposes in the research process. Yin (1989a) uses the terms Exploratory, Descriptive and Explanatory to categorise the uses to which Case Studies may be put in research. It is believed that these latter two - Descriptive and Explanatory - do not fit the model under discussion particularly well. This is because that model, of course, is a vehicle for considering many kinds of research as well as Case Studies. Certainly, Yin's (ibid.) Explanatory category seems to fit neatly into the activity of theory building. Also his Descriptive category may pertain to the confirmatory activities although his Explanatory category more strongly maps to confirmation, explanation being a more useful kind of confirmation (answering the questions "how" and "why") than description (answering the question "what".) The nomenclature introduced here, however, is thought to be suitable for all kinds of research approach.

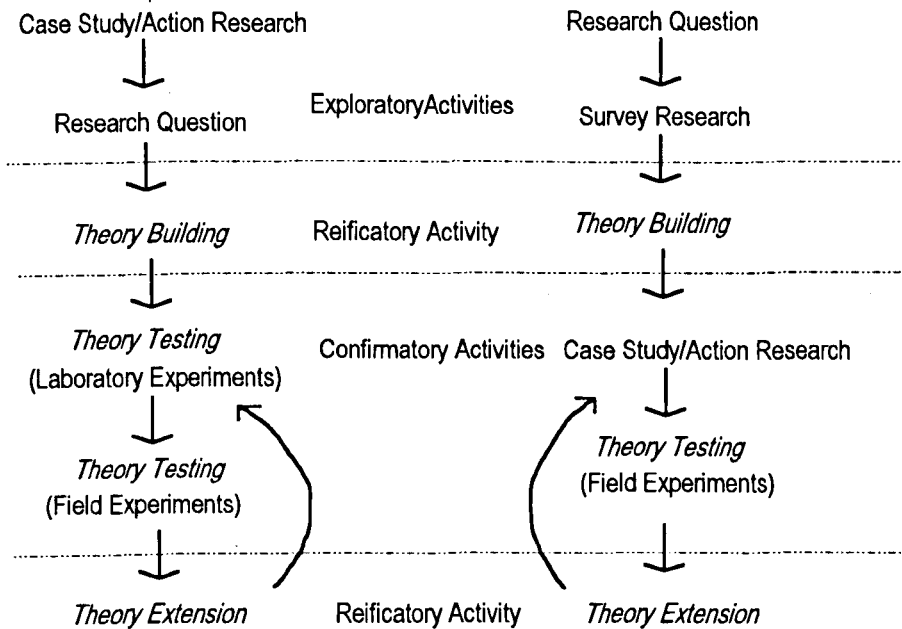


Figure 4.1 Alternative routes to Theory Extension adapted from Galliers (1991a) extended to show activity types

The use of the word “reificatory” may be disputed by some. Its use asserts that a theory is a “thing” brought into the world by the researcher. From identifying the purposes of the activities in the examples of research process models Galliers (1991a) gives, there appears to emerge a recommendation of a generic process which may be defined in words as the following algorithm;

1. Explore the given world;
2. Reify theories;
3. Confirm (or dis-confirm) the theories from evidence, observed in the given world or constructed (through case study or experimentation respectively, for example);
4. Extend theory (reify moderating theories) then return to 3. above iteratively until understanding is near satisfied whence return to 1 above.

If the extended interpretation is accepted from Figure 4.1 it can be observed that in the first of Galliers’ (1991a) examples (leftmost in figure 4.1) Case Study or

Action Research is used for finding research questions from which theories are built. These theories might be tested using Laboratory Experiments and further tested in Field Experiments. The theories may then be extended and the experiment cycle repeated. There is an implication that it is wise to perform Laboratory Experiments before Field Experiments. Further, it can be read with this process model that the early Case Study / Action Research work is of the exploratory type - searching for initial theories, rather than the explanatory use of Case Studies to interpret the causes of effects. The pattern - explore, theorise, explain / confirm - is implied. It is apposite to point out here that confirmation may take the form of explanation as well as failure to find disconfirmatory evidence in repeated attempts. There would be no reason why some other approach could not be deployed in later iterations following multiple theory extensions. It would be possible to use descriptive and exploratory Case Studies during the exploratory phase and explanatory Case Studies in the substantiation and theory extension confirmatory phases.

Interestingly, Galliers (*ibid.*) does not label Case Study / Action Research as Theory testing in the rightmost model (see figure 4.1) possibly indicating a doubt that evidence brought through exploratory Case Studies is a test of the theory or alternatively an assertion that Case Study research implies more than Theory testing alone. Yin (1989a) shows how case studies can confirm theory. He explains that Case Study is most pertinent to confirming causal theories, those answering the questions “how” and “why” rather than the questions “what” and “how much” and further provides a caveat:

“This theory should by no means be regarded with the formality of grand theory in Social Science...”

(Yin, 1989a page 28.)

On inspection, Yin’s use of the word theory here refers to theories specific to the circumstances (context) of the cases studied. Only through repeated such studies could we begin to infer the partial substantiation of general or “grand” theories. Helpfully, Weick (1984) proffers two observations of theory with respect to Management Information Systems research. These are that all theories are limited and that contextually, all theories are correct.

This research has studied six cases where there is some commonality amongst the situations studied. Some of the cases (e.g. the Banks and Country Club may be representational, in several dimensions, of populations of similar organisations in Hong Kong. On the other hand two of the most interesting cases (the Software House and the Royal Hong Kong Jockey Club) are of organisations which are peerless in Hong Kong. Further it is suggested that in its development and use of Information Technology the Royal Hong Kong Jockey Club is probably peerless in an exemplary sense, internationally. Prior to the Case Studies a theoretical maturity model, similar to two other models from the literature (Nolan, 1979, Humphrey, 1988), has been reified. The introduced model is used in the case studies, together with the alternative theories of the other models (explained in Chapter 5). It is not asserted that the work carried out to date is strong evidence of the veracity of any of the models in the Hong Kong context. Rather, while no evidence has been found dis-confirming the model, the evidence found tends to suggest the veracity of the model in preference to the other models in the context of IS development and its management.

4.2 Path to Theory Development and Confirmation in this Research.

In this research a number of broad research questions were defined and a previously executed questionnaire survey was repeated. The results of the questionnaires were analysed and compared. This analysis yielded information about the background of the area of interest as well as a basis for ordering the responding organisations in terms of their volatility in respect to the facets of interest (acceptance of change in Information Systems Development). From this analysis and a survey of the relevant literature a model was built. It was with the purpose of attempting to confirm or dis-confirm this model that the most volatile and least volatile organisations responding to the survey were approached. They were requested to allow more in-depth study of their organisational practices regarding Information Systems Development. Six of the most volatile organisations eventually agreed to participate in Case Study building. Interestingly none of the more conservative organisations agreed to this. After a series of interviews and the collation of available materials case studies were built. The process model of this study is shown at figure 4.2

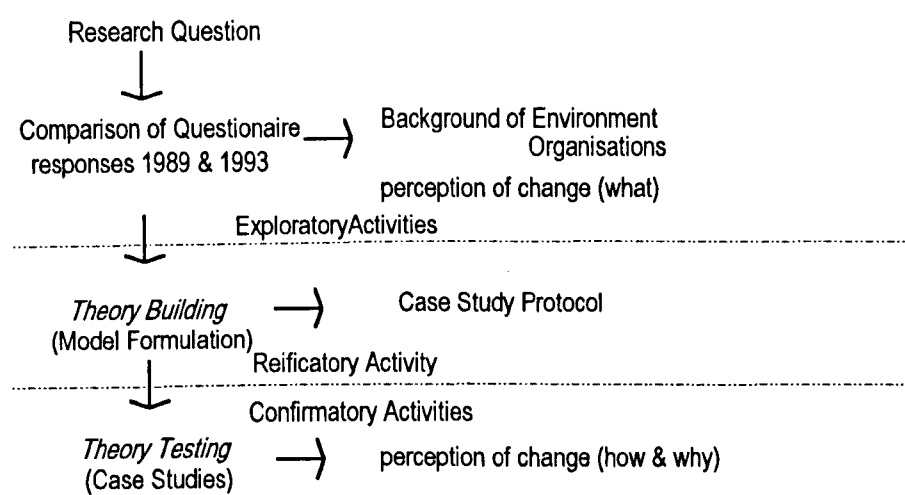


Figure 4.2 Research process used here with products shown on the right.

Figure 4.2 shows in a similar fashion to figure 4.1 how this research was carried out. It is immediately apparent that the form of the process is broadly similar to that suggested by Galliers (1991a) whilst the activities selected differ markedly from those suggested in his examples. Within the confines of the current project there has not yet been any attempt at theory extension and this aspect is amongst matters addressed in Chapter 8. The process used here is controversial in that it differs markedly in the selection of activities, as they are mapped to purpose, from those suggested in Galliers (1991a). However, the process sequence of exploration, reification of theory followed by confirmatory activity is maintained.

4.3 Longitudinal Research in IS

There is a dearth of Longitudinal Research in IS. This is unfortunate but not entirely surprising. It is unfortunate because longitudinal study is the only way effectively to study change (Pettigrew, 1989) and change is relevant to IS development in at least two important ways. Firstly there is the change experienced by those whose lives are impacted by the change process which IS development inevitably implies. Secondly there is the rapid change in the tools and techniques available to the IS Developer, including, but not limited to, the artefact that is left behind as a, hopefully, working system, probably including Information Technology.

The dearth of longitudinal research in IS development is not surprising. Firstly there is a problem of finding research funding for longitudinal studies. All research funding is an act of faith and, understandably, research funding bodies find it easier to commit smaller acts of faith at any particular instant than to commit funds to large long-scale problems. Further, the funding problem is compounded by the fact that the reason for wanting to do longitudinal research is often allied to the kind of research

being done longitudinally. The great strength of longitudinal research is that it allows the researcher to observe change. It may be exploratory to find what is changing or whether one element of a context is changing at a greater rate than another. It may be theory building perhaps correlating a change process of one element with another or explicating a time based model. It may also be confirmatory or dis-confirmatory showing that a model did or did not behave, over time, as predicted. It is likely that the methods used in such research will be pluralistic and not be the scientific methods which Fitzgerald et al (1985) claim have traditionally found favour.

“The relevant research committees do not appear to support a pluralism of research methods, the research which receives the lion’s share of resources is that which exhibits the traditional scientific values”

(Fitzgerald et al. 1985. p5.)

Until the relatively recent advent of small computers and tools which it is sometimes claimed (Gane, 1989) allow what is called “Rapid Application Development” the prospect of longitudinal research was even more daunting because IS change processes were likely to span years rather than months. It is almost impossible for a Ph.D. candidate to contemplate performing any kind of longitudinal research completely within the Ph.D. context as most candidates would wish to complete as early as possible and most examining bodies would wish completion to be in reasonable time frames. So whilst longitudinal research may be feasible for Ph.D. students studying generations of fast breeding micro-organisms the different temporal resolution that the IS researcher is faced with during the formal research education process militates against the adoption of longitudinal methods.

Pettigrew (1989) enumerates some of “the broad research goals” pursued by Social Scientists. These may include:

1. precision of measurement;
 2. generality over actors and situations;
 3. realism of context;
 4. theoretical and contextual development;
- and
5. contribution to particular and general questions of policy and practice.”

(Pettigrew in Cash & Lawrence, 1989. p14.)

He goes on to decry that despite the recognition of the latter three goals much research fails to address adequately contextual, historical and process considerations. His own research has used longitudinal comparative case methods and he explains that this has led to the revelation of

“multiple loops of causation and connectivity so crucial to identifying and explaining patterns in the process of change”

ibid. p14.

He concludes that the “analyst of change” has no option but to gather and interpret information over time with an awareness and documentation of the time element. He recognises time as a socially constructed and meaningful phenomenon and states that our understanding is not of multiple sequences of events but of the logic behind the sequence which contains the meaning of the processes.

A number of issues are identified. Is there a recognisable beginning and end?
Are there different levels of time cycles in the context of the phenomenon under study?

Are the perceptions of the researcher consistent over time? Is the social construction of time a significant phenomenon in the context of the research?

Vitalari (1985) opines that longitudinal studies seem to offer the most promising escape from the limitations of scientific method identified by the post-positivists. There are two methods of carrying out longitudinal studies proffered. One is the case study re-constructionist method indicated by Pettigrew (1989) and Vitalari also introduces the multiple snapshot concept where the current states of relevant phenomena are captured at particular instants. Vitalari (1985) identifies several benefits of a longitudinal research design. Most important, he says, are that it allows the researcher to track change and to make causal statements. Further, the activity at any particular time can be both exploratory and targeted. Using the activity language introduced in section 4.1 above, it can be seen how at one “snapshot”, other than the initial one both exploratory and confirmatory activities might be undertaken by the researcher. Thirdly, a longitudinal “multi-wave” study can point to the dynamics of change in the situation which are unlikely to reveal themselves in “single-shot” studies. Fourthly, each study acts as a preparation for the next.

Since there are so many positive reasons for carrying out longitudinal studies it might be expected that there would be a high incidence of enactment. As previously mentioned this is not the case and the following elucidates and extends the disadvantages mentioned by Vitalari (*ibid.*)

Funding has to be procured and sustained over long periods and is high anyway simply because of the time involved. Similarly the effort required must be sustained and the initial design requires greater care than other projects as the research design is

submitted to the test of time. The designer needs to take care to attempt to anticipate events and their contingencies. The relevance of concepts and phenomena under measurement may become irrelevant as factors interplay during the study. In order to avoid obsolescence a great number of phenomena may be required to be studied from the outset although it may not be obvious that they will have significance during the study. Participant attrition is an ever present problem. Even if the current actors are enthusiastic they may move away from the organisation under study, come under different political pressures or simply lose interest. The researchers may not be rewarded by publication because of the need to wait until the completion of the project. If the organisation is likely to be affected by interim publication then the researcher is constrained. It may not be possible to publish interim results where they are of limited interest compared to the findings viewed as a whole. The repeated polling of the respondent may influence the respondent both in their response and behaviour. Greater care than is in any case taken needs to be used to avoid “leading” the respondent. When societal values change during the life of the project it needs to be considered to what extent adjustment of the instruments is justified. An example of such change would be the avoidance of the use of gender specific terms in academic works from the United Kingdom. Sophisticated analysis methods, correctly reflecting the time dimension may be required in analysing longitudinally collected data.

4.4 Use of Longitudinal Method in the Current Project.

This project used a questionnaire longitudinally. The original questionnaire had been developed in conjunction with another research project (Burn, 1989) and was adjusted as explained in Chapter 5 before being re-issued. The main purpose of using an instrument longitudinally in this way was to make an informed selection of case study sites. However, the method also yielded useful contextual and case specific

ancillary material. The contextual analysis was carried out before the framing of the case study protocol and before each case study visit the information yielded from the questionnaires and any other available documents was reviewed. This is believed to have increased the effectiveness of the case study respondent contacts as the researcher attuned to the stated knowledge and to a lesser extent the “world-view” of the respondents. Pettigrew (1989) gives a number of recommendations for selection of case sites - to go for extreme situations, polar types, high experience and informed sites. Since it was desired to study the mechanism of change in IS development then it was postulated that there was a requirement to know which organisations were changing the most in IS development and which were not. The longitudinal activity allowed the researcher to see this clearly. In the event only the greatly changing organisations were amenable to closer inspection, the more conservative organisations being more secretive. Great care, elaborated in Chapter 5, was taken to elicit response from the incumbent of the responsibility from which data was obtained in 1989. This was not always the same person and it is believed that two major sources of attrition in response are the removal of the responsibility - the disappearance of the post - or the removal from the post of sympathetic respondents.

4.5 Case Study Research in IS.

Unlike longitudinal research there has long been a significant body of Case Study research in Information Systems. Benbasat et al (1987) carried out a survey of a sample of work published in significant Journals and Conferences. They established criteria for categorising and evaluating Case Studies and suggested areas in Information Systems which they held to be particularly well suited to Case Study research. The following working definition of an IS research case study was suggested

“A Case Study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organisations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used.”

(Benbasat et al, 1987, p370)

A contrast is drawn with other research methods such as experiments in that at the outset of the Case Study, the researcher will have less knowledge of which variables in the situation are likely to be of interest and how or whether they can be measured. There is no intention to manipulate or intervene in the situation (cf. Action Research.) Benbasat et al (ibid.) are of the opinion that Case Study research is distinguished from other uses of Case Studies by the prior formulation of research questions prior to the Case Study development. How broad these questions may be is not indicated but the question formulation is cited as the distinguishing feature from Case Studies developed for other purposes e.g. illustrative Case Studies developed for teaching purposes. Action Research is distinguished from Case Study by the active allegiance of the researcher in the phenomenon under study. Case study research, then is similar to application development description, the distinction being that the primary objective of the “researcher” (i.e. the IS developer) is to document difficulties and opportunities which occurred in a development process. Whilst useful research data concerning the development process may be reified as a by-product *post hoc* the activity is more properly regarded as development rather than research.

Benbasat et al enumerate four guidelines for deciding whether Case Study is an appropriate method for a given situation. These are elaborated hereunder and will be

used to evaluate the appropriateness of the method for the current project in the following section. Firstly, consideration should be given to the relationship between the phenomenon of interest and its context. If the phenomenon is not easily separable from its context then Case Study is a strong candidate method. The corollary of this is that findings are not likely to be generalizable. Theories formulated and tested will be small scale and it will be appropriate to attempt to identify which elements of the context are likely to be variable whilst the theory remains not disproved. For example in studying whether successful system design is influenced by the number of views used in defining the design it is likely that the complexity of the systems design is a factor in the scenario. Results obtained in less complex situations are not likely to scale to more complex problems. Secondly, Case Study would not be appropriate where the focus is not on contemporary events and their interplay. Thirdly, where it is possible or desirable to perform the research controlling or manipulating elements of the research scenario it would be more appropriate to use an experimental strategy because of the persuasive force of the results obtained. Fourthly, if there is a strong theoretical base for the phenomenon under study then the Case approach will be less likely to be chosen. The existing theory should enable the researcher to separate the phenomenon from its environment in a satisfactory way. Going back to the models of figure 4.1 we would not expect to find frequent use of Case Study in the later iterations of theory extension.

Lee (1989) demonstrates that the Case Study method can satisfy the requirements of the “natural science method”. Using Markus’ (1983) exemplary case study he shows how it satisfies four criteria of natural science. These are the need to make controlled observations, the need to make controlled deductions, allowance for replicability and allowance for generalizability. What is not argued is the relevance of

the natural sciences to research in IS. Lee gives three arguments for the use of the natural science model.

1. The model is well-known and widely accepted.
2. Many of the criticisms of case studies are from the perspective of natural science.
3. The natural science model is a model for testing theories and complements case study activities for formulating theories.

The first two of those arguments appear to be ethnocentric, of the nature “we do this, because this is what we do.” If there is a logic in using natural science paradigms in social science then it must flow from the “naturalness” of the phenomena to be studied. Whether socially constructed realities, as are found to be the main objects of interest in IS, consistently display the regularities of the natural world is very doubtful. However, if an ontological position of realism can be justified, Lee has shown that even a single case study can be as rigorous a method as any found in the natural sciences. It is the usefulness of the realist position to IS research which this researcher doubts.

There is some detailed guidance as to how Case Study may be approached (Benbasat et al, 1987; Yin, 1989.) A suitable unit of analysis must be chosen. The unit of analysis gives guidance to the boundary of each case and should be thought of as selectable from various orthogonal views. For instance one view is people centred. From this view the unit of analysis may be the individual, the work-group, the organisation and so on. Another view may be relationship centred i.e. transactions, client/server relations, markets. Still another perspective could be time, particularly

where the case is built mostly retrospectively as suggested by Pettigrew (1989.) In this case the granularity of time should relate to the other real phenomena and not simply to the calendar or other constructed division.

The unit of analysis should also be selected in anticipation of the dimension along which generalisation is expected. If there is strong doubt as to which candidate unit of analysis is most appropriate this is most likely to be resolved by inspecting the research questions posed if they have been defined tautly. However, they may have been broadly laid out in recognition of the tentative stage of the research. In such a situation the researcher might be well advised to perform a broad, exploratory, pilot study with an open mind to possibly changing the unit of analysis for subsequent studies. Of course the pilot study may indicate that further case study is not the most appropriate research strategy at all.

It must be decided whether there is a need for multiple case studies or whether a single case is sufficient to demonstrate the point to be made. As is mentioned above a pilot study is useful in more closely defining the research questions, determining the boundaries and dimensions of the units of analysis and may indicate an alternative research strategy. This may be termed an exploratory single case situation. Later in the research cycle we may wish to generate specific hypotheses for testing and a single case is unlikely to be an adequate vehicle, for we may be led to focus on phenomena which are peculiar to the case rather than those which are typical of a class of cases. Theories built on peculiarities will not last long or find areas in which generalisation is apt. Multiple cases allow the researcher to identify the essences of the phenomena under study and the relationships to essences of the contexts. A model constructed of undisproved theories may emerge.

Paradoxically at later stages of the research cycle single cases come back into utility. A single case may be revelatory, dis-confirming a previously sound theory. Such revelations, however, must be treated with great care to ensure that the case does indeed fit the classes to which the, now dis-confirmed theory pertained. The disproving case may serve only to narrow the scope of the theory. Consider, for a moment, the case of the first black swan sighted in Australia. This case dis-confirmed any theory that all swans were white. Had the native Australians explored and colonised Europe, rather than Australia's colonisation by Europeans, and held a theory that all swans were black they would, perhaps, have been familiar with the concept of albinism. They would have had to satisfy themselves that the first white swan they observed was truly a white swan and not an albino "black" swan. This is not an extreme case because there is a whole "universe" in which the particular object is common. Further, the particular object (swan) is viable in the familiar "universe". On the other hand, single extreme cases can help the researcher delimit the boundary of the veracity of the theory under investigation. A single case may be sufficient disproof of a theory if that is the object of the study.

Yin (1989a) also explicates what he calls the single revelatory Case Study. The example he gives is that of a researcher with a single set of unique relationships which could be exploited to examine a situation. By publishing the method of the study other researchers were encouraged to form similar relationships and stimulated to replicate the method. Although the researcher could not replicate more sets of such relationships himself, publication was worthwhile as a stimulus to others.

Numerous authorities advise against opportunistic case site selection (Benbasat et al, 1987; Pettigrew, 1989; Yin, 1984). As is stated above, Pettigrew advocates the seeking of the extreme case and conflict situations where the interacting forces will have been revealed. Yin (ibid.) differentiates between “literal” replication where the sites display a number of significant common factors e.g. size, industry sector and “theoretical” replication chosen such that contradictory results may be predicted. Benbasat (ibid.) recommends site selection related to the phenomena of interest. He also recommends care in approaching the potential site and especially stresses the importance of reassuring the respondent organisation of confidentiality and benefits that will accrue.

Finally, we need to explicate the means of data collection. In this area Yin (1989a) provides an extremely useful device. This is the Case Study protocol. The Case Study protocol lays out in an ordered fashion the procedures which will be used in the execution of the Case Study as well as the questions which will be posed. It is important to note that the questions in the protocol are posed to the researcher and that the researcher is seeking multiple answers triangulating the evidence which satisfies the protocol questions. More than that, the protocol may also contain instructions as to how the respondents are to be approached and any ancillary procedures. The existence of the protocol increases the reliability of the research, helping to ensure that the units are treated similarly, as closely as possible.

4.6 Use of Case Study Method in the Current Project.

As stated in section 4.2 multiple Case Studies are used in this project in an attempt to confirm the veracity of a theoretical maturity model of IS development. In Chapter 5 it was stated that the sites were selected from an analysis of the difference in response between the 1987 and 1993 questionnaires. Although it was hoped that Case

Studies could be built using both the most volatile and least volatile responding organisation, in the event none of the less volatile organisations approached consented to further interaction after the questionnaires. It was, perhaps unfortunate that the second batch of questionnaires had not indicated that deeper investigation was envisioned. On the other hand such an indication may have had the effect of discouraging even more respondents. The protocol (Appendix 1) was developed and the companies approached. A fault in the protocol, similar to the point regarding the questionnaire above, discovered retrospectively, was that insufficient emphasis was given, in the protocol, to explaining to the participating organisations the amount of access which would be required and also that the findings would eventually be deposited for public access. Had this been explicated more clearly it is likely that three of the sites which were chosen would have declined and it is doubtful whether similar replacements would have been found. One of those sites was the only locally based Software House responding to the questionnaire, another was an exemplary developer of state-of-the-art systems unique on a global scale. The third was a medium sized Hong Kong based Bank similar to a bank which did co-operate fully, therefore potentially providing a literal replication. After the studies had been fully documented it was felt that further data, a third attempt to perceive movement on the models, would be useful and the respondents were asked for access again in August 1995. Only one third of the respondents responded favourably to this request.

Prior to visiting the consenting sites the questionnaires and any public domain information concerning the organisations were scanned in relation to the protocol and relevant information entered into the Case Study information base. The unit of analysis of interest to the Study was chosen to be the main division of the organisation responsible for designing, implementing and maintaining Information Systems in the

organisation. As far as possible an attempt was made to “drill-down” into the organisation’s IS division by firstly interviewing the executive-in-charge. During this interview the structure of the organisation was captured and permission sought to interview typical occupants of lower level responsibilities. In one organisation the executive, who had recently been appointed, requested the researcher to interview all his immediate underlings and “as a favour”, to report their activities and attitudes, as well as to mount a short course in a specific Information Systems Development methodology. Since these activities would have taken the activity out of the realm of Case Study towards the realm of Action Research, the Case Study data was captured and written up before the further activities were undertaken. In no organisation was it possible to get interviews with the lower levels of staff, e.g. analyst/programmers. However, for many of the organisations we were in possession of information from this level, as reports from sandwich course undergraduate students, and whilst this information was used by the researcher in self-briefing it was not specifically carried through into the Case Study information base. This was because its reliability was dubious and some of it was already quite dated. It acted as an aid to interviewing so, only where it was confirmed by the respondents is it reflected.

4.7 Summary

Whilst the previous Chapter used a well-known taxonomy of research approaches to review candidate research approaches and methods this Chapter has examined the research methods selected in detail. The knowledge building process in IS was also reviewed and a nomenclature has been suggested for phases in this model. Through application of the approaches the following strengths and weaknesses of the approaches were confirmed; confirmed rather than identified since without exception

they are identified by previous researchers (Vitalari, 1985; Fitzgerald et al, 1985; Yin 1989).

There are a number of severe obstacles identified with longitudinal research. Least frequently mentioned is the problem of possible change in the perceiving system - researcher and his readership. During this research it was recognised that there was some shift in objectives during the period of the research if the period of the research is taken to include the date of the original questionnaire. Areas of the original questionnaire were influenced by another researcher with entirely different research objectives though the areas most pertinent to this research were entirely cast by this researcher. However, the objectives of this researcher at the time of the casting of the original questionnaire were somewhat different from the objectives as they were cast for the current project. The original project sought to discover the extent and nature of the use of IS development methodologies and IS development implementation methods and tools in use in Hong Kong. It can be seen that the current project is wider and more theoretically grounded than the first project. Also, when the 1993 questionnaire was issued new factors such as outsourcing (Lacity & Hirschheim, 1993; Huff, 1991; Martinsons, 1993) seemed to have entered the area of interest in the literature. Although these were catered for in the 1993 questionnaire, had these been anticipated at the time of issuing the 1987 questionnaire a clearer picture of their emergence would have been gained.

The most commonly cited problem with longitudinal research is that of respondent attrition and this is clearly demonstrated in this research. From an original questionnaire response base in 1987 of 117, only 45 usable responses were obtained in 1993. In 1994 six organisations participated in Case Study research but only two

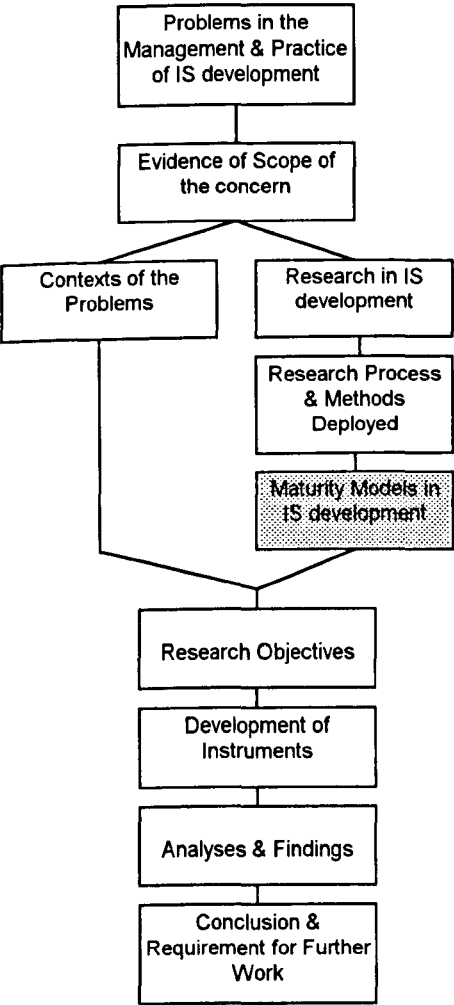
responded favourably to a request for a further follow up in 1995. Perhaps this proportion would have been greater had the need to follow up been explained in 1994. On the other hand perhaps the original access would not have been obtained. Some researchers ameliorate the attrition effect to some extent by polling similar populations at different times but this is a less satisfactory situation than the direct comparison available from the same respondent. Here, the “same” respondent is taken as the incumbent of the organisational position of the original respondent. Most often this was the same person. Of course, here there is also an assumption that the position still exists.

These considerations are strongly countermanded by the advantages of longitudinal research in perceiving change processes. A clear, precise, unquestionable picture of what has changed is immediately available. This gives the researcher a lead into deeper studies of how and why things have changed as they have. This is the strength of the case study in which causal relationships can be discovered. The weakness of the case method is that its findings do not have the imperative conviction of replicability as do more clearly identified scientific methods in the natural world. It should not be forgotten, however, that the study of Information Systems and their development is a study of interactions in a social world to which the laws of the natural world do not necessarily pertain.

This chapter has reviewed the process of theory building and extension, related it to the Information Systems discipline and suggested a nomenclature for the various phases of the process. It has elucidated the process taken in this particular research and identified the approaches used in each phase. Each of these approaches has been examined both in the way they are broadly used and in respect to their utility in this

research. Finally the advantages and disadvantages of the approaches used have been examined. In the next chapter the process of forming the questions with which the research concerns itself is explained.

Chapter Five - Synopsis



The concern, location, ontology, and epistemology of the research have been explicated in previous chapters.

This chapter analyses a number of overarching models found in the literature. These are Nolan’s maturity model, Humphrey’s maturity model and Hirschheim’s paradigms of the IS analyst.

5. Maturity Models in IS Development

5.1 Background

The main body of the research commenced in 1992 and the original proposal included the block diagram in Figure 5.1. The activity shown on the block in Figure 5.1 as “1987 Questionnaire” flowed from a research proposal to discover what IS development and implementation Approaches, Methodologies, Tools and Techniques were in use at the time in Hong Kong. This proposal was made to the Department of Computing at Hong Kong Polytechnic and was a request for the appointment of a research assistant. Since the departmental administration received another request for funding, for an altogether different project, polling a similar population, at the same time, it was suggested that the questionnaires involved in both projects should be combined. Also it was suggested that the Research Assistant should be appointed to the Department as a whole rather than the individual projects.

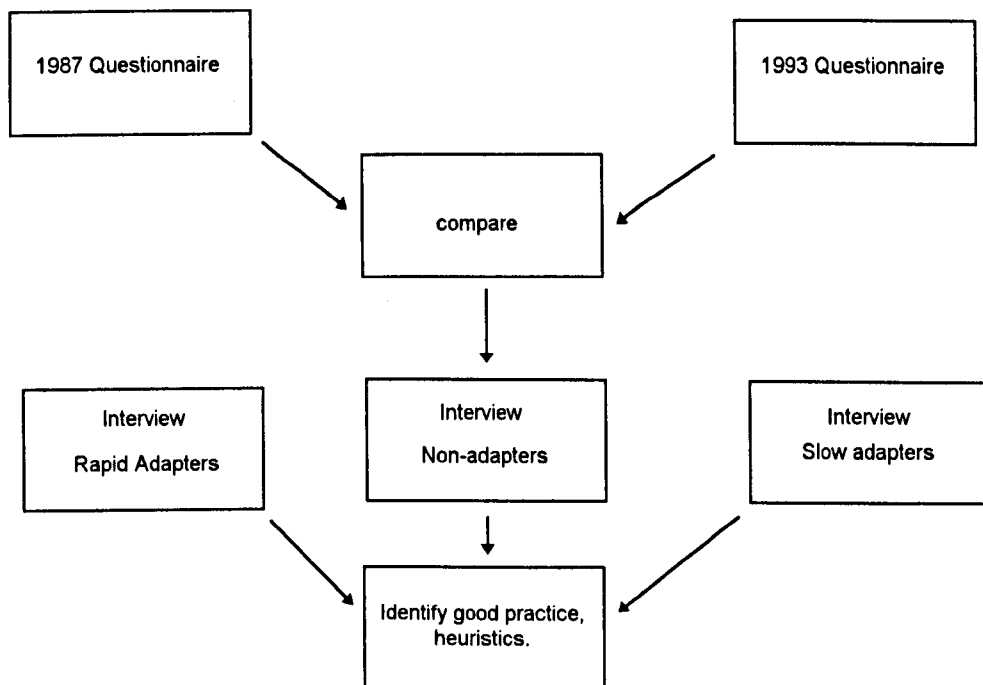


Fig 5.1 Schematic representation of the research plan

The questionnaire was developed in co-operation with the leader of the other project (Burn, 1989). Most of the contextual areas were originally included for the other project including the suggestion to seek respondents' self-assessment on Nolan's (1979) model. The areas of the questionnaire concerning Information Systems Development Tools and Methods were developed by this researcher. At that time it had not been intended to use the data as the foundation of longitudinal research nor to register later for a research degree.

When the decision was made to register for a research degree it was perceived that the data and contacts generated by the 1987 research would provide a good starting point. At this point a wide analysis of the literature of Information Systems Development was carried out. Threads in this literature are outlined in Chapter 1. From this activity the research objectives described in Chapter 6 emerged.

The research was seen as crucial for three reasons. Firstly it was believed, because of personal practice and frequent contact with practitioners in Hong Kong, that there was a significant gulf between theory and local practice. This gulf was not perceived as a local aberration - perhaps, a characteristic of practice in a developing country. Rather the approach was to attempt to define the gulf between the literature and practice in Hong Kong. It has to be stated that a suspicion was held that practice in Hong Kong is not markedly different from practice in countries said to be "developed." This leaves a door open so that at some later stage, we, or other researchers, might usefully demonstrate whether that gulf is wider in Hong Kong than in other societies, developed or otherwise. Secondly it was felt to be an exciting time in the practice of Information Systems Development. The tools and processing configurations becoming

available were presenting opportunities, indeed necessities, for the redesign of “the way we do business”. It was thought that an examination of the way we go about the business of developing information systems - including the redesign of the way we redesign our own business - was overdue. Thirdly, it was recognised that identifying possible change in and of itself was insufficient. We should be able to discover the change mechanisms utilised by those organisations which were changing in the area of interest and evaluate these mechanisms with respect to their generalizability.

5.2 Maturity Models

At this point it was mooted that a maturity model of Information Systems Development would serve to provide a framework for understanding change processes in the practice of Information Systems Development itself. A maturity model is an abstraction of the normal life of a class of the objects that we wish to study. The model consists of a number of identifiable stages during which features or attributes of the object may change. Such change may include the appearance or disappearance of a particular attribute. The model can be described as a maturity model if the transition through the stages is always in the same linear sequence although instances of objects belonging to the class may omit a particular stage. It should be noted that it is not necessarily desirable to progress to the next stage. The object in question may be most potent and vigorous during early or middle stages. Another significant notion of maturity models, illustrated by Greiner (1972), is where a single object of study may, in its parts, display the attributes of different stages of the maturity model. This notion is useful in studying complex organisations.

5.2.1 Greiner's Model

An early maturity model in the management literature was presented by Greiner (1972). This was a Stages of Growth model for whole organisations. Greiner uses the model to show how problems and crises can be predicted from the model. Greiner's model is one of periods of growth followed by predictable crises resulting in a metamorphosis followed by the next period of growth. He takes the position that the future of the organisation may be more conditioned by its history than its current situation and environment and draws an analogy with:

“the legacies of European psychologists (their thesis being that individual behaviour is determined primarily by previous events and experiences, not by what lies ahead).” (ibid., p38.)

Stages, that is growth periods during which the organisation is relatively stable, are terminated by crises which are the inevitable consequence of the solutions determined for the previous crisis. His model is not a plan or set of directions but a description of what he sees as an inevitable process. The model assists management to identify the stage they have reached and to face up to and navigate the coming crisis. Further they are enabled to recognise the limitations of the solutions to the crisis and the opportunities for growth in the next stage. For each stage he identifies a number of the characteristics typical of the stage and explains the crisis. Finally he identifies a number of heuristics for organisational management. The model is a reflection largely from case study research. Whilst Greiner does not spell it out - the maturation process is an ideal. If the crises and growth are not managed skilfully then the organisation is in danger of collapse through failure in the transition crisis or of stagnating at a particular point. Unlike natural models the end state could be the state of maximum growth. To judge this the most desirable state is to make a judgement concerning the validity of the views

of particular stake-holders in the organisation and society at large and to make a judgement as to why organisations exist. This, however, is beyond our current purpose.

5.2.2 Nolan's models.

The Nolan maturity model has become known as the Stages Theory, in the Information Systems literature, or simply Nolan's model (Gibson & Nolan, 1974; Nolan, 1979; Nolan, 1984). It may be viewed as several models, an evolving model or indeed, a maturing maturity model. The data on which these models are based appears to be largely drawn from Nolan, Norton and Company's consultancy practice. For example, mention is made of the "companies we know." (Gibson & Nolan, 1974, p77). From those contacts Gibson and Nolan noticed some remarkable similarities in the problems being faced by companies in differing industries. They plotted the EDP Budget over time for a number of companies and discovered an S-curve with three significant change points enabling them to identify four distinct "stages". In contrast to Greiner they state that their purposes are to obviate for the company as a whole the inevitability of crises following periods of growth. Further it is intended to explicate the nature of management tasks during the periods of growth and through the crises.

Although they only used one indicator to place companies on the curve in 1974 they identified three dimensions of the growth processes as following coincidental paths. The first of these was "growth in the applications portfolio." The four stages of this dimension were: -

1. Cost Reducing Accounting Applications;
2. Proliferation in all functional areas;
3. Moratorium / emphasising control;
4. Database Applications.

Next growth process dimension was “growth in the specialisation of staff.” The four stages of the dimension being: -

1. Operator/Programmer Analyst;
2. Systems Programmer/Scientific Programmer/Business Programmer/System Analyst;
3. Computer Systems Programmer/Maintenance Programmer/Functional Systems Analyst;
4. Database Systems Programmer/ Teleprocessing Systems Programmer/ Operating Systems Programmer/ Database and Teleprocessing Applications Programmer/Database and Teleprocessing Systems Analyst.

Finally they identified growth in formal management techniques and organisation. The four stages of this dimension were identified as:-

1. lax management;
2. sales oriented management;
3. control oriented management;
4. resource oriented planning and control.

It is not clear whether Gibson and Nolan observed these changes happening coincidentally, in the sense of being in close proximity in time. They certainly do not state that such changes are coincidental. This is important to understand if one has the urge to disprove this theory through empirical snapshot sampling methods. The theory will not stand up because not all the changes will take place coincidentally. The theory is better understood as an abstraction of the sequence of the general trends. There will be organisations which may be at stage 2 in one growth dimension and stage 4 in another but these exceptions do not disprove the theory. This point is explained by Galliers & Sutherland (1991) in their extension of the later (Nolan, 1979) theory.

Gibson and Nolan were stating at this point that some companies were essentially in a “first flush” stage. Other companies were essentially in a “contagious” stage whilst still others were typified by a recognition for the need for “control”. Finally, some were expected soon to go into a “mature” integrative mode of operation. Whilst the stated indicator was the investment in EDP, any of the growth states might have been used as the indicator. The advantage of using a monetary amount was in perceiving a smooth curve.

Prophetically they cautioned that the framework they had outlined was a simplification of the phenomena they were observing and predicted that there would be more S-curves beyond the one described. Five years later Nolan (1979) published a revised model in six stages. “User awareness” had been added to the stage characteristics which I am suggesting might also be used as stage identifiers. Nolan (1979) uses “Organisational Slack” and “Control” of “computer”(budgets) and data as his identifiers. Also two new stages were added, labelled “Integration” and “Data Administration”. This model was stated to be based on studies of a number of companies (38) and a large number of IBM customers and other corporations. Whilst there are six stages in this model the most significant observation is the recognition of the change from management of the computer, to management of the data resource. It is noted that this change of emphasis entails not just the restructuring of the organisation but also the infusion of new management techniques. In his 1979 paper Nolan produces the table at figure 5.2 which is a set of recommendations on the form and objective of control systems for organisations having identified their current stages.

Optimum balance of organisational slack and control					
Stages	Organisational Slack		Control		Objective of Control System
	Computer	Data	Computer	Data	
Stage 1	Low		Low		
Stage 2	High		Low		Facilitate Growth
Stage 3	Low	Low	High	Low	Contain Supply
Stage 4		High		Low	Match Supply & Demand
Stage 5		Low		High	Contain Demand
Stage 6		High		High	Balance Supply and Demand

Figure 5.2 Optimum balance of organisational slack and control. Adapted from Nolan, 1979, page 181

At this point Nolan explicates his method for assessing the stage of maturity for a given company or subsidiary. It is clear that the enactment of the assessment will provide the company with a useful guide to the optimum deployment of available and obtainable Information Technology resources. He proffers a number of heuristics exhorting management to:-

1. recognise the profundity and extent of the transition from computer hardware management to data resource management;
 2. recognise the importance and availability of the database, telecommunications and microprocessor technologies which will enable organisational growth in different forms;
 3. use the stage theory to understand where the company has come from and where it is possible to go;
- and
4. develop sound, feasible plans in a pro-active rather than re-active mode.

By 1984 Nolan had recognised that there were other scenario shaping factors associated with the emerging technologies. As well as the importance of the integrating effect of the availability of database technologies, to usher in an era of mature practice, characterised by data resource management, the availability of networks of microprocessors and similar technologies had profoundly affected the implications of the concept of information resource management. Whilst the user, data resource and hardware had been elements in the previous scenarios analysed, the emphasis now moved from data resource management to the user as the centre of concern. It was asserted that growth was being driven by user-oriented technologies rather than data processing technologies. Further he now recognised that there were multiple technologies with various growth profiles, or levels of maturity, requiring to be managed. The concepts of vertical and horizontal management were introduced and an exhibit purporting to represent various levels of maturity in the computer architecture product spectrum was proffered. Discussion at the Harvard Business School Research Colloquium concluded

“Nolan’s Stage theory, however useful in earlier practice, now must adjust to a number of issues concerning underlying phenomena, multiple curves, organisational learning, and stage based management and organisation. The new conditions posed by diffusion of IS technology and the emergence of User-dominated systems call for research to aid current and future management of the IS resource.”

(McFarlan, 1984, p216)

The stages theory has been the subject of considerable discussion, criticism and attempts at replication (Lucas & Sutton, 1977; Benbasat et al, 1984; King & Kraemer,

1984; Earl, 1989; Galliers and Sutherland, 1991; Grégoire and Lustman, 1993.) The following are some of the most prevalent criticisms.

A number of empirical studies have not been able to substantiate the various findings - albeit in different situations and at different times - reported by Nolan. The model itself is a bold simplification of complex situations. This leads to conclusions which may not be justified. Indeed by arguing for “Organisational Slack” in certain situations, Nolan appears to argue against the need for rigorous justification in the name of evolving to maturity. The models are rooted in the times that they were formulated. The four stage model reflects the Data Processing era and the six stage model reflects an era of large databases on large machines. It is doubtful whether a single model is appropriate in the IT era. Whilst the veracity of these criticisms is clear the model “rang true” to many in its time. It was extremely influential, lending support to expenditures which were acts of faith into new ways of doing business. A major problem when dealing with untried technology will always be that the real down-line benefits will often not show up in the cost analysis frames of the previous technology. Nolan’s approach may not have been strictly empiricist. His groupings may have tended towards the arbitrary and have been sampled over extended time frames. However, the observations seem to have been somewhat correctly interpreted resonating for many practitioners at the time. This resonance, a feeling that there is a “ring” of truth in the theory is substantiated by the high level of citation of the Nolan papers both in the academic and promotional literature. The models, especially the 1979 and 1984 models, were easily accessible to practitioners. A conclusion that practitioners find maturity models useful may be drawn.

5.2.3 Humphrey's Maturity model.

The maturity model proposed by Humphrey (1988), sometimes called the “capabilities” model, is fundamentally different from those of Greiner and Nolan in many respects. Firstly, the concept of crisis is different. Greiner asserts that the crises leading to the next stage are solved when management adopt a new set of organisation practices. He goes on to say that these practices

“eventually sow their own seeds of decay and lead to another period of revolution”

Greiner, 1972 p 40.

Whether this revolution leads to progression or regression in the maturity model, depends, I suggest, on the skill of the management in finding and introducing the appropriate set of new practices. The inevitability of the crisis is to some extent accepted by Nolan but he places more emphasis on means of managing the crisis. It is implicit that there is crisis and that the organisation has no choice but to meet these crises and either weather them into the more mature stages or wither. This is a reactive stance. Humphrey's model is pro-active. Transition through it is dependent on specific actions by management - the building and use of specific artefacts.

Secondly, whereas Greiner and Nolan are considering entire organisations, Humphrey is only considering an entire organisation if the product of that organisation is a Software system. Otherwise it is the software production part of the organisation which is the user of Humphrey's model. Further, although the process outlined in Humphrey's model includes consideration of systems aspects, the emphasis is on systems of software rather than systems including software.

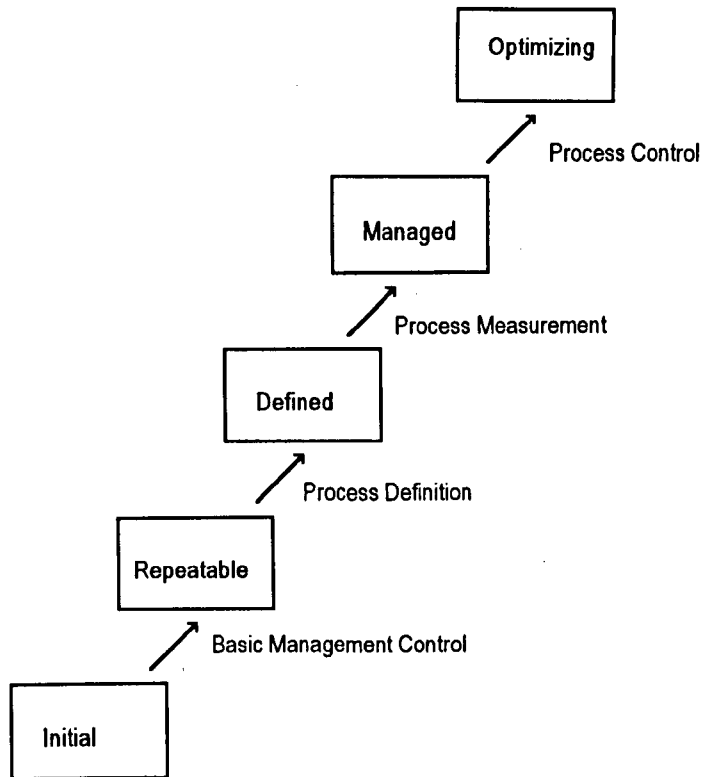


Figure 5.3 Process Maturity Levels (adapted from Humphrey, 1989,p6.

Humphrey's model grew out of research enabling advice to the United States Air Force on the suitability of software contractors (Humphrey & Sweet, 1987). This was a qualitatively different market, possibly with different objectives and constraints from that in which Nolan operated. The most striking contrast, however, is in the philosophy of management which each model derives from. It is trite to say that Humphrey's model is "Bottom up" whereas Nolan's is "Top Down". Better to say that Humphrey's model is an incremental management development process seeking to build and refine sound practice. Nolan's model is a framework for perceiving, predicting and managing threats and opportunities perceived in the dynamic growth of technology. Both models are valuable and instructive. Can they be brought together or their best features arranged into a usable framework combining the management of the enterprise with the development and management of the IS resource?

5.2.4 Klein and Hirschheim's Four Paradigms .

Another interesting meta-model is provided by Hirschheim & Klein (1989).

Taking Burrell & Morgan's (1979) paradigms of social and organisational interaction they construct four metaphors for the Information Systems developer which they describe as four stories. The stories are:

- the Analyst as Systems Expert;
 - the Analyst as Facilitator;
 - the Analyst as Labor (sic) Partisan;
- and
- the Analyst as Emancipator.

The metaphors are not intended to be hard and fast representations of actual practitioners discovered in the field. Rather their description captures essential facets of analysts discovered from interaction with analysts and close reading of the literature. The facets which Hirschheim and Klein highlight are the key actors, their motivations and purposes, the "ideals" sought and the epistemological and ontological precepts in the practice of analysis. From Burrell and Morgan's figure shown adapted at Figure 5.4 below, we can see that the differentiating factors in framing this model are the dichotomies Conflict/Order and Objectivism/Subjectivism.

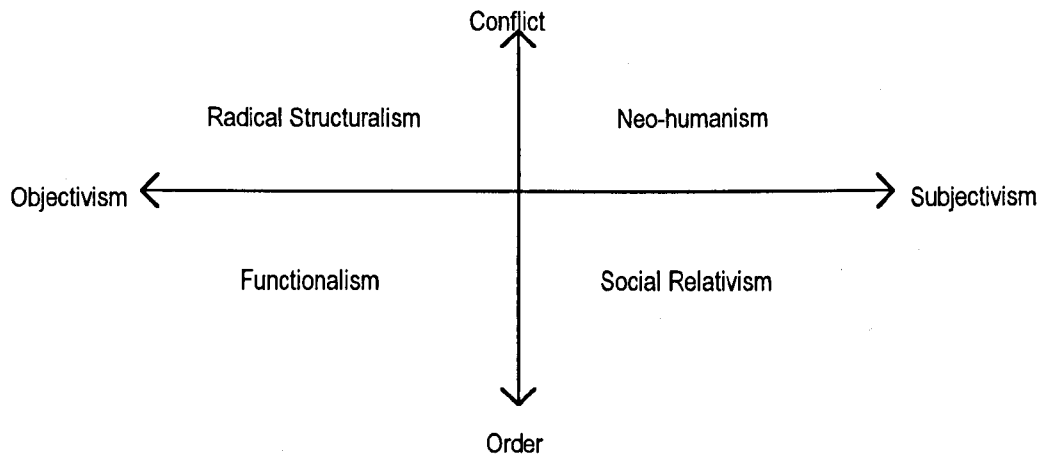


Figure 5.4 Information Systems Development Paradigms (adapted from Burrell & Morgan, 1979 quoted in Hirschheim & Klein,1989)

Whilst this is not claimed to be a maturity model it is of interest to this research in that it might be thought of as such. Hirschheim & Klein assert, with some justification that the metaphor of the Analyst as Systems Expert equating to Functionalism is appropriate and widespread. They go on to say that there is evidence of instances of practice resembling the metaphors of the Analyst as Facilitator and the Analyst as Labor (sic) Partisan (especially in Scandinavia) emerging. The Analyst as Emancipator is proffered as an ideal expected to be attainable. The premises are highly plausible but we cannot treat the model as a maturity model through which a practitioner or practice may progress. Rather there is an indication of two possible paths (shown in Figure 5.5 below) to the most “mature” state.

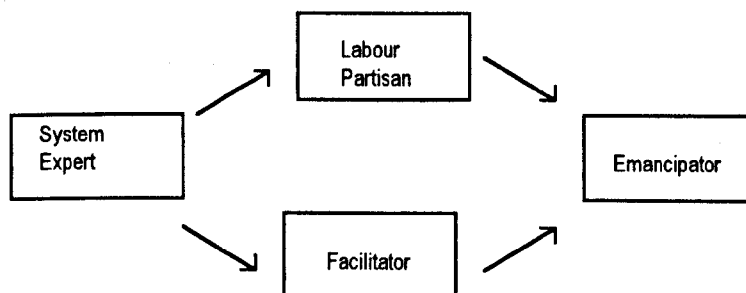


Figure 5.5 Klein & Hirschheim's Metaphors for the Analyst arranged to show possible paths to “maturity”.

5.3 Reflections

It is opportune at this point to reflect on Maturity Models in a general sense and also on generalisations which may correctly be derived from them. Maturity Models are a class of analogies. They are that class of analogy between sociological constructs (including business) and living things where the concept that the instance of the thing normally attains a desired stage after passing through a number of preliminary stages. As with all analogies it is important to know what similarities the analogy points out and where the analogy breaks down. Maturity models then are only informative with classes of things where there is a clear normal path of stages. In a sociological construct the later stages should be more desirable than the earlier stages or at least worth transiting in the hope of reaching a more desirable later stage. This does not seem to be the case with the natural model. "Old age" is probably thought by most to be characterised by more negative than positive factors.

Being an analogy we need to be careful that the class of thing described by the model is not changing in some fundamental way as to invalidate the analogy. This is a possible explanation of what happened with the Nolan models. When computing and computers implied large capital investments in hardware, written off over a prolonged period, a model which explained business and organisational benefits suggesting that these disbursements were not merely acts of faith found a useful role. They could demonstrate and support the wisdom of difficult decisions (Gibson & Nolan, 1974). Later came the era of the development of large, complex and integrated database centred software configurations in business and organisational computing. A revised version of Nolan's model found new users of the model promoting a new breed of sophisticated and expensive products with a new and more sophisticated model (Nolan, 1979). It is interesting to note the comparison with the changes in Nolan's models and

Friedman and Cornford's (1989) three era's of concern (hardware, software and applications). However, it is not so clear that a maturity model is so useful at strategic decision levels in the current era though it is certain that Nolan's early models are no longer particularly informative. The decisions required, nowadays, are less risky since the amounts being spent can be taken on incrementally. Further, the rate of change in the technology is such that models whose main use is in justifying large purchases of hardware or software may quickly be overtaken by arguments of capacity, flexibility and incrementalism. Clearly maturity models at this strategic level require adjustment as new kinds of technology come to dominate the information processing scenario. As the change in technology speeds up it overtakes our ability to formulate useful models for each technology.

The Capability Maturity Model has found growing uptake recently in the software engineering community. This stems from an altogether different social concern than the previous popularity of the Nolan models. The Nolan models were used by proactive strategic management and vendors to justify large disbursements. The Capability Maturity Model is being used by the management of large software development concerns to demonstrate the quality of their processes. It is being used to counter a certain perception that software is unreliable. The premise is that if the software development process is certified as being sound then its product will be sound. Use and interest in this model is growing in the United States and the United Kingdom. For instance, the Information Resource Management Association Conference will dedicate a track to maturity models and the call for papers clearly shows that it is this and related models, rather than the Nolan models, that the organisers are seeking discussion of. The Capability Maturity Model addresses itself to the concerns of software development

managers. This research attempts to develop a model informing those managers who find their activities between software development managers and strategic managers.

5.4 Summary

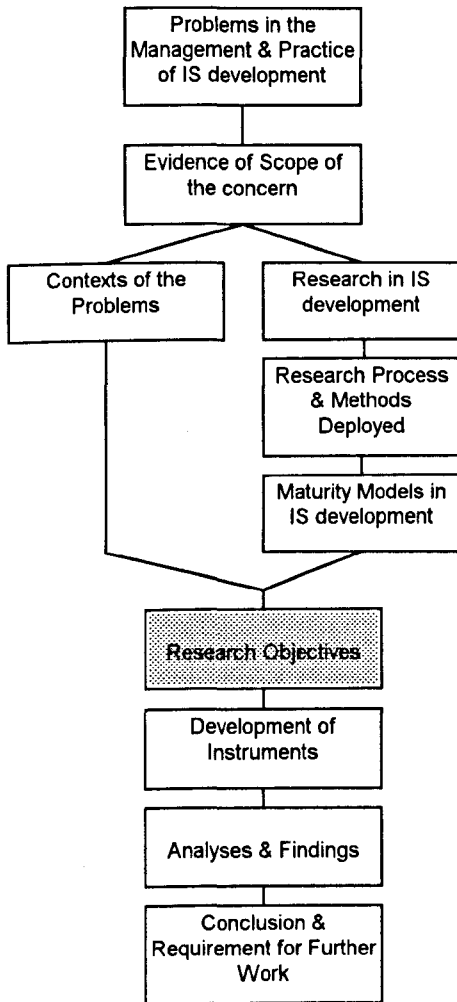
Although the models studied differ, some of the difference is thought to pertain to the actual roles to which the models are most pertinent. Greiner's model is most pertinent to senior organisational management, Nolan's to senior information systems Management, Klein and Hirschheim's to the analyst and Humphrey's to the programmer. At this point it was felt that a generalised method, without reference to particular models, for identifying a maturity model may be useful. Before such a process can be identified, however, it is necessary to re-iterate what is meant by a maturity model. Essentially a Maturity Model is an abstraction of the changes of form which a class of phenomena typically exhibit in a single pass of their life-cycle. The model, therefore, consists of various identifiable stages through which an instance of the class will pass in a pre-defined sequence. The utility of such a model is that it allows us to predict what is likely to happen to the instance. A number of benefits flow from this. We may be presented with the opportunity to manage the transition to the next phase ameliorating any ill-effects. We may have the opportunity to trigger or, conversely, retard the entry to the next phase.

There are therefore three concepts of interest. First there is a set of identifiable stages occurring in a given sequence. Next is found a number of conditions causing a transition from one stage to the next. Thirdly a set of attributes, the change in values of which may be used to determine whether a transition has occurred or not should be present. It is noted that none of the models described above fully satisfy this description of a Maturity Model. The Greiner and Nolan models do not conjecture regressed states

- “old age” to use the human analogy. They do, however, admit that it is probable that further stages will exist but do not hint that these might be degenerative. Navigation through Humphrey’s model is not a question of sets of conditions leading to crises. Progress through Humphrey’s model is a consequence of the activities of management. Being totally a management construction it can only be maintained by active management. It is not clear whether there are synergies or intersecting interests to be capitalised. The bleak assumption is that while the developer may be respected for the contribution brought to the company the *raison d’être* of the developer is as the tool of the organisation. Of course the Klein and Hirschheim model makes no claim to be a maturity model but it does fulfil some of the criteria given. There is an identifiable sequence of stages which may be transited in one of the two possible sequences shown in figure 5.5.

Together with the previous chapters the scene is now set so that detailed research objectives can be formulated. The process of setting those objectives is the substance of the next chapter.

Chapter Six - Synopsis



Previous chapters established the concerns, context, location and philosophical foundation of the research. Existing maturity models and another over-arching theory have been examined.

This chapter explains the process by which the specific research objectives that focused the research were arrived at. This was a process of refinement from identified areas of concern through an examination of threads in the literature and the contexts identified in Chapter 2. An analysis of various schools of IS development produced a categorisation of ontologically “hard” and “soft” schools. It was perceived that there was a disjunction between certain areas of the literature and practice in the contexts identified. The objectives formulated flow from this disjunction.

6. Development of Research Objectives

6.1 Introduction

In the most general terms this research aims to develop the core of a body of knowledge pertinent to supporting the management of change amongst organisational IS developers. There are a number of reasons why continual change is the norm amongst the practitioners of the development of information systems. Also the turbulence of the situation poses risks to the practitioners themselves as well as the organisations and societies they serve.

As explained in Chapter 1, the IS developer is not only the harbinger, generator, and architect of change. The IS developer's practice is subject to a faster rate of change than that of most professions for a number of reasons. Firstly there is the fast moving pace of the development of the technology which the IS Developer introduces. Secondly, there is the youth of the profession. The practice of IS development is still a relatively recent development and there is not yet a full body of well-trusted theory from which to proceed. This is evidenced by competing schools proffering various paradigms in similar problem situations, e.g. the structured (De Marco, 1978; Jackson, 1983; Orr, 1977; Ward & Mellor, 1985; Warnier, 1974; Yourdon, 1989) versus the object-oriented paradigms (Coad & Yourdon, 1991; Booch, 1986; Rumbaugh et al, 1991; Wirfs-Brock & Johnson, 1990) in IS Analysis and Design.

6.2 Strands of Concern in the literature.

Chapter 1 dealt in some detail with the key issues in IS research. Another strand might be termed the information systems developer's milieu. This strand decomposes into another set of strands. There is a contextual strand - researchers

identifying maturity models (stage theories), and generation based models (Couger et al, 1982; Friedman & Cornford, 1989; Gibson & Nolan, 1974; Nolan, 1979; Nolan, 1984); their critics (Benbasat et al, 1984; King & Kraemer, 1984; Grégoire & Lustman, 1993) and those who have extended or re-cast the concepts in the light of eventualities (Earl, 1989; Galliers & Sutherland, 1991).

There is the strand that is the source of the practitioner's sagacity. It has been previously classified by several researchers (Wood-Harper & Fitzgerald, 1982; Lyytinen, 1987; Iivari, 1991). The classification contrasts "hard" and "soft" schools. It identifies a stratified hierarchy from "soft" issues to "hard" issues. The hierarchical sequence, might be put in the sequence shown as table 6.1.

Level		References	
Philosophy		Hirschheim, 1985; Gregory, 1993	
Approach		Martin, 1984, Mumford & Weir, 1979; Checkland, 1981; Boehm, 1988; Yourdon, 1989	
Methodology		Coad & Yourdon, 1991; Booch, 1986; Downs et al, 1992; Jackson, 1983; Martin, 1986; Orr, 1977; Rumbaugh et al , 1991; Wirfs-Brock & Johnson, 1990; Wamier, 1974	
Level	References	Level	References
Techniques	Jackson, 1975; Codd, 1970; Ward & Mellor, 1985; De Marco, 1978	Tools	Bachman, 1969; Chen, 1976; McClure, 1989

Table 6.1 Contexts of Tools and Techniques in IS development

A number of points must be explained concerning Table 6.1. Firstly the references are not intended to be exhaustive, rather they are representative of reification advocacy or consideration of a set of IS pertinent concepts at a particular level. The purpose of the table is to differentiate those levels by reference to wider IS discourse. Secondly it should be noted that the cells containing references contain references in the same cells to documents which might be said to be in conflict or competition with each

other. They are juxtaposed here as demonstration of discourse at the particular level shown in the associated cell. Thirdly, it should be noted that tools are regarded as being at the same level as techniques.

Philosophy is taken as the underlying system of beliefs about the nature of objects of interest to the activity of IS development. Burrell & Morgan (1979) provide a useful Cartesian classification of philosophy pertinent to sociological study by unfolding dimensions between radical change vis-à-vis regulation and subjectivism vis-à-vis Objectivism. Approach stands between philosophy and methodology. It is less generic than philosophy and more generic than methodology. Guided by philosophy it serves to mould methodology. Methodology is held to be the sum of the tools and techniques used by a practitioner or a group of practitioners in their professional practice. These may be integrated through a set of heuristics determining such things as sequence of activities, rules for recognising the completion of activities and so forth. The distinction between tools and techniques is not as clear-cut as may be thought. We could define a technique to be a set of heuristically guided activities which take us through a strand of one of the steps of our IS development life-cycle. A tool may be defined as something which enhances our natural abilities. Clearly automated drawing devices and Data Dictionaries (as found in many CASE tools) are tools. It is not so clear as to whether sets of particular view modelling heuristics should be classed as techniques or tools.

The recognition of this hierarchy is useful to the information systems developer's understanding of the practice because the practitioner is likely to be using the same abstract models in neighbouring levels. For instance a notation used in conceptualising a problem area may also be an effective tool in defining the architecture

of a solution. However, it may not be the best tool for fleshing out the detail of that solution. In the delivery and management of information systems the practitioner should clearly understand at which level operation is current. The practitioner should also understand when it is legitimate to move into a neighbouring level.

6.2.1 Classification of Schools of IS Development

The following attempts to categorise some important schools of IS development in terms of the above mentioned hierarchy. These schools may be described by the levels outlined above but here they are divided by their perceived ontological stance i.e. the “hard” positivist guided schools and “soft” realist guided . This tension between dealing with tangible artefacts and dealing with social realities such as agreements, political acts etceteras is what differentiates disciplines such as Software Engineering and Information Systems is a major concern.

6.2.1.1 Software Engineering

In the late 1970s various ISD consulting houses developed structured methodologies from the ideas of Dijkstra (1968), on structured programming. Jackson (1975,1983) developed an elegant notation useful for modelling the functional (data flow) and dynamic (life history) views of the Information System. Also notable were De Marco (1978), Constantine working with Yourdon (1979), Orr (1977) who refined and extended the ideas of Warnier (1974). Ward and Mellor (1985) developed a methodology which found favour in the real-time problem domain using similar techniques. Progress in this school was from the original application of the ideas to programming then to the design of programs and finally to the analysis of problem areas as suitable for the development of applications. The philosophy of the school is

soundly rooted in Burrell & Morgan's (1979) Functionalist paradigm. The phenomena of consideration are regarded as mechanisms with imperative properties - an extremely objective position. There is no suggestion of the social responsibility of the practitioner. In accepting the social order of the commissioning agent the sociology of regulation is tacitly accepted. The approach assumes that all power rests with the commissioning body, good software engineering brings the IS development process as close as possible to an imitation of a "well-run" factory. Since the practitioners accept for themselves the recommendations of Deeming (1982) it is reasonable to suspect that left to design the lives of others they would replicate the cage they advocate for their own practice. This does not really address the more current need of holistic, strategic information provision such as described in Rockart & Hofman (1991).

Methodologies of this school tend to be tightly defined, multiple view constructions, with strictly defined "deliverables" (sets of definitions, reports, sets of instructions including programs). The main emphasis of Software Engineering rests in the area of the tools and techniques both advocated and proffered. There is a push towards organising the world to utilise automata, at all costs. This cost may include the job satisfaction of both the IS developer and the user.

6.2.1.2 Information Engineering

Bachman (1969) and Chen (1976) independently devised methods for mapping relationships between entities for the purpose of defining entities and relations to be described in Databases. This was a top down approach more heuristic than the rigorous normalisation techniques devised by Codd (1970). Martin (1986) and Finkelstein (1989) coined the phrase "Information Engineering" developing from a base of Entity Relationship modelling elaborate methodologies which aimed to take top-down views of

organisations' strategic needs through to implementation. Much of the positivist criticism levelled at Software Engineering may also be levelled at Information Engineering as to its implicit philosophy and approach. However, in the case of Information Engineering the emphasis is on capturing the ownership of the data rather than the total domination of the activities of the developers and users. An elaborate hierarchy of heuristics is constructed within which developers appear to have some freedom to pick and mix the tools and techniques they prefer and provision is made for explicit identification of strategic information systems planning.

6.2.1.3 Object-orientation

Recently some of the leading proponents of Structured Software Engineering, e.g., Yourdon with Coad (Coad & Yourdon, 1990,1991), have taken on wholesale the Object-oriented paradigm originally developed in the Simulation and Human-Computer Interaction communities. The practitioners of Object-oriented methods may use similar tools and techniques to those who use the structured methods but it is asserted by some that use of the paradigm requires a re-orientation of the approach of the practitioner (Trowbridge, 1990).

Poo (1991) points out that what Jackson was calling an Entity in 1978 actually embodied both Data and Process (the essential concept of the object in this paradigm). Thus the Jackson method was in fact Object-oriented at its inception although the terminology in use did not coincide with that of the pioneers of Object-orientation. It is not so clear that the underlying philosophy here is Functionalist as use of the methodology beyond the development of the Human-Computer interface is still in an emergent phase although it is being steadily taken up as the demand for systems partitioned on Client/Server lines increases.

These three schools may be termed "hard" schools. The objectives for using the methods, tools and techniques are often in hard, easily identified terms, e.g. to obtain magnitude improvements in the reduction of programmer effort, to create re-usable code, to break the tasks down so that they may be more easily managed, to facilitate maintenance and enhancement by ego-less code development. Progress in these schools should be thought of as the combination of both process oriented and data oriented techniques, firstly in combination in methodologies (such as in SSADM, Cutts (1987); Ashworth & Goodland (1989); Downs et al (1992)) then in the definition of Objects embodying both process and data. However, more mature development practices are believed to occur when these hard methods are enveloped in methods focusing on wider, softer issues.

6.2.1.4 Automated School

During the 1970s, Daniel Teichrow led a development research project at Michigan State University which had as a central concept the idea of iteratively, automatically generating systems until an acceptable system was obtained. The technology of the time was inadequate to realise many of the ambitions of the project. Latterly, however, with ever decreasing hardware costs, improvements in technologies such as Database management systems, Data Dictionaries, Application generators, Report generators and Code generators it would seem that Teichrow's dream is beginning to come true. However, this "school" has few coherent proponents or leaders except perhaps Gane (1989), Martin (1984) and McClure (1989). The school's philosophy underlies Gane's Rapid Application Development. This methodology ameliorates problems caused by the lag between requirement definition and delivery by automating the delivery process as much as possible and limiting the ambition of the

requirement, often to a 90 day project. Although there is a great emphasis on technology amongst proponents of this school it is not a totally “hard” school. This is because the tools are often used to develop worthwhile prototypes, actively involving the end-users in defining the systems (Wilson, 1993b).

Boehm (1988) developed a spiral model for prototyping aimed at reducing the risk implied by the gap between user inspection and systems delivery. End-user computing may be viewed as part of this school. Wilson (1993b) explicates how prototyping may be used in Participative approaches. Whilst there is still a largely Functionalist element in this school there is a movement towards radicalism in the involvement of the user. Progress in this school is believed to be when the user involvement is not an abdication of the developer’s responsibility but an acceptance of a responsibility to conjecture possible outcomes and promote creative solutions in concert with the user. There is also a need for an injection of holism into this school as all too often there is an application orientation and the interfaces and structures of the tools are allowed to dominate the design. Sometimes end-users are allowed to concatenate tool activities to achieve “one off” goals. The antithesis of holism, such activity allows the organisation no chance to learn.

6.2.1.5 Soft Systems School

The Soft Systems school has developed under Checkland (1981) at Lancaster University from concepts and practice developed with G. M. Jenkins. A basic premise of the methodology is that a user organisation, whilst aware that it has a problem, may not understand the real problem it has. So Checkland’s methodology facilitates the problem owning organisation to enunciate its situation through systems models until corrective measures can be defined. Philosophically, Checkland’s methodology is

positioned in the interpretative sector of Burrell & Morgan's (1979) paradigms. The influence of the German philosophers is even evident in a reluctance to translate the terminology completely. However, the radical element of the Critical Theorists is not prevalent and the emphasis of the school is at the early stages of IS development. That is, sorting out what should be the concern of the developer rather than how the intervention should be carried out.

6.2.1.6 Strategic School

In more recent years the importance of holistic, strategic thinking on using Information Technology to create leaner, flatter organisations as predicted by Drucker (1988) has been espoused by many, significantly Porter (1980), Earl (1989), Galliers and Sutherland (1991) and Galliers (1991b). Galliers (1987) has compared the practice of this school in Australia and the UK. Again this school belongs in Burrell and Morgan's interpretative paradigm; there being little evidence of a radical stance but concern being for subjective as well as objective realities.

6.2.1.7 Socio-Technical School

The Socio-Technical School grew out of the general problem approach work of the Tavistock Institute (Trist, 1963). With the movement of Electronic Computers into the workplace Mumford, (Mumford, 1971; Mumford & Weir, 1979) developed a methodology which focuses on both social and technical issues in parallel. The premise is that where various fits are made between the social system and the technology, the technology will be accepted in the workplace. This work is related to Participative Design (Land & Hirschheim, 1983) and the Scandinavian socio-technical school exemplified by Hedberg, Björn-Andersen and others (Bansler, 1989).

Whilst, as is stated above, the previously mentioned schools implicitly recognise the ownership of the system with the shareholders of the enterprise, the Socio-Technical school also recognises the autonomy of the operators and their power within the IS to reject designs in which they have not been sincerely involved. The contention that involvement in the design of the system to be implemented will resolve the possible conflict between operator and entrepreneur is questionable. It is only valid if the involvement is a deep and genuine attempt to align objectives amongst the various stake-holders. This concern with the interests of the end-users would appear to place the school in the radical hemisphere of Burrell & Morgan's (1979) plane. However, Burrell & Morgan squarely place the progenitors of this school amongst the Functionalists with the following assertion:

"The quality of working life movement is often seen and presented as a radical action-oriented response to the current problems facing modern Western industrial societies. However, their stance is essentially a regulative one, concerned to make piece-meal adjustments designed to improve the viability of the technological society characteristic of the present era."

(*ibid.*, p 183.)

Hence, whether positioning is in the radical or regulative hemisphere depends significantly on the intention of the practitioner.

6.2.2 Concern indicated by the 1987 Questionnaire

Analysis of the 1987 questionnaire responses suggested that all too often reactive practice jumps around the lower levels of development activity failing to deal

with the issues of the softer end. Further there appeared to be a major difference between the recommendations found in the literature and the practices extant amongst the respondents. Although some practitioners showed an awareness of some of the schools outlined above, especially the techniques of Software and Information Engineering, the responses left room for reasonable doubt as to whether the methodologies were followed assiduously or rigorously. Whereas the focus in the literature had moved from hardware, through software to applications, this process having been most clearly modelled by Friedman & Cornford (1989), practitioners appeared to be reporting a continuing focus on hardware concerns.

6.3 Management of Change

The management of change literature, also extensive, informs this research as it is concerned with facilitating change amongst change agents. The work of Lewin (1947) and Schein (1964) may be viewed as starting points for much of the work on the management of change in organisations. Nutt (1992) contributes with recipe style manuals whilst Scarborough & Corbett (1992) and Wilson (1992) place focus on the emergence of power in the change process. Lundeberg (1993) focuses on building frames for the perception of the context and content of change.

All three bodies of management of change literature are heavily influenced by the societies from which they emerge - North America, the United Kingdom and Scandinavia. These bear distinct differences from each other especially in regard to the relationship between practitioner and employer. It is not at all clear that the heuristics which they proffer are applicable in Asia.

6.4 Research Objectives

The research objectives were formed from the interaction of the bodies of discourse outlined above, i.e., the various schools of IS development, the various Maturity Models in use and the understanding of research methods in IS. The tension between the disciplines informing IS development described at 6.2.1 was a major factor. If the movement of emphasis from focus on the physical artefacts in IS to focus on the social constructs in IS is seen as progress towards maturity in development then a Maturity Model of IS development might inform the management of the movement to more mature practice. The question arose as to whether the extant Maturity Models examined in Chapter 5 were specifically useful to IS development practice or whether a new Maturity Model is required. It was decided to develop a Maturity Model specifically targeted at informing IS development and to seek confirmation of its usefulness amongst a group of IS development managers and practitioners. As explained in Chapter 2 because the researcher had strong ties with the Hong Kong IS development community at the time the research was carried out amongst IS development managers and practitioners in Hong Kong. Hence the research objectives were formulated thus:

- a. to discover how change in IS development practice is managed in Hong Kong;
- b. to discover whether such change as occurs follows the maturity and other models found in the Western literature;
- c. to formulate a maturity model of IS development practice;

and

- d. to partially instantiate the maturity model developed here with reference to practice in Hong Kong.

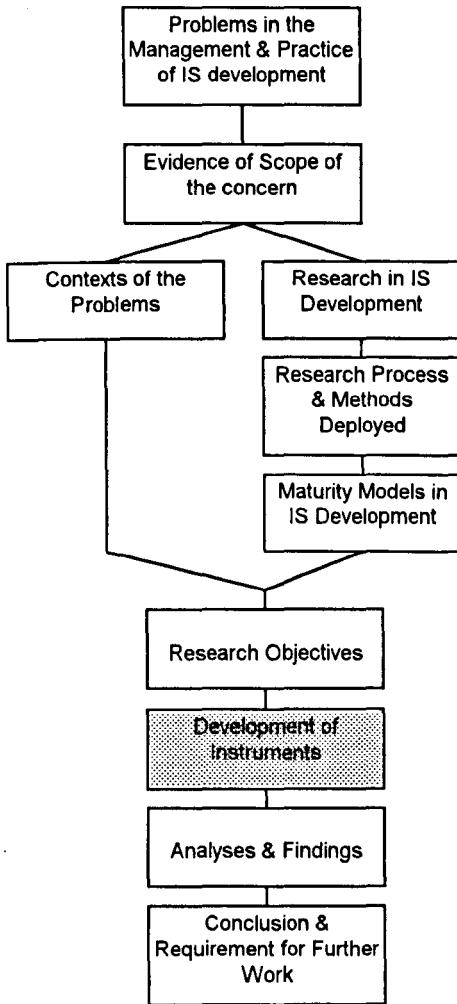
6.5 Summary

This chapter examined the IS developer's milieu and identified strands in the literature as context setting or the source of the developer's sagacity. A categorisation into ontologically "soft" or "hard" schools has been proposed for philosophies, approaches, methodologies, tools and techniques of IS development. Concerns are identified from the 1987 questionnaire and the management of change literature.

From these three strands research objectives are developed. It can be immediately noticed that the research objectives are stated in broad terms and that specific, precise questions or hypotheses have not been posed. In a sense these are encapsulated to some extent in the model which was formulated. This is an indication of the tentative stage of the research. It is asserted that there has been very little of this longitudinal kind of research, or research in the IS development area carried out in East Asia. Within the confines of the current research project it is not anticipated that precise replicable answers to precise questions will be found. Rather the research will indicate directions for deeper research both in Asia and comparatively with the communities from which the literature springs. The requirements for further research are outlined in Chapter 9. In the next chapter, Chapter 7, a detailed explanation of the process of the development of the instruments used in the research is given. This is an explanation of the revisions made to the previously used, shared questionnaire which had been largely developed by another researcher (Burn, 1989) and the process of developing a case

study protocol which would serve as a kind of template to ensure that similar relevant information would be sought from each of the respondent organisations.

Chapter Seven - Synopsis



Having identified the concerns, location, ontology, and epistemology of the research as well as analysing extant Maturity Models and schools of IS development the actual instruments to be used could be prepared.

This chapter describes the revision process enacted on the 1987 questionnaire, the development of the candidate model and the development of the protocol used in the case studies.

7. Development of Research Instruments

7.1 Finding Case Study organisations

The main purpose of re-iterating the 1987 Questionnaire in 1993 was to identify those organisations, receptive to further research, most widely separated in terms of the change in their practice of Information Systems Development. In other words it was intended to find the most volatile and the most conservative organisations with respect to Information Systems Development practice.

As previously stated, the original questionnaire (the 1987 questionnaire) had been developed as part of a data collection exercise supporting two independent research projects (Burn, 1989). The main reason why the projects shared the questionnaire was to avoid annoyingly referring to the same potential respondents at roughly the same time. Also, some items, particularly those of a contextual nature, were required by both projects. During development, the 1987 questionnaire was tested using the cohort of Final Year students enrolled on Hong Kong Polytechnic's Bachelor of Arts in Computing Studies. These students, numbering approximately one hundred, had recently returned from the Industrial Placement part of their course. During these placements they had each spent a full twelve months in Information Systems Development activity in a major organisation in Hong Kong. They had been fulfilling roles such as Programmers and Analysts/ Designers of Information Systems and were hence regarded as quality surrogates for the persons who were their actual supervisors and managers during the placement period. Lessons learned from this exercise are identified in the following section but few adjustments were required.

The results of the 1987 survey were coded into a database by a research assistant employed for the Department of Computing at Hong Kong Polytechnic. Whilst all the data is preserved in this format, because of the lack of knowledge of database principles of the assistant, it is not simple to navigate. However, detailed notes were made of the meaning of the database entries.

In this research the data pertaining to organisations and Information Systems developers from the 1987 questionnaires was compared and contrasted with some of the data that was collected with the redesigned questionnaire. The primary objective of this phase of the research was to identify those organisations where there has been significant change in the practice of Information Systems Development, those where there has been moderate change and those where there has been little change. At the same time information concerning change in the technical and organisational contexts was collected to enable the interpretation of the perceived change or lack of change. Also new information pertaining to attitudes to management styles was sought. The data from both questionnaires was used in preparation for the case study activities as were materials on the IS development activities of the selected organisations collected over a number of years through student placement reports, local press cuttings and the Asia Computing Yearbook (Barty, 1982 and 1990).

It was intended that after comparison of the practice in 1987 and 1993, the extreme organisations (volatile or conservative) and some from the middle would be selected for closer examination. Case studies would be built through the data already collected, published information and a series of structured interviews in the selected organisations. Each question of the original survey was assessed for relevance to the current research and retained (perhaps modified) or dropped as found appropriate. For

ease of processing the original question numbering, was preserved. Some questions were added reflecting unexpected directions having developed in the practice of Information Systems Development and a narrowing of the focus on development.

7.1.1 Revisions to the questionnaire

A first principle was, that in order to facilitate comparison the form and content of the original questionnaire should be retained as far as possible. However, this was moderated to some extent by acknowledging the behaviour and conceptions of the original respondents and changes in the environment which the researcher had noted since the dispatch of the original questionnaire and feedback from the surrogate cohort.

Since the main objective was to identify candidate organisations for deeper interpretation of their change process in Information Systems Development (or lack thereof) only organisations that responded to the 1987 questionnaire were sent a copy of the 1993 questionnaire. The new questionnaires were addressed to the current occupant of the position held by the signatory of the 1987 questionnaire. The outer envelope carried a request in English and Chinese. This request pertained to the situation where the original signatory was no longer in the same position in the organisation. It was requested that in such a case the questionnaire should be handled by the person who was fulfilling the position indicated in the address or the nearest equivalent position. In brief, the outer envelope carried the wording shown at Appendix 3 Section 11.

To detect inter-organisational or intra-organisational movement of the respondents the first questions collected data on such movement. Since the Section numbers of the original questionnaire were used to ease analysis and comparison, the first Section of the 1993 questionnaire was numbered 0, the questions not having been

asked previously. It was envisaged that not all questions would be pertinent to all respondents. Therefore, to minimise respondent effort, the questionnaire was produced as a set of one sided single sheets that showed the researcher's facsimile number on the reverse. Instructions lead the respondents to transmit only those pages on which they had made a response. This additional question and the instructions are shown at Appendix 3 Section 0.

The original Questionnaire which preceded the currently registered research and which was shared with a partner project is shown at Appendix 2. Appendix 3 shows the formatting of the second questionnaire. The rationale of the changes is given here.

The questions in Section 0 concern the organisational movement of the respondent. It would have been possible to place this section after Section 10 but it was felt more logical to ask questions about the respondents before coming to questions about the organisation and organisational practice. The formulation of the Section is shown at Appendix 3 - Section 2.

In Section 1 of the 1987 Questionnaire respondents gave information about the organisation. Much of this would not have changed and was, therefore, removed whilst other questions were removed because they were solely pertinent to the partner project. For the convenience of analysis original numbering was preserved and extended logically where additional questions have been inserted. The information gathered here constitutes a significant segment of the context of the investigation. It was considered to be of paramount importance to note change, or lack of change, in the context, in understanding and interpreting the phenomenon of change in the Information Systems Development.

Although question 1.2 - Type of Organization, was formulated in the degree of detail shown in Appendix 2, mainly to satisfy the partner project, it was retained here because change in the response is an indicator of a highly significant event. That event would indicate major expansion or contraction of the organisation. Since high rate of change is not expected, where there has been change the research would be led to interesting candidates for further Case Study. Should it transpire that there has been a high incidence of change, there would be grounds for comment on the dynamism of the Hong Kong economy. The question was retained.

Question 1.3 - Ownership Nationality, could have been retained on similar grounds to the previous one. It was not, because what it might reveal may have more to tell us about the value of the Yen against the US or HK dollar and political uncertainty than about the nature of organisations employing Information Systems Developers. The question was really to convenience the partner project which was seeking correlations. Where there had been change in the Case Study organisations that was discovered through interview - one of the banks had indeed moved from American control to Japanese control. In other words the question was not used to identify candidate Case Studies but was carried forward to the interview stage. Hence it was dropped from the questionnaire.

Question number 1.4 - number of years established in Hong Kong, is a time based question and it did not make sense to repeat it. Although the bands were not in increments of six they indicate a continuum between young and old companies.

Increase or decrease in the overall number of employees in Hong Kong is a significant event in the context of the change in Information Systems Development practice, hence question 1.5 was retained with the same bounds as the original shown in Appendix 2.

Question 1.6 - Sector of industry, was retained since a change of industry sector would constitute a significant event. The labels shown in the original at Appendix 2 were retained.

Question 1.7 concern Annual Gross Turnover. It might be useful to plot annual gross turnover change (against the mean change) to use as an indicator of success in some later analysis of the responses. Note could be taken of movement amongst the bands and the average movement in band terms could be derived to identify organisations moving significantly contrary to the average. The question was retained with the same bands as in the original

For most of the questions in Section 2, which provided a rich source of contextual material, the situation arises again where the response is interesting if there is a change from the 1987 situation. The page was headed with instructions as shown at Appendix 3 Section 2.1

In recent years Drucker (1988) has claimed that the introduction of diffuse Information Technology leads to "leaner, flatter" organisations. This may be interpreted as the widening of the span of control of professional and executive staff being enabled by Information Technology. By correlating the changes indicated by the following question with those concerning the diffusion of the technology, it would be possible to

see whether Drucker's findings are replicated in Hong Kong; Hong Kong, of course, representing an economic situation markedly different from that in which the theory was formulated. Hence questions 2.4 to 2.9, were retained.

In order to link the research to Organisational Practice and Change Theory (Taylor, 1911; Handy, 1986; Lewin, 1951; Scarborough & Corbett; 1992; Wilson, 1992) and to perceive whether the practice reflects theory, a number of questions were added. They started a separate page in case the respondent was not transmitting by facsimile, information regarding the previous nine questions. The new questions are shown at Appendix 3 Section 2.2. A further question, shown at of Appendix 3 Section 2.3 was asked to test whether the ideas of Lewin (1947) and Schein (1964) are shared by the sample. Then a question, shown at Appendix 3 Section 2.4, was asked to test whether the learning organisation ideas of Argyris & Schön (1978), Checkland (1981) or Senge (1990) are widely subscribed to in the sample. Next a question, shown at Appendix 3 Section 2.5, was asked to test whether there is anything to be had from developing a theory following from Couger's (Couger et al, 1982) generational view. The next two questions, found at Appendix 3 Section 2.6, were intended to provide a clue as to whether the ideas of Scarborough & Corbett (1992) and Wilson (1992) have any following in Hong Kong.

Section 3 was aimed at discovering the structure of the provision of Information Services. In 1987 interest centred on the kinds of Computers (mainframe, mini, micro) and the distribution and linking form of the facilities, i.e. the networking topography. In 1993 there was additional interest as to whether the Information Services were obtained in-house or out-sourced. Response to Questions 3.4 and 3.5 that asked for historical dates (i.e. Year of first computer acquisition and year of first computer system use) could not have changed and hence the questions were dropped.

Otherwise, the section remained the same, therefore, except for some additional questions giving the form shown at Appendix 3 Section 3.

Section 4 examined the platforms and tools of development. In question 4.1 the word "outsourced" was added to the second of the first row of options. This was because this particular jargon had gained some currency in the intervening period. However, it was believed that the concepts alluded to in the original questionnaire were congruent to the restatement using the current jargon. The concept was controversial as evidenced by the appearance of a specific jargon and a question exploring the controversy was inserted at 4.4 on the questionnaire as shown in Appendix 3 Section 4.

Consideration was given to whether questions 4.2 and 4.3, asking about equipment and software in use, should be left in their original form. This would ease the construction of graphical data showing shifts in these areas. It was considered that to revert to the original "tell us everything" mindset from the current "tell us the changes" mindset the respondent is being asked to adopt may confuse the respondent. For the test exercise, with the surrogates, the questions were recast as shown at Appendix 3 Sections 4.2 & 3 leaving the researcher with the possible task of laboriously reconstructing graphical data if the responses indicate that such a picture would be meaningful. However, the surrogates indicated a preference for a "tell us the current state" style and the words "dropped since 1987" and "adopted since 1987" were taken off the final version.

Since the original questionnaire "Outsourcing" has become a widely used term to mean the acquisition of Systems services from external sources. There is some discussion in current literature (e.g. Lacity & Hirschheim, 1993) on this topic. Whilst some of the issues were addressed above, the terminology was not specifically aligned

to the term that has become widely used currently. Time will tell whether this jargon will persist. Question 4.4, shown at Appendix 3 Section 4.4 was inserted to gauge the spread of interest in the topic.

The section on End User Computing is thought to be a good indicator of change in the organisation. Since there was not a great deal of End User computing reported by the original sample, at this stage it was decided to ask the respondent to report what is the state now rather than changes. This style was then retained to the end of the questionnaire. Although the section was not changed in substance it was re-formatted. An exhortation asking the respondent not to complete it if End User Computing was not practised in the organisation was inserted at its head. Its final form is shown at Appendix 3 Section 5.

At the conception of the original research, and currently, the Development Methods section was seen as most pertinent to this particular research as opposed to the partner project. A core element of this section was a matrix in which respondents were asked to tick which methods they used for Systems Analysis, System Design and Program Development. Six years later this core was retained and extended to include a column for Strategic Information Systems Planning and rows for Object-oriented and Hierarchical (which had been frequently mentioned in “Other” in 1987) development giving the form shown at Appendix 3 Sections 6.1 & 2.

In 1987 it was simply asked whether there were Automated tools available to support development. This time the question was expanded with some of the tools reported in 1987 (i.e. Case tools, Automated Data Dictionary, Word processors/Desktop publishing, Diagramming aids), giving the form shown at Appendix 3 Section 6.3.

If CASE tools have been adopted it would be useful to know which stages of the IS development life-cycle they were being used in so a new question 6.3.1 whose form is shown at Appendix 3 Section 6.3.1 was inserted. Question 6.4, regarding Data Dictionaries remained unchanged in substance but is shown in its revised form at Appendix 3 Section 6.4.

In 1987 a brief synopsis of Nolan's 1979 maturity model was sent with the questionnaire. Respondents were asked to indicate the stage of the model they believed their organisation to be in. It was decided to re-issue the same synopsis with the questionnaire since it is likely that Nolan's model has not been at the forefront of respondent's consciousness over the last six years. The synopsis referred to the most widely cited version of Nolan's model. Simply referring to Nolan's model might have confused the more informed respondents. Further, using the same set of stages facilitated direct comparison. In their original (1987) responses many respondents ticked more than one stage. Since the stages indicated were invariably contiguous the response was taken to mean that the organisation was believed by the respondents to be between stages. To remove any ambiguity a response space between stages was provided on the re-issue. The finished question was stated as shown at Appendix 3 Section 7.1.

Question 7.2 asked respondents to estimate the percentage of applications according to Anthony's (1965) triangle five years ago, at present and in 5 years time. Clearly it is unnecessary to repeat the question in that form since the current state reported in 1987 approximates to the state "5 years ago". The 5 years hence, projected in 1987, approximates to the 1993 current state. Thus it was decided to enquire about the current 1993 state and the expected state of 1998. A valuable insight to the accuracy of prediction was expected to be obtained with the format shown at Appendix

3 Section 7.2. Question 7.3 asked about the current major problems. A shift in the problem perception was expected to prove interesting and the question was retained unchanged.

Section 8 - DP Growth asked, retrospectively, about change in various attributes of the organisation over the situation 5 years previously. By repeating the questions it was hoped to be able to gauge any change in optimism or pessimism of the respondents and the section was retained unchanged.

In 1987, Section 9 concerned itself with future projections for the next five years. Hence the opportunity of assessing the accuracy of the predictions made at the time and the change in levels of optimism or pessimism was available. Whilst the questions in 1987 asked only for a projection it was decided to now ask for a report as shown at Appendix 3 Section 9.

Finally, Section 10 called for the respondent's contact information. This is what was to be used to contact the respondents in this second sampling and follow up for the case studies. In 1987 facsimile transmission was not widely used but it was anticipated that most response to the 1993 sample would be received by facsimile. Telephone numbers have been updated as far as possible from published sources e.g. "The Asian Computer Users Yearbook", Polytechnic and the researcher's contact records. Section 10 was completed as far as possible and the respondent asked to confirm the details. The revised Section is shown at Appendix 3 Section 10.

As the 1993 responses were received they were entered into a relational database.

7.2 Developing a Candidate Maturity Model

A method of perceiving and substantiating maturity models was constructed at this point. It was postulated that for a given phenomenon, thought to behave within a strict maturity model then those attributes whose values vary for an instance of the phenomenon over time, should be examined to see whether coincidence can be found amongst the values of the variable attributes. A strict maturity model is defined as one where any instance of the phenomena will certainly visit the stages in the same sequence. That is to say that the model is effectively constructed from a number of dimensions which hold values which always change in the same sequence and together. If two or several such dimensions can be found for the phenomena then a useful strict stages theory can be claimed since, from the observation of one dimension, the value for the other can be induced. In social systems the reality is not so mechanistic. However, if several dimensions which are usually visited in the same sequence can be found and sets of values appear coincidental on various dimensions for several instances, then whilst prediction may not be able to be made with certainty, it can be asserted that there appears to be a maturity model appropriate to the phenomenon in question. In such a case prediction and recommendation based on the model may be valid.

With the concept that Information Systems Development was the activity of staff engaging in investigating organisational problems, designing and defining solutions to those problems, where these solutions take the form of automated information systems which the IS developers then construct and manage; several candidate dimensions with identifiable positions which may be used to indicate coherent states of maturity in practice, were postulated.

7.2.1 Candidate Dimensions of the Model - Scope.

The Scope of the Information Systems Development yields two dimensions. These are scope in terms of where the main focus of the development activity resides with respect to the Information Systems Development Life-cycle and scope in terms of the boundary within which the problem lies.

Avison & Wood-Harper (1990) identify a “classic” system life cycle consisting of three phases (define, develop, install and operate). Within each phase there are number of tasks. Whilst early popular texts in IS development did not explicitly use the term “life cycle” (e.g. Daniels & Yeates, 1969) some of the concepts were treated implicitly especially in passages relating to implementation and project management. Davis & Olson (1984) state that there are a “growing number of applications” that should be developed using an experimental strategy rather than the life cycle approach but that much development of large, highly complex and structured systems demand a life cycle approach. This gives a clue to the origins of the life cycle which is also found to be in use by other professionals in the design, development and implementation of large complex solutions to problems in their areas such as civil engineering, mechanical engineering, manufacturing systems etceteras. The life cycle has been “classic” for some time outside IS development.

The IS development life cycle can be used as a management tool for scheduling tasks and resources in planning developments. It is an abstract model with assumptions of sequence. In this research it is assumed that practitioners will be guided by a life cycle model of some sort. All systems development life cycle models are assumed here to consist of a series of tasks, perhaps grouped into phases, extending from tasks in which the strategic considerations of the commissioning organisation are dealt with through problem analysis, solution design, implementation, use and degeneration until

the need for the reconsideration of the organisation's strategic position must again be addressed. There are often cycles within cycles and the experimental approach identified by Davis & Olson (1984) is regarded here as the tightest of these cycles limited to creating solutions to immediate problems without regard for wider issues.

As far as the scope in terms of the Life-cycle emphasis is concerned, the most basic level would be similar to this experimental practice taking a piece-meal contingency approach, solving problems as they arose with little planning, analysis only of the immediate problem and design without regard to foreseeable change. Such practice would be severely focused on implementation. Practitioners at this level would tend to solve the same problem over and over, perhaps believing that they take an incremental approach when in fact the practice would be better described as "patching". Because of the implementation focus the rewards systems underline speed of implementation with little consideration for quality. Quality might be assessed in terms of speed of execution of solutions, simplicity, elegance of fit with other components, ease of access for maintenance amongst other factors and the like. There would seldom be an appraisal of opportunity and by-and-large old system structures would be forced into new technology "warts and all". It is not suggested here that no time is spent in other stages of the Systems Development Life-cycle, rather that the emphasis is on implementation. As implied above this practice is justified as the experimental approach for certain kinds of problem where there are a high number of unknown variables and the implementation will not have knock-on effects for other systems.

The next level up would be where the emphasis moved one stage back in the Systems Development Life-cycle, albeit retaining competence in implementation. Implementers would make a conscious effort to design before implementation.

Components would be designed so that they could easily be re-used, easily interfaced with other components and maintained by colleagues both current and future. This difference in emphasis may pay the price of an overhead in code implemented. More likely the cost is in the time it may take to implement a given system. The benefits are found in more reliable systems and down-line improved implementation times with easier maintenance. When the emphasis moves to more careful, holistic analysis then a further point on the dimension has been reached. Benefits are an improved likelihood of the identification of the “real” problem, the affects on other components and systems, as well as the recognition of opportunities for synergistic design. The most mature situation is thought to be where the scope displays competence in the full Systems Development Life-cycle but the prioritisation and co-ordination of systems development flows from a competent process of Strategic Information Systems Planning itself dependant on a competent process of strategic organisational planning.

The other scope dimension refers to the usual location or boundary of proposed solutions. The least mature situation is where most solutions do not cross departmental boundaries. This enables stake-holder satisfaction at a simplistic level since the satisfied stake-holders tend to number no more than one, the commissioning agent - generally a middle manager responsible for a single function of the organisation. In this least mature situation the interests of other stake-holders, such as the operational personnel or customers would be largely ignored (De Marco, 1978; Jackson, 1983; Orr, 1977; Ward & Mellor, 1985; Warnier, 1974). The next point is reached where solutions frequently redesign the organisation (Burn, 1989; Drucker, 1988; Keen, 1981, Ping & Grimshaw, 1992). Frequently solutions are proposed which make use of Information Technology mostly by automating the communications between organisational functions (Tolvanen & Lyytinen, 1994). Functions which were found to be mostly manual

protocol handling are likely to be subsumed into the automated systems, obviating or severely reducing the departments which previously handled them. A further point is reached when analysis identifies and actualises opportunities for the development of systems crossing organisational boundaries. (Angell, 1990; Björn-Andersen & Cavaye, 1993; Checkland P, 1981; Checkland & Scholes, 1990; Earl, 1993; Galliers, 1991b; Vidgen et al, 1994; Wood-Harper, 1992)

7.2.2 Candidate Dimensions of the Model - Methodology.

Consideration of the methodologies employed by Information Systems

Developers yields three dimensions as shown below. These are:

1. the rigour with which the methodology is applied;
2. the form that implementation of the methodology takes and;
3. the diversity of the perceptions on which the methodology rests.

It is stressed at this point that these are candidates for dimensions to be included in the model. It is explained below that reading the rigour value of “loose” in isolation might indicate either a very low level of maturity or a very high level depending on other considerations. However, it would not indicate the intermediate level.

There is some discussion concerning rigour in the application of methodologies. Avison et al (1992) found a number of difficulties in the use of a “blended” methodology in a contingency fashion. Beynon & Skidmore (1987) argue for a “toolkit” approach causing Avison et al (1987) and Mingers (1987) to counsel for the need of such “toolkit” users to perceive accurately the philosophies underlying the tools available and to appreciate the role of guiding frameworks for the less experienced practitioner.

The lowest state of rigour is where there is no apparent consistent methodology. The practitioners may behave purely reactively. Such a situation is noted by Avison et al (1992) in the United Kingdom and was perceived to be common in Hong Kong from interpretation of the 1987 questionnaire. One step up from this is a situation where a methodology is very tacitly applied. This may indicate a very low level of maturity if it is merely a question of “lip-service” being paid to the methodology. Alternatively it may be the highest state of maturity. This would be the case if the relaxation is because the practitioners are sufficiently adept consistently to appraise each situation with respect to the appropriate level of deviation from the espoused methodology. In application of the protocol to the case studies this value was initially used to indicate the second level but was tempered with an awareness that it may actually indicate the highest level. A more advanced state is believed to be where the espoused methodology is normally adhered to but when deviance occurs, a process is enacted which is consensual amongst the practitioners and documented. The next level up would appear to be where the methodology is most rigorously applied with effective sanctions in place or perhaps mechanisms which force the practitioner to apply aspects of the methodology. However, there is suspicion that this may indeed be the mid-point rather than the end-point of maturity on this dimension.

The dimension of methodology enactment form is more likely to give a sound indication of development practice maturity. Davis & Olson (1984) argue a model for “selection of development strategy for requirements development assurance”. They identify acceptance, linear and iterative assurance strategies. Extrapolating the argument to all stages of the life-cycle it could be asserted that where the stages of the methodology are visited sequentially in a single pass it is unlikely that complex or risky problems are being tackled. More maturity may be indicated where reiteration to the

previous stage or back several stages is not unusual. This may be in the formalised incremental spiral model espoused by Boehm (1988). These forms are the subject of some discussion especially in view of the prototyping and Rapid Application Development movements (King & Galliers, 1994; Kumar and Welke, 1992; Oivo & Basili, 1992; Tate & Verner, 1990; Wilson, 1993a). A form possibly indicating more virtuosity suggests the permissibility of a “drop down” activity with jumps forward to test feasibility of particular coding. If the situation is apparently chaotic with iterations forward and backwards it needs to be asked whether the form is used because of great skill in meeting the exigencies of the situation or because of an inability to plan and assert the benefits of a more orderly approach? The former case would be classed as the most mature state whereas the latter would be classed as the least mature state on this dimension.

The third dimension in the methodology class is that of paradigm diversity. Here the term paradigm is being used to refer to the model types that the practitioner uses to investigate the problem area and construct solutions. In Information Systems Development, typically such models are defined by their focus on data structures (Bachman, 1969; Chen, 1976; Codd, 1970; Dijkstra, 1968; Finkelstein, 1989; Orr, 1977; Ross, 1977; Warnier, 1974), objects (Booch, 1986; Coad & Yourdon, 1990, 1991; Lockemann, 1989; Rumbaugh J et al, 1991; Shlaer & Mellor, 1988, Wirfs-Brock & Johnson, 1990; Won, 1990), state-transitions (Ward & Mellor, 1985) or information flows (Constantine & Yourdon, 1979; De Marco, 1978; Stevens et al, 1974). There is much comparative discussion amongst these paradigms (Cameron et al, 1991; Klein & Hirschheim, 1987; McDermid, 1987; Necco et al, 1987; Olle W T et al, 1991; Poo, 1991; Smithson, 1991; Sutcliffe, 1991). The situation might be thought of as least mature where one paradigm dominates all phases of the life-cycle. However, in

the case of the object paradigm this may be misleading since that paradigm includes elements of at least two of the others. The next level of maturity would be where each phase is dominated by the particular paradigm most appropriate for dealing with the tasks of that particular stage. For instance it may be most appropriate to investigate the problem area by initially viewing the data flows whereas constructing the data structures may be the most appropriate design foundation. A more advanced state would be indicated where several orthogonal views are defined in certain stages, especially analysis, and reconciled to ascertain veracity. If this were done in all stages it could be viewed as a further point towards maturity along the dimension.

7.2.3 Candidate Dimensions of the Model - User involvement.

The involvement of end users is one of the most crucial factors for systems acceptance and success in Information Systems Development. It is unimaginable that a model could be constructed without taking this important factor into account. The importance of user-involvement in IS development was not always strongly appreciated however an irrefutable movement advocating the consideration of user views has grown from early beginnings (Mumford,1971; Mumford and Weir, 1979) founded on the socio-technical systems movement (Trist et al, 1963). This movement has evolved into a participative systems development movement (Hirschheim, 1986, Land & Hirschheim, 1983; Tait & Vessey, 1988; Wilson 1993a) and finds resonance with Scandinavian practice (Bansler, 1989). With the availability of Fourth Generation Languages, packaged end-user software and Database Management systems and user-friendly interfaces another user-involving movement has been enabled around prototyping (Alavi, 1984; Mayhew & Dearnley,1987; Tate, 1990; Tate & Verner, 1990; Wilson 1993a).

The least mature state on this dimension is thought to be where the developer dominates the design process making most decisions after commissioning. A similar situation may be asserted to apply in a situation where a particular system is dictated for use by senior management without regard to local peculiarities or sensitivities. Barely one state higher is the situation where the user involvement is tacit, evidenced by displayed attitudes to the user or user enunciated dissatisfaction. Where mechanisms for involving the user (e.g. prototyping, walk-throughs) are frequently invoked or invoked but only in part of the life-cycle, there is a more mature state. The most mature state may be where mechanisms for involving the user are always invoked and systems are usually user designed or user implemented using appropriate tools.

7.2.4 Candidate Dimensions of the Model - Automation.

Earliest attempts at automating Information Systems go back through the generational model in the language dimension. In the 1970's a number of projects attempted to harness the computer's power in IS work (Waters, 1979, pp107 -110). Very few of those were translated from research to successful commercial products at the time except for the development of a Problem Statement Language (PSL) (Teichrow & Hershey, 1977). More recently, through the emergence of Fourth Generation Languages and Computer Aided Systems or Software Engineering (CASE) tools the dream is rekindling to a certain extent. Some took a missionary zeal to the promotion of these tools (Martin, 1984; McLure, 1989; Rudolph, 1983). This was perhaps justified in the case of the Fourth Generation Languages which would appear to have found their niche for the generation of new systems and the facilitation of end-user querying of organisational databases. With CASE the success is not so clear cut. A number of authors take a neutral stance portraying what can be (Avison et al, 1992; Bader et al, 1987; Bachman, 1988; Banker & Kaufmann, 1991; Fischer, 1992; King &

Galliers, 1994; Robinson, 1991; Rock-Evans & Engelen, 1989; Tate et al, 1992) or give guidance to successful use (Corbitt & Norman, 1991; Hughes & Clark, 1990; Wilson, 1990). Another set of authors appear to raise a question mark over the appropriateness of the tools (Brooks, 1988; Conner & Vaughan, 1992; Burkhard & Jenster, 1989; Howard & Rai, 1993; King, 1991; Stobbart et al, 1991)

At this stage it may be noted that most of the dimensions fall neatly into having four identifiable points. This researcher recognises that he may be unduly influenced by this coincidence in selecting points for the automation dimension in an effort to perceive four points. However, it is not unreasonable that a given dimension of a maturity model may hold a null value for certain of the stages especially those stages at the extremes of the model.

The first state of the automation dimension is believed to be the null state answered by the question - is there no automation other than compilers? Whether the next state is really an increment or should be regarded also as the null state is open to question. This is the state which is answered by the question - are they using Word Processors and Drawing tools in a non-integrated manner? The first real signs of automation are at the adoption of a toolset. This may include CASE tools or code generators integrated with the development process. A higher state would be a toolset integrated with the operational databases and communications processors. Of course, various degrees of integration may be exhibited in the third stage here.

7.2.5 Candidate Dimensions of the Model - Metrics and Quality Control

Finally the concepts of Metrics and Quality Control would appear to offer a dimension through which Information Systems Development Maturity may be viewed.

Although metrics may be used for purposes other than quality assessment such as cost estimation (Hcemstra, 1992) metrics and quality are inextricably linked. The proponents of the quality movement assert that quality can only be assessed through measurement. Quality assessment has come to centre on the enactment of the IS development process (Deeming, 1982; Humphrey 1988). Metrics are proposed which hope to objectively measure where this process is being enacted optimally (Shepperd, 1992). A major problem facing the metrics movement is the chameleon like nature of the IS development field. By nature metrics are a “following” phenomenon. They cannot be established *a priori* but are constructed from observation of practice. While many current metrics are rooted in traditional practice it is necessary for emerging paradigms to develop new metrics (Chidanber & Kemerer, 1991) otherwise apples would be measured as if they were oranges.

The lowest end of this maturity dimension is where there are no quality control procedures in place. Moving up from this situation we might expect to find organisations where the act of collecting metrics by itself provides sufficient improvement to the situation such that their analysis does not bring greater benefit. Where management makes formal use of metrics and has built sufficient historical data to be able to make meaningful analyses, improving their management and estimating procedures, then a fairly mature stage will have been reached. This would be viewed as one point below a situation of quality management approved by an external body such as the British Standard Authority or International Standards Organisation.

7.3 The development and use of the Case Study Protocol.

The need for the case study protocol was explained in Chapter 3. It served as a guide to the fact finding exercise which took place with the organisations which were

co-operating in the research. Since it had been possible to identify a number of relevant dimensions and identifiable points thereon, these formed the main substance of the protocol. As Yin (1989a) suggests, the protocol is composed not of questions to representatives of the organisation but rather questions to the researcher. In this way the researcher acts as a filter to the biases and internal politics in which some respondents may indulge. A process of triangulation, verifying factual data from several sources, is sought. In this research all notes made of information gathered from individuals were sent to the individuals in question and they were invited to correct any mis-conceptions which had arisen. Later the collated version of the case material was sent to the most Senior Managers responding in each organisation. At this point two of the organisations asked that the organisation be disguised and one manager, in an undisguised organisation, sought to modify information supplied by one of his subordinates. Because the information in question was partly an opinion and the Senior Manager stated that the paradigm involved may be taken on-board in the future, the modified version was allowed to stand. The information gathered, therefore, has been triangulated by cross-reference within the organisation which it comes from. The protocol has proved a useful instrument for guiding the data collection.

The protocol, shown at Appendix 4, is derived mainly by framing the postulations at paragraphs 7.2.1 through 7.2.5 above as questions to the researcher. The purpose of framing the model was to enable the promulgation of meaningful recommendations for the change of Information Systems Development practice. Hence the researcher believed it to be opportune to ask himself a number of questions concerning the management of change in the organisations which were co-operating. It was sought to discover how the organisation generally managed change and whether different methods or styles were used amongst IS developers from those in the

organisation as a whole. Further it was hoped to discover whether the participants were guided by a particular model that they were conscious of. Also it was sought to discover whether the process is particularly “Asian” i.e. markedly different from models found in the Western literature (Lewin, 1947; Schein, 1964; Scarborough & Corbett, 1992; Wilson, 1992.) If that were the case was the difference traceable to oriental philosophical underpinnings? In retrospect, whilst the protocol was used as a search for points on various dimensions, another approach would have been to gather and hermeneutically analyse “war stories” of actual changes amongst Information Systems developers. Attempts could then be made to analyse the components of the stories to see whether they relate to states of the model. This approach is noted for future action in Chapter 9. It is believed, however, that the “war stories” approach would not have worked well in Asia. This is because it seems likely that managers would be less willing to discuss conflict than their counterparts may be in other societies. This belief is supported by a succinct statement from the comparative psychology literature:

“The difference between East and West can be interpreted in terms of their divergence on cultural values surrounding affiliation. In Chinese culture, where collectivism and interpersonal “dependency” are highly valued, an individual’s concerns about establishing, maintaining and improving interpersonal relationships can be viewed as desirable traits, which make him attractive to others or to himself. On the contrary, in Western culture, which sets high values on individualism and independence, a strong affiliative tendency can be perceived as a weakness which consequently decreases an individual’s interpersonal attractiveness.”

Bond & Hwang in Bond, 1986. p241.

Whilst this state of affairs indicates significant difficulties in using many means of social investigation in the East, a means, such as the hermeneutic analysis of “war stories” that uses as its starting point, voluntary enunciation of conflict, is going to meet with great difficulty in Asia although this approach may work better in the West.

7.4 Ancillary Activities and the Actual Path Taken

As with the 1987 questionnaire, the revised 1993 questionnaire was piloted by the cohort of approximately 100 Honours Bachelor in Computing students who had been placed during the twelve month period beginning June 1992 in IS developing organisations. The pilot exercise was performed on their return to the final year of their course in October 1993. This exercise was particularly helpful in highlighting confusions which might arise by over drastically reducing what was asked for. The students pointed out that the respondents may not know precisely what should have been reported previously. In some questions asking for the whole current picture rather than the difference from 1987 was more likely to produce a reliable response.

As stated in the proposal, case studies were to be built illustrating the change process in IS development practice. Following Pettigrew's (1989) exhortation to study extreme cases (Pettigrew, 1989), access was first sought to those sites in the 1993 response population judged to be most volatile in the application of IS development approaches, methodologies, techniques and tools. Also response was sought from some sites where the opposite is true as well as some from the centre of this dimension. In order to identify the preferred targets for these cases it was decided initially to concentrate on the information given in response to question 6.1. Originally the question consisted of a matrix in which the respondent was asked to indicate the development

methods most commonly used. In 1987 the columns were headed "Systems Analysis", "Systems Design", and "Program Development". In 1993 the words "Program Development" were replaced with "Implementation" and a new column was added headed "Strategic IS Planning". The first of those changes reflects the growing emphasis being placed on holistic systems development by information systems development managers. It also reflects a belief that many respondents, whilst developing software artefacts, such as database schemata, communications protocols and query structures, may not view this activity strictly as "Program Development". The second addition reflected the growing awareness of methods of aligning the development of information infrastructures and data processing facilities to organisational strategic plans. Finally the questionnaires were dispatched and analysed on their return as reported in 8.3 where it is explained why the response to the self-selected Nolan stage was included in the organisation selection. Since only rapid adapters consented to further study (which is an interesting finding in itself) the instantiation of the plan shown at figure 6.1 was as is shown as the shaded area of Figure 7.1 below.

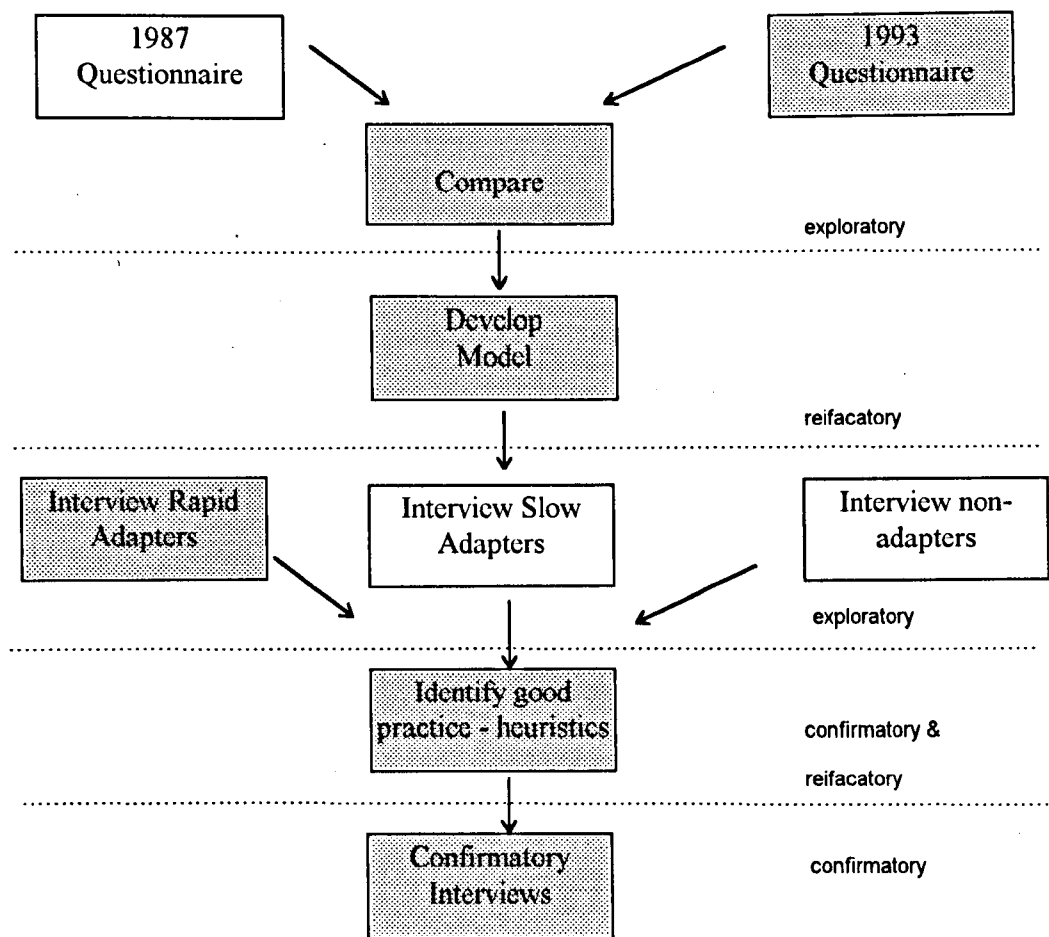


Figure 7.1 Schematic representation of the research plan shaded to show what was actually carried out, identifying the nature of the phases of the research

Interviews were not carried out cold. The protocol was used to ensure consistency between the interviews and before each interview self briefing was performed so that the effectiveness of the interviews was enhanced. Any available sources of information on the organisation to be visited were reviewed. Both questionnaires from the organisation were reviewed. Other particularly useful sources of information were the Asian computing directories (Barty, 1982 & 1990), reports written by students placed in the organisations, notes of interviews with such students, and cuttings from the Hong Kong and Asian computing press. This enhanced the effectiveness of the interviews because before the interviewer met the interviewee there was already some awareness of the scale of the development operation, numbers of staff

involved in IS development, jargon favoured by the respondents, development tools in place, projects in which there was particular pride as well as other interesting points.

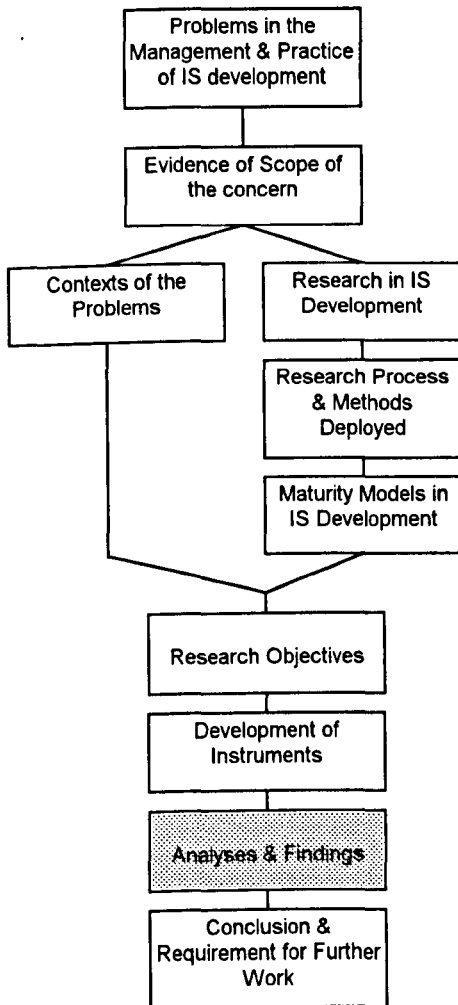
There was a variation in engagement amongst the various organisations. At the Computer Services Company (see Appendix 1.1) multiple interviews were carried out with the Director of Professional Services followed by interviews with all the staff reporting to him. These were 5 Senior Managers whose duties ranged from marketing a complex Decision Support/Database product sourced from the United Kingdom to the day-to-day relationship with a large banking client requiring bureau and outsourcing services. Following the interviews, interview reports were agreed and the company requested a training consultancy to be performed by the researcher in appreciation of the access obtained. At HACTL (see Appendix 1.2) the briefing material included notes and a video tape, shot by this researcher, during an installation visit to the company in 1991, organised by the Hong Kong Computing Society (HKCS). Interviews were carried out with the Deputy Managing Director and the General Manager (IS Services). Interview notes were agreed with minor revisions and a follow-up interview was performed with the General Manager (IS Services) one year later. At the recreational club (see Appendix 1.3) multiple interviews were conducted with the Assistant General Manager who agreed the interview records. A follow-up interview was held with the EDP Manager a year later. The Jockey Club respondent was the Research and Planning Controller in the Information Technology Directorate (see Appendix 1.4). Preparation for the interview included notes from an installation visit to the Club organised by the HKCS in 1991. Further interviews proved impossible to arrange and comment was not received on the interview record. However, a significant amount of documented material was received during the interview. At great deal more contact was possible with the Chekiang Bank (see Appendix 1.5). Multiple interviews were held with the General

Manager, EDP who arranged further interviews with the Assistant General Manager and a Systems Analyst. Interview records were agreed after minor changes. This contrasted with the Shanghai Commercial Bank (see Appendix 1.6). It was only possible to interview a Senior Manager in the EDP department who raised no comments on the interview record sent to him.

7.5 Summary

This chapter has explained the logic behind the activities of the research. The reason for re-issuing the questionnaire is given. The changes made to the questionnaire are explained and the use of surrogates for testing the questionnaire is described. Next the development of the candidate Maturity Model is dealt with and this is shown to spring from a large body of literature in the IS field including that identified in Chapter 6. This leads to the development of the case study protocol. It has been mentioned that sources other than the case study interviews were used as briefing material before the interviews were executed. Finally the actual path taken by the research vis-a-vis the research proposal is detailed diagrammatically. The next chapter gives an analysis of the information collected both in the questionnaires and during the case study interviews.

Chapter Eight - Synopsis



Previous chapters explained the grounding of the research, setting of objectives and research questions, the building of the candidate model and revision of the questionnaire and development of the candidate model and case study protocol.

This chapter explains in detail how the data collected has been analysed. From comparison of the questionnaires there have emerged three significant substantiations and evidence to suggest a link between support for Nolan's theory and the concept of a learning organisation.

8. Analyses and Findings

8.1 Changes since 1987

Since the questionnaire was minimally adjusted, a wealth of information not particularly pertinent to the central quest of the research, but rather, pertaining to aspects of the environment of the phenomena being examined, was gathered as a by-product. The most striking findings are presented at this point. It should be mentioned here that some trouble has been exercised to make the comparisons very strictly like with like. This differs from and is superior to, comparisons of findings where similar target populations in the same locality were polled at different times. In the comparisons which follow responses were obtained from the persons fulfilling the same role in the organisation (the person with closest overall responsibility for Information Systems Development) as the original respondent. In 40% of the responses this was the same person. In only 1 of the 6 most volatile companies where the case study was carried out was the incumbent a different person, the original respondent having been promoted. The comparisons are between the responses in 1987 of those organisations who also responded in 1993 so that actual changes are being perceived and reported rather than changes in trends. It is also possible, of course, if it were desired to perceive changes in trends, to compare the full response of 1987 with the response of 1993 on a percentage basis. However, this would not be as true a comparison as there may be characteristics of the population not responding which would skew the result. The main purpose of the comparison of the longitudinal data was to discover which organisations were volatile in their approach to Information Systems Development as well as those which were conservative. In other words the main purpose of the longitudinal comparison was to order the respondent organisations with respect to the dynamism of their change in Information Systems Development practice.

8.2 Findings from the longitudinal comparison of the questionnaires.

What has been found from the comparison of the responses between 1987 and 1993 is:-

1. substantiation of the change of processor deployment profile between the samples;
 2. substantiation of the change in file structure usage between the samples;
 3. substantiation of the change in language usage between the samples;
- and
4. evidence suggesting that organisations where organisational learning is widely trusted are likely to reach higher levels in Nolan's model.

Together these changes may be taken as strong evidence that between the two questionnaires the Hong Kong IS development community underwent a generational change of the type identified by Couger (1982). It is believed that further substantiation of this change is apparent from the number of respondents reporting regression on the Nolan (1979) model between the questionnaires. A plausible explanation for a high incidence of perceived regression would be that the organisations had moved to a new generation in technological dimensions but the turbulence in organisational relationships because of the changes had caused them to regress in the IS management dimension which Nolan's theory makes explicit.

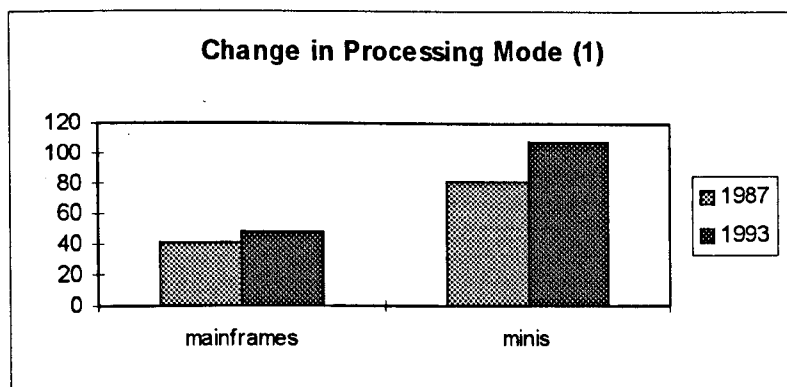


Figure 8.1a Changes in numbers of types of processors 1987 to 1993 Note the change of scale between figures 8.1a and 8.1b.

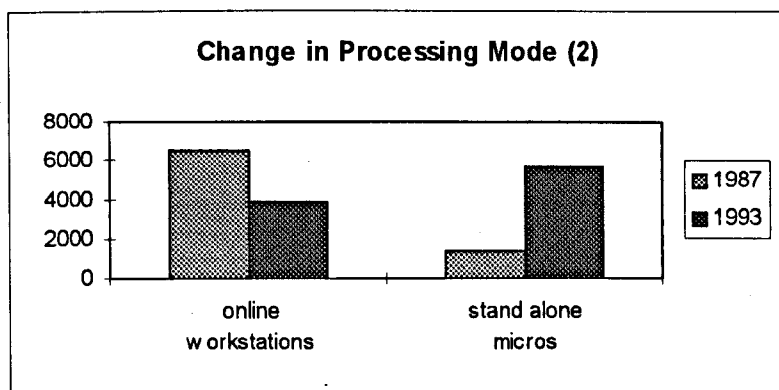


Figure 8.1b Changes in numbers of types of processors 1987 to 1993 Note the change of scale between figures 8.1a and 8.1b.

Figures 8.1a & 8.1b report the changes in numbers of the four types of information processing equipment operated by the respondents to both polls. Here the numbers of processors in use by the respondents were summed to provide the figures. It can be seen that whilst there has been some growth in the total number of mainframes and mini-computers in use there has been a dramatic turn-around in the pattern of distribution of on-line workstations as against micro-computers. This suggests that legacy systems are still demanding powerful mainframes and minis to operate on. However, whereas previously data capture and delivery of results might have been through an on-line workstation this activity is now moving to or being displaced by activities on microprocessors possibly linked by local area networks. This migration to

network processing is borne out by the responses represented in Figure 8.2. These show a mix of central and network processing attracting support from organisations which previously only used central computers, only used networks of micros and, in greatest numbers, organisations which had previously used central and remote resources.

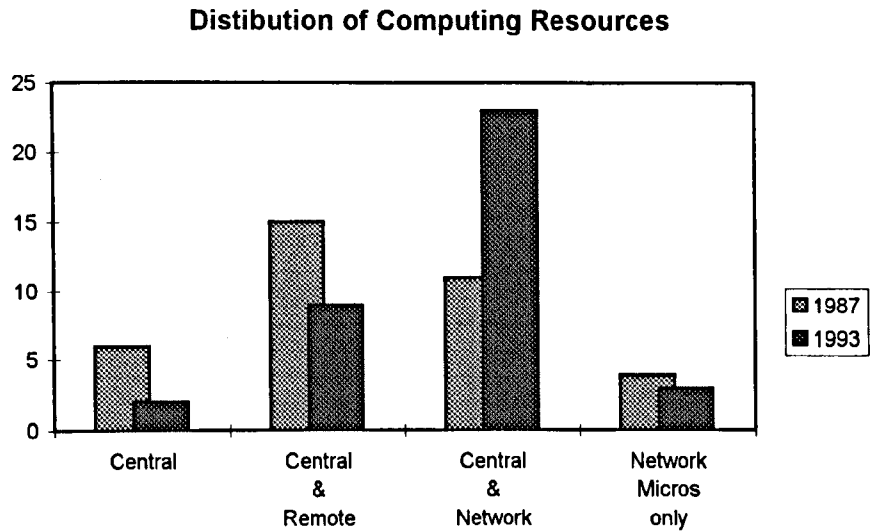


Figure 8.2 Number of organisations using particular hardware deployments

Hand-in-hand with this revolution in the platforms upon which data is processed there is evidence of a major shift to the use of Fourth Generation Languages and Database retrieval languages. Fig 8.3 shows what the respondents declared to be the main languages used both in 1987 and 1993. Each instance of a mentioned language is represented in the chart. Again only responses from respondents who replied in 1993 are included.

It is apparent that if SQL were added to the column marked DBL (for Database languages) then DBL would have been the most popular language “type” reported in 1993. It might also be argued that some of the 4GLs are largely database access

languages so the shift to this kind of processing environment is very large. This has not, however, rung the death-knell for COBOL which, whilst losing a few users, is still far and away the most popular single language. Pascal and PL/1 have disappeared from this population and the number of organisations mainly using BASIC has decreased dramatically.

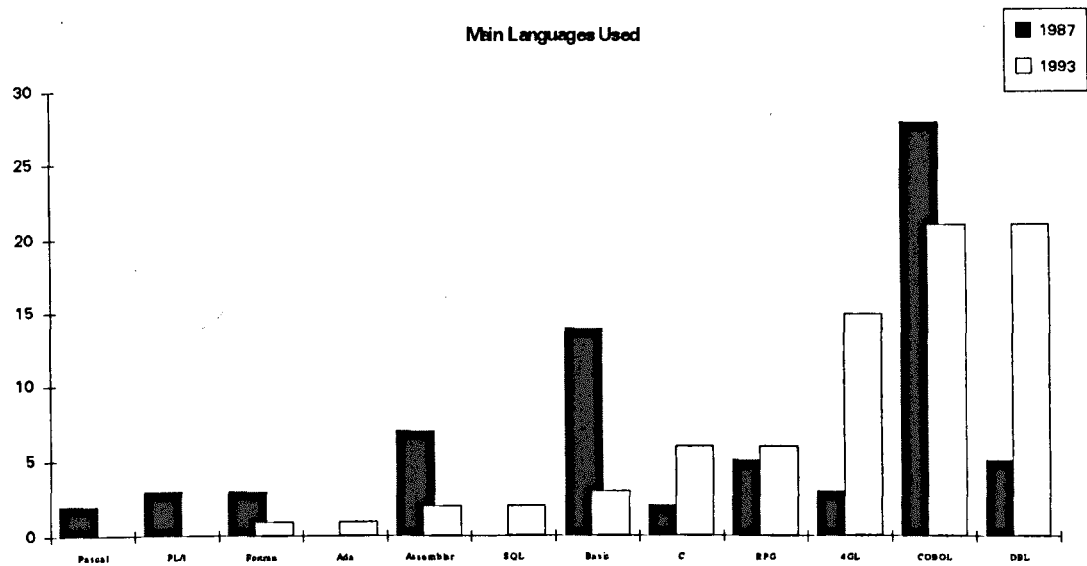


Figure 8.3 Languages stated to be main languages in use in 1987 and 1993 by 1993 respondents

These findings are supported by responses to question 4.1 which was identical in both questionnaires. The question consisted of three columns and respondents were asked to show a spread totalling 100% between three options. Figures 8.4 - 8.7 show the comparison of the responses between 1987 and 1993. Again only responses from respondents who also responded in 1993 have been used. If for a particular triplet respondents did not answer in either questionnaire their non-response is not represented in the particular histogram and the number of responses used to divide the sum of the percentage was decreased by one. Where a respondent did respond in one questionnaire but not in the other for a particular triplet, the numbers reported in the questionnaire response given were copied to the other response in order to cancel the effect of the presence of the single response. In other words an assumption of “no change” is made.

The number of cases where this procedure was followed was small. It is felt that this is a reasonable analysis strategy since what is being looked for is significant change.

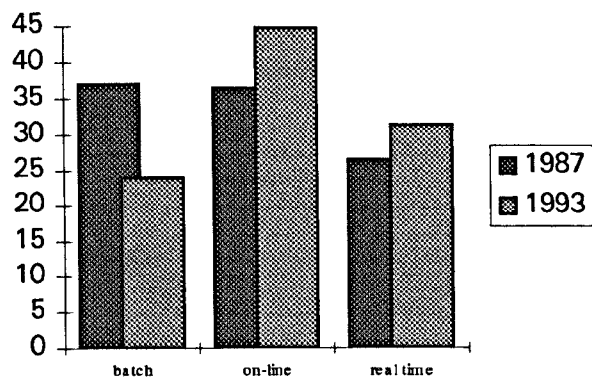


Figure 8.4 Percentage spreads of modes of processing 1987 versus 1993.

From Figure 8.4 the movement from batch processing to on-line and real-time processing is quite apparent. It has to be said that whether the respondents interpret the terms “on-line” and “real-time” in the same way as each other or as the researcher is open to question. What is not open to question is that there has been a significant shift away from batch processing in the period studied.

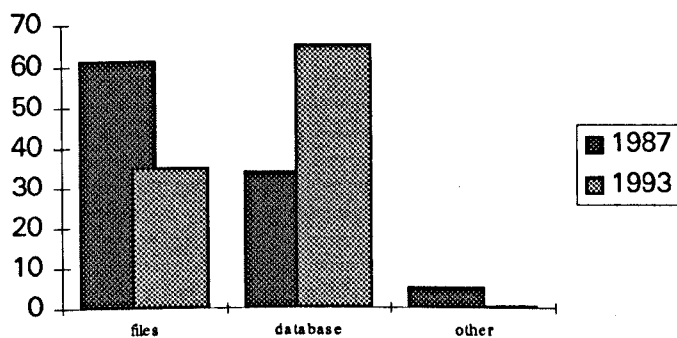


Figure 8.5 Percentage spreads of data storage methods 1987 versus 1993.

The movement away from file based processing into database processing is illustrated by figure 8.5 and supported by the movement towards database processing languages illustrated in figure 8.3. This is related to the change in the use of programming language type since many of the Fourth Generation Languages which are being introduced are database processing oriented rather than file processing oriented.

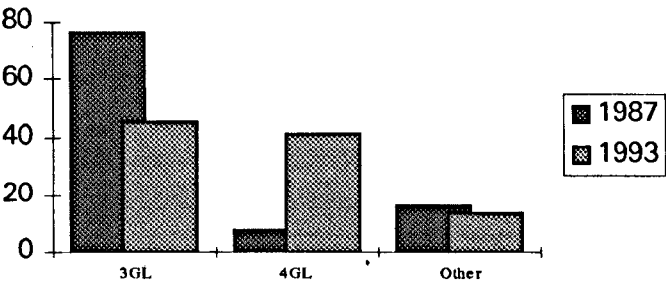


Figure 8.6 Percentage distributions of Programming Languages 1987 versus 1993.

The large change in emphasis in programming language is illustrated by Figure 8.6. Whilst there is only a small reduction in the “other” category there is a large change in emphasis from the use of third generation languages into Fourth Generation Languages. From the annotations on some of the forms the “other” languages reported were seen to be mainly Assembler. This, again, is consonant with the results reported at 8.3.

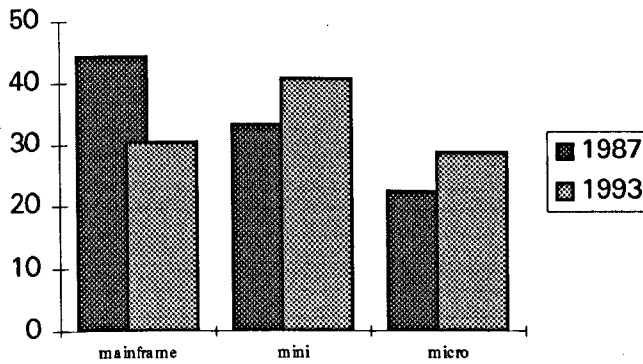


Figure 8.7 Percentage distributions of development for targeted Processing platforms 1987 versus 1993

Figure 8.7 contains a surprise. The movement in development effort away from mainframes is slightly more towards minis than towards micros although there is a rise in the effort towards micros. This may be because much of the software which will be used on micros will be proprietary packages and therefore requires integration more than development.

The overall picture emerging of the organisation of development therefore is that during the six year period there has been a significant take-up of layered product environments largely on central and network heterogeneous platforms, using databases. This is attended by significant changes in the needs for particular programming skills. This revolution has not been total and much of the previous structures remain albeit in maintenance rather than development. However, it is perhaps not too much to assert that during the period between the questionnaires there have been radical changes in IS development and processing. These change are evidenced by:-

1. changes in the processing topography (see figures 8.1b, & 8.2);
2. change from process focused languages to data focused languages (see figures 8.3 & 8.6);

3. growth in on-line and real-time processing at the expense of batch processing (see figure 8.5);
and

4. growth in the use of 4GLs at the expense of 3GLs (see figure 8.6).

The changes in question were technology enabled and are amongst the changes accommodated by Nolan's revised model (Nolan, 1984). The implications for IS development are profound. The platforms on which new and revised IS will perform are more diverse and complex than previously. Data will be stored and accessed in different ways with different languages. Much of the data will be distributed and the dangers associated with replicated databases may persist.

Figure 8.8 plots, for the companies which on both the 1987 and 1993 questionnaires reported their perceived position on the Nolan maturity model, their degree of change on that model against the control procedures reported in 1993. "Perceived position" here means the point in the Nolan Scale identified by the respondent as most accurately reflecting the company's status. Remembering that some organisations identified positions on the Nolan model between Nolan's stages it will be understood why there are 11 scale points for two polls here. These are 1 for initiation, 2 for between initiation and control, 3 for control and so on to 11 for maturity. The point at which the company is placed on the x-axis of figures 8.8 through 8.11 is derived from the difference between the number assigned to the position identified in 1987 and the number assigned to the position identified in 1993. Whilst in theory this could have given a 21 point scale (-10 to 10) it did not and only the occupied bounds are shown. The negative numbers arose because a number of companies reported a negative movement on the Nolan model and this is labelled with negative numbers on the x-axis of the figures 8.8 through 8.11. It is suggested that those companies seeming to have

move backwards may have in fact undergone the radical generational change evidenced in figures 8.1 - 8.6 above. The majority of companies reported that there were centralised procedures in place. However, it is interesting to note that of the few companies reporting a control procedure other than centralised, only one does not report progression on the maturity model and three report significant movement.

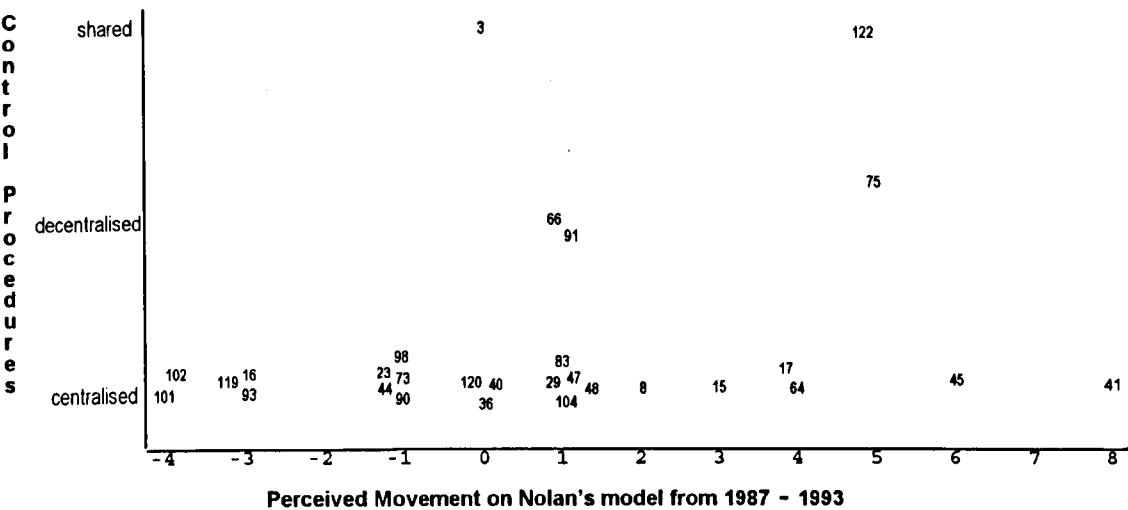


Figure 8.8 Perceived movement on Nolan's Stage model in terms of number of stages and intermediate points against Control Procedures.

No relationship was found between the perceived change in positioning in Nolan's model and formality of communication or emphasis on training. The scatter for emphasis on training is shown below at figure 8.9.

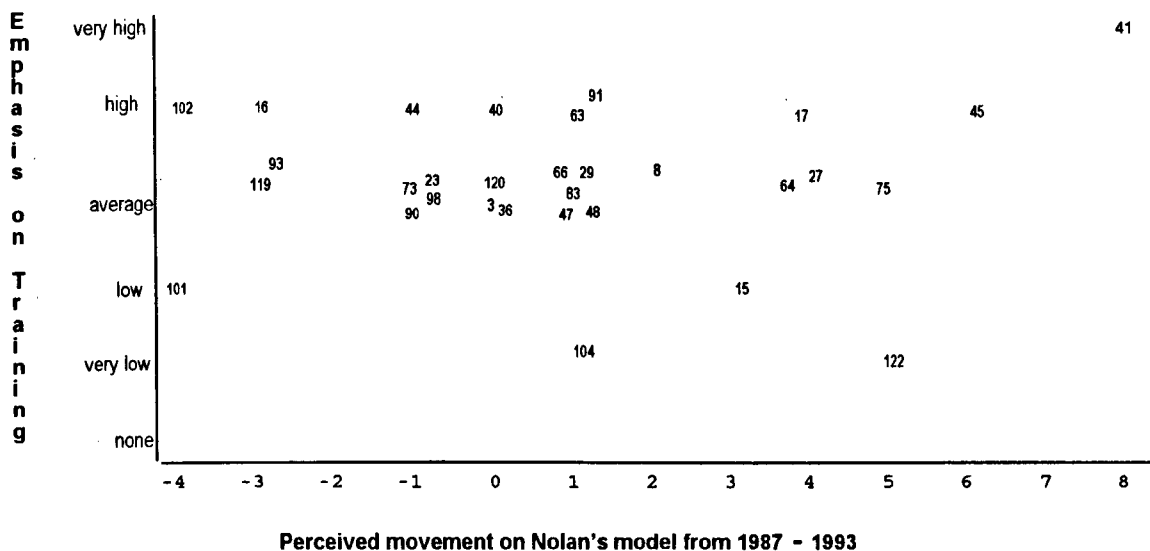


Figure 8.9 Perceived movement on Nolan's Stage model in terms of number of stages and intermediate points against Emphasis on Training.

No relationship was found between the change in perceived Nolan position and the perception of the veracity of Taylor's (1911) views or the view expressed from the writings of Scarborough & Corbett (1992.)

However, when the perceived movement on Nolan's Stage model is plotted against belief in the concept of the Learning Organisation, as in Figure 8.9, it is seen that, whilst most respondents cluster around the central response, a significant number of those whose responses indicated great movement up the Nolan maturity model also report a widespread belief within the organisation in the concept of the learning organisation. This would suggest that the dissemination of the concept of the learning organisation facilitates maturity in Nolan's terms.

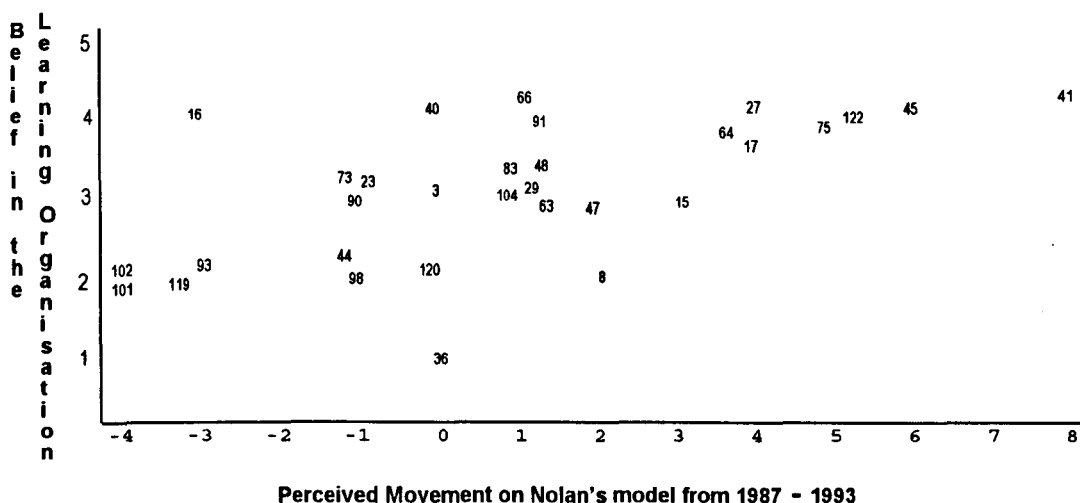


Figure 8.10 Perceived movement on Nolan's Stage model in terms of number of stages and intermediate points against belief in the Learning Organisation

8.3 Selecting Target Organisations for Case Study.

As stated in the proposal, case studies were to be built illustrating the change process in Information Systems Development practice. Pettigrew's (1989) exhortation to study extreme cases would be followed. Access would first be sought to those sites in the 1993 response population judged to be highly volatile in the application of Information Systems Development approaches, methodologies, techniques and tools as well as some sites where the opposite was true. In order to identify the preferred targets for these studies it was decided initially to concentrate on the information given in response to question 6.1. Originally the question consisted of a matrix in which the respondent was asked to indicate the development methods most commonly used. In 1987 the columns were headed "Systems Analysis", "Systems Design", and "Program Development". In 1993 the words "Program Development" were replaced with "Implementation" and a new column was added headed "Strategic IS Planning". As indicated in Chapter 5, the first of those changes reflects the growing emphasis being placed on holistic systems development by Information Systems Development managers. A belief that many respondents, whilst developing software artefacts, such as

database schemata, communications protocols and query structures, may not view this activity strictly as "Program Development" is also reflected. The second addition reflects the growing awareness of methods of aligning the development of information infrastructures and data processing facilities to strategic needs.

Similarly a number of rows were added. Only one of these, "Prototyping", had been included by respondents to the 1987 questionnaire, under the "other" option, justifying an assertion that there was not a wide awareness of the usefulness of the other additional methods in 1987. The rows added were labelled "Prototyping", "Soft Systems Methods", "Rapid Development Methods" and "Object-oriented Methods".

There is now a dilemma in attempting to find those organisations that have most rapidly changed. Should the responses to the new items be considered? Such an act would habilitate the assumption that if they are now in use they have been adopted since 1987. Conversely, should the comparison be strictly limited to items explicitly included in both questionnaires? Since this activity is a process of determining a rating indicating the aforesaid volatility of members in the set of 1993 respondents, it was decided to derive two such scores that were converted into ranks. That is, the organisation whose respondent appears to claim to have changed most, was ranked 1. The organisation whose respondent appears to claim to have changed least, was ranked 37 (one of the 38, 1993 respondents did not answer this section) unless of course that position is shared with a number of others. If there were two such others the position would be 35 and so on.

To determine the rank, matrices were constructed reflecting the respondents' answers. A matrix was required where it would be apparent whether the respondent had

indicated the use of a particular method, tool or technique only in 1987, only in 1993, in both, or not at all. To obtain this matrix responses in 1987 were given the arbitrary value "1" and responses in 1993 were given the arbitrary value "2". Intermediate matrices were loaded with these values and these intermediate matrices were added together so that the following statements were true of the final matrix. If there was no value in a cell it meant the respondent did not use the method, tool or technique in either 1987 or 1993. If the value in the cell was "1", then the method tool or technique was used in 1987 but not in 1993. If the value in the cell was "2", then the method tool or technique was used in 1993 but not in 1987. If the value in the cell was "3", then the method tool or technique was used in both 1987 and in 1993. The score, reflecting the amount of change therefore, for each respondent, is the count of the number of "1"s or "2"s for each respondent. The number of "0" and "3" indicate the number of methods tools or techniques which have not been adopted (1) or were in use both in 1987 and 1993 (3). This second count, indicating "no change" was used to check that all cells had been processed.

Ranks were derived which took account of both a strict comparison of the responses, that is only comparing responses to questions that had been asked in both surveys, and a loose comparison where the response to the new questions in the 1993 survey is assumed to have been zero had it been asked. The reasons for failure to enquire at the earlier stage are as follows. Firstly, it was assumed that there was not a wide awareness of the method or the activity at the time. Secondly, the respondents did not include the methods under the "other" category. At this point it was noted that 5 of the top 6 organisations perceived to be most volatile, through this perspective, had tendered questionnaires completed by different incumbents in 1993 of the position responding to the questionnaire in 1987. It was felt that some respondents may have

interpreted the question in terms of "mainly in use" whereas the other incumbent may have interpreted the question more widely. It was felt that other evidence of volatility should be sought and that the responses of the same respondent should be given more value than those of different respondents.

For these reasons the responses to question 7.1 were added in to the process. Originally this question had asked respondents to indicate their perceived position on Nolan's (1984) maturity model of information systems in organisations. In 1987 many respondents had placed responses against two contiguous stages in the model and this was taken to mean that they believed themselves to be in transition between stages. In 1993 this kind of response was accommodated with actual response positions on the questionnaire to indicate both the stages and transition point between them. Since the model is a six stage model there were therefore 11 possible responses. Numbering the responses from 1 - 11 and subtracting the 1987 response from the 1993 response it was clear which organisations perceived that they had moved most in Nolan's model.

8.3.1 Weighting

It is recognised that the weighting process is somewhat arbitrary. Clearly the "strict" (as the term is used above i.e. looking only at criteria explicitly on both questionnaires) responses should count more than the loose ones but by how much? Also responses from the same respondent should count more than those from different persons albeit in the same post. However, if we apply a multiplier for this situation we must bear in mind that we are applying it to three sets of data and therefore its effect is trebled. It was decided to examine the data twice firstly putting twice as much emphasis and then three times as much emphasis on the "strict" difference in responses as on the "loose" difference in responses to question 6.1. Responses to question 7.1 were given

the same weight as the loose interpretation of responses to question 6.1. Responses by the same respondent were treated as twice as valuable as those from different incumbents of the same post. The "final factor" below therefore is derived with the formula $S(N+2s+1)$ where S is 2 if the questionnaires are completed by the same respondent and 1 if they are completed by different respondents, N is the absolute difference between the points on the 11 point scale derived from Nolan's stages theory, " s " is the amount of difference only looking at the approaches, methods, tools and techniques explicitly on both questionnaires and " 1 " is the difference taking into account the approaches, methods, tools and techniques introduced on the second questionnaire.

Examining the resulting tables (figures 8.11 and 8.12 below) a break in the results was found. We saw that at the "most volatile" end of the table where the "strict" factor is weighted by two there is a break of two points after the "most volatile" seven, the last two scoring the same. At the conservative end of the spectrum three organisations stand out as having changed their practice and their perception of their practice least. Referring back to the names of the organisations it was found that there was an interesting pair. Both sets, "trend-setters" and "conservatives", contain an organisation that provides outsourcing services. It was decided to approach these organisations first as obviously an opportunity to perform a close comparison may have existed. In the event, one of the outsourcing organisations did not consent to participate in the Case Study phase of the research. Attempts were made to gain further access to organisations which were contacted sequentially from the top seven and bottom five of the volatility ranking.

Company Code	Final Factor
23	76
45	60
87	46
17	46
90	42
66	40
44	40
115	38

Table 8.1 The most volatile respondents

Company Code	Final Factor
75	12
83	10
91	6
80	5
8	2
50	1
9	0

Table 8.2 The least volatile respondents

None of the less volatile organisations were willing to participate further but of the top seven only the organisation coded “66” was unwilling to participate in Case Study research. Therefore case study research was carried out with six of the seven most volatile organisations in the population.

During the volatility analysis several correlations were tried on the population. These are shown in figures 8.11, 8.12 and 8.13.

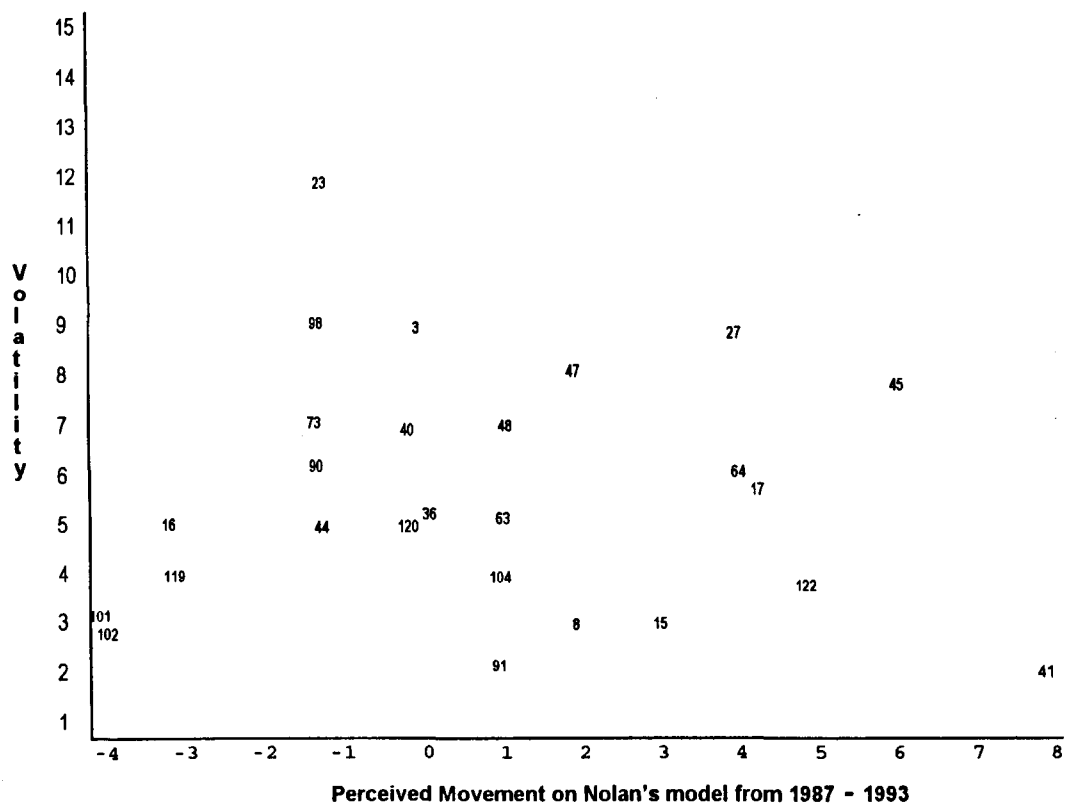


Figure 8.11 Perceived movement on Nolan's Stage model in terms of number of stages and intermediate points against volatility in change of Development Methods

In figure 8.11 there is a tendency of a cluster round non-change in Nolan's terms and low to middling volatility in relation to change in development methods as might be expected. However the extremes are more interesting. The organisation reporting most progress is a small operation, new to computing in 1987, led by an IT enthusiast. This runs counter to the finding of Chan (1993), that computer literacy enthusiasts are not the most useful End-user representatives. Chan (ibid.) ascribes his finding to the imbalance of enthusiast's views and tendencies to focus on facilities of the tools being selected rather than the use to which the technology is put. A different factor here is that the respondent identified as 41 above had control of the DP budget whereas in the implementations looked at by Chan the enthusiasts were treated as End-user representatives. Also Chan's investigation was in a large Engineering oriented organisation. This area is one where further case studies might prove useful. The five organisations clustered in the bottom left are an extremely diverse group comprising some of the biggest and smallest companies in Hong Kong, in some of the most mature

and immature industries. The conclusion that conservatism in change of systems development is related to regression on the Nolan model for many types and sizes of organisations at the early stages is supported also by the fact that this cluster is not reflected at other corners of the plane.

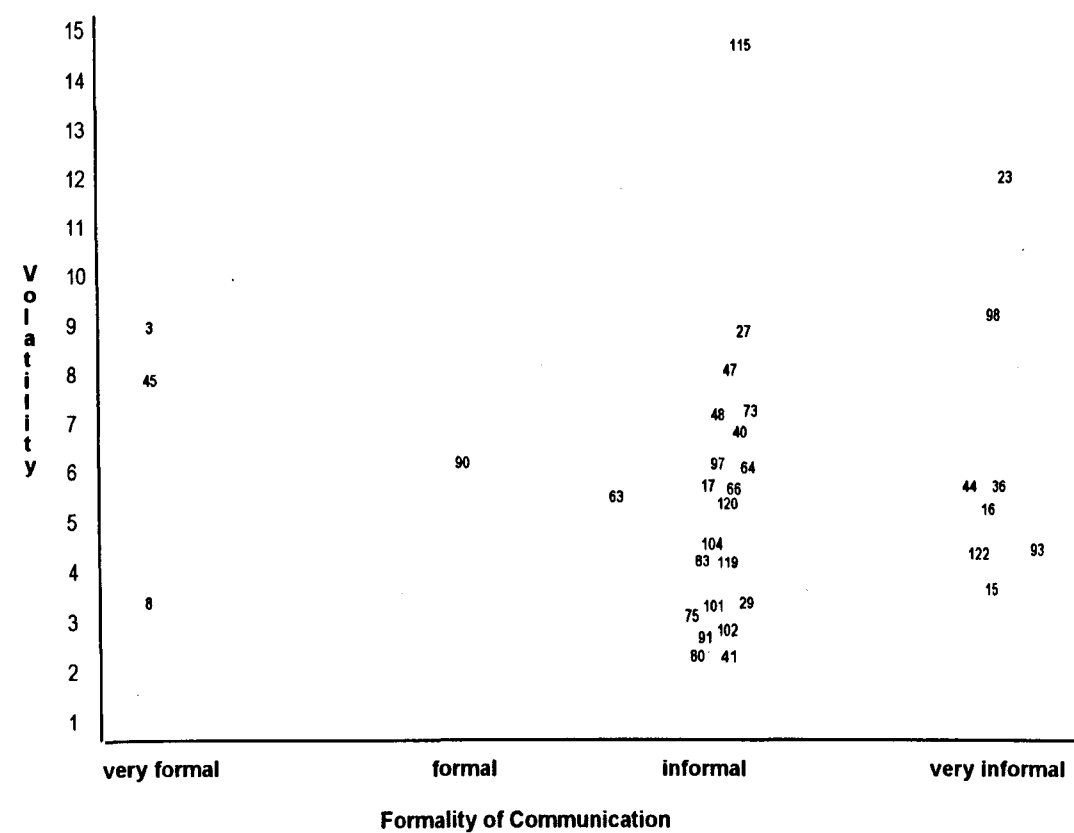


Fig 8.12 Volatility against formality of communication

There is an expectancy flowing from the work of Burns & Stalker (1961), whose research initially took place in Central Scotland, of an association between informality of communication and volatility in the adoption of new methods in Information Systems Development. This expectancy is partially substantiated since the most volatile are amongst those organisations reporting the highest levels of informality in communication. However, there are many more organisations reporting low volatility but the same highest level of informality in communications. A partial explanation is found in figure 8.13 where it will be noticed that the bulk of the respondents expressed agreement that the view that

“organisational change is brought about mainly and simply through the direction of Management”

was widely held or held somewhat. It is of course impossible to turn the clock back to the late 1950’s but even in today’s Central Scotland, it is unlikely that we would find such widespread agreement with this statement. There is an opportunity for further cross cultural comparison - particularly interesting in view of the importance of the work ethic amongst both Confucian and Calvinistic cultures.

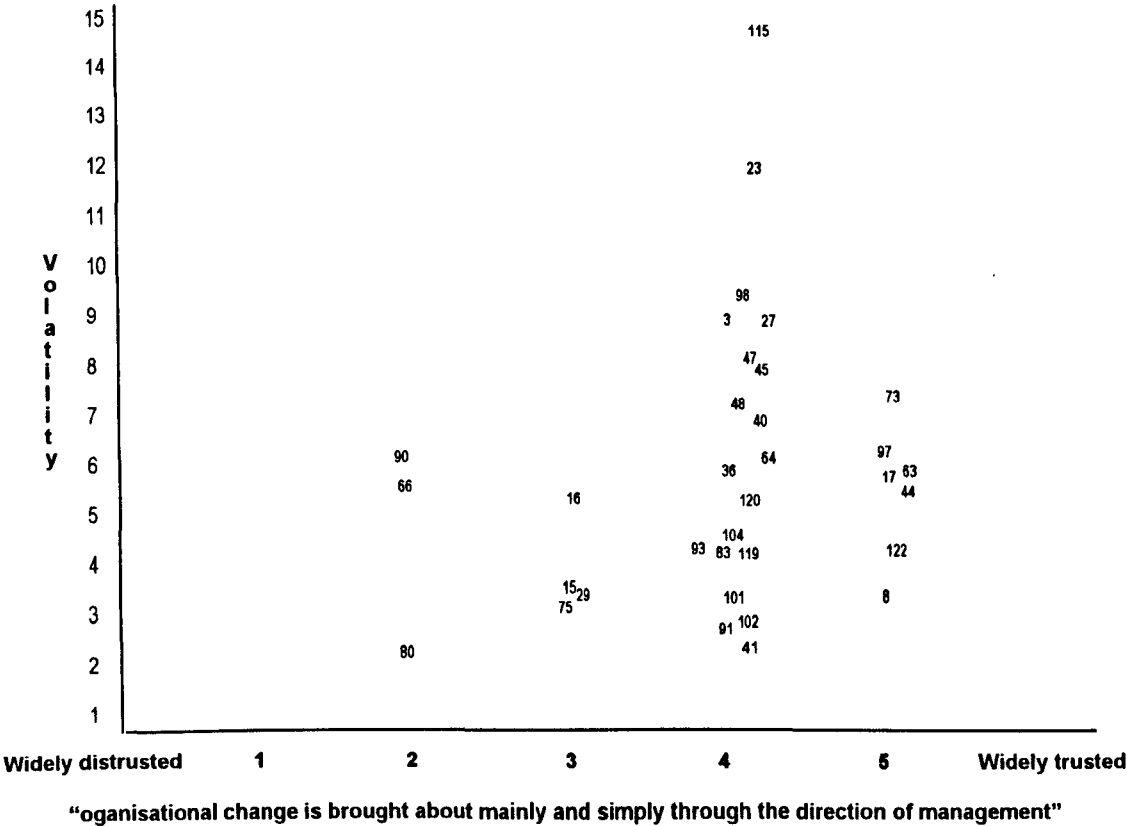


Fig 8.13 Agreement with statement against volatility

The preceding analyses are a quick attempt to find associations between the factors reported on the questionnaires. This is especially with respect to the volatility of the organisations in respect of their adoption of emerging approaches, methods, tools and techniques of Information Systems Development. In fact few associations have been

found but some valuable insights into the design and use of longitudinal instruments have been obtained. These were outlined in Chapter 7.

In summary a plethora of detailed information has been obtained from the comparison of responses from holders of the same positions (usually the executive responsible for the IS function) in the same Hong Kong organisations. The focus of the analysis has been the change in these responses and it has clearly shown that between the responses there has been a widespread change in the environment in which IS development is practised.

8.4 Findings from the Case Studies

The main purpose of the longitudinal aspect of the research, that is repeating a previously executed questionnaire data collection, was to find volatile and conservative organisations in which further exploratory case study could be performed with a view to substantiating partially the theoretical framework, i.e. the maturity model conjectured from an interpretation of the literature. In the event, as indicated above, only volatile organisations were willing to participate in deeper study. Thus any results must be interpreted in the light that they are obtained from the high end of the spectrum of the rate of change in adoption of approaches, methods, tools and techniques of Information Systems Development in Hong Kong. The unwillingness to co-operate in prolonged study may be a facet of conservative organisations, but since only three such organisations were approached, experience from other research programs as to whether conservative organisations have a greater tendency to secrecy, as might be expected, could be sought.

Case study research as it is used here is an ideographic method. Multiple facets of significant objects or events are intensively studied in their context and successful practice may be assessed in relation to the likelihood of its replicability. As in the interpretation of Chinese ideograms where several characters are juxtaposed each with its own meaning so that the interplay of the meanings suggest a more sophisticated concept, no particular facet of the ideograph is presumed at the outset to be dominant. Here the analysis will firstly take each facet from the ideograph and assess how the questions of the protocol have been answered. Such answers are not proofs but evidence of trends and tendencies. The answers may also be indicators to further areas of enquiry. This is different from nomothetic research where the objective is to discern laws which will hold in given circumstances. Results from nomothetic research may be expressed with greater confidence than those from ideographic research but when the area of interest is highly volatile quickly maturing technologies, the numbers of instances of the particular phenomena to be studied will be small in the early stages. Whilst the researcher may lead the practitioner where laws have been discerned, in ideographic research, excellence in practice is sought and tested to see whether it will transfer to other situations. The point of discerning a maturity model is to be able to predict with some confidence the likelihood of movement, pro-active or re-active, from one stage to another. If the model is good, movement from one stage to stages other than neighbours would indicate severe disruption.

In the following analysis the organisations have been assigned identifiers 1 to 6 (CSC, HACTL, ARC, RHKJC, CHEK & SHANCOM). This is because the questions of the protocol are questions not to the respondents but to the researcher. The final answer to the question is the researcher's and to some extent it is a subjective judgement. However, it is a judgement tempered through the rigorous process outlined

in Chapter 7. To facilitate the analysis and verify the utility of the model an appropriate position reflecting the state on each dimension for each organisation was sought. Each of these states had been identified in the protocol as a positive response to one of the questions for that dimension of the model. Evidence justifying placing practice in a particular organisation at a particular point was what was sought.

8.4.1 Facet 1 - Scope of IS Development Concern

In the Case Study protocol the questions, posed to the researcher, not the respondents, regarding Scope of IS development Concern are split into those which concern the scope in extended systems development life cycle terms, as explained in Chapter 7, and those which concern scope in problem boundary terms. These are two orthogonal views. The first question posed was:

Do they take a piece-meal contingency approach, solving problems as they arise with little planning, analysis of the immediate problem only and design without regard to foreseeable change. Is the focus mainly on Implementation? Are existing problems likely to be carried forward to new systems?

None of the participating organisations were believed to operate mainly in this way although in the case of organisation 6 some practice was of this type.

Paradoxically this was in the maintenance of the most matured systems. One project manager stated that the work is mostly of an “ad hoc” nature and small enhancements and maintenance take about half a day or up to two days for larger changes.

The next level is sought with the question:

Is most attention paid to Design and Implementation? Are implications of designed change identified, catered for?

SHANCOM fitted this description to a fair extent. The interview respondent in SHANCOM (see appendix 1.6) stated

“Projects are severely focused on Detail Design”

“ the user acceptance document is typically produced in half a day. Following a meeting the project proceeds to screen design, file design etc.”

Whilst in 1987, the only current major problem was identified as “backlog”, in 1993 the only current major problem was identified as “maintenance”. It is reasonable to conclude that very little other than piece-meal development and maintenance is being undertaken. Although the 1993 questionnaire respondent asserted that Strategic Planning was performed using Soft Systems, Rapid Development and Data Flow oriented methods, the interview respondent stated that there was no Strategic Planning either in the company or in Information Systems. This would fit with statements that

“the company is Hong Kong based and it is difficult to see the future of Hong Kong at this point in time”

“Change in IS development is driven by the hardware vendors. It is recognised that this strategy is very conservative but not felt that risks can be taken. Mature technology is accepted from the trusted vendor if it is found appropriate. We can’t afford long experimental projects”.

He went on to describe a coat-tail strategy of providing the same services as their competitors.

The third level was to be elicited by the question

Is the focus mainly on Analysis, Design and Implementation?

This would appear to fit organisations 2, 4, 5 and 6. While the questionnaire respondent for HACTL (see appendix 1.2) did not report an Analysis method in 1987, by 1993 the same method as is used for Design and Implementation was reported for Analysis. An interview respondent stated that

“Projects are of various sizes and duration, from several years to a few days. The division between development and maintenance is not always clear. Office Automation projects tend to be short but highly effective.”

Recently the company had completed what was described as the biggest project ever undertaken which was the move from centralised equipment to network based working.

In 1987 the questionnaire respondent in CHEK (see appendix 1.5) reported that unstructured methods were used for Analysis, Design and Implementation. In 1993 they reported that Hierarchical methods were in use. During interview it became apparent that these were based on a pre-structured version of the National Computer Centre's Systems Development Standards. Whilst the tools may not be the most up-to-date they were followed assiduously, though on magnetic rather than paper media. This leads to

the inescapable conclusion that life-cycle stages Analysis, Design and Implementation are fully covered.

ARC (see appendix 1.3) outsourced the development of its systems. However, the manager overseeing computer related matters was recruited at the time of the first computerisation and stated that he may spend as much as month preparing a requirements specification for a large project. At least one of their systems is ground breaking, in their particular market, and believed to give strategic advantage. However there is no formal information systems strategic planning activity.

As was mentioned previously CSC (see appendix 1.1) displays some reactive practice at level 1 but most activity is thought to be at level 3. It was found that there was a wide range in scale and scope of the projects being undertaken and coverage of the life-cycle activities was contingent on these factors. Much of the work was incremental with most concentration on design and implementation. However, there were also large projects in progress at the time of the interviews, involving several teams in Analysis, Design and Implementation.

A positive answer to the question identifying level 4 could only fully be given to RHKJC (see appendix 1.4). It is true that strategic planning is practised in most of the other organisations but only in CHEK (see appendix 1.5) are there formal links between management strategic planning, information systems strategic planning and information systems development. Between the questionnaires the development practice had been expanded, re-organised and upgraded. This was the only organisation where there was a high level member of staff for long range planning for Information Technology.

The question the researcher asked himself concerning scope of the problem boundary confining organisations to a perceived possible level 1 was

Are solutions usually contained in one department of the organisation?

None of the case study organisations were operating at that level. All the case study organisations gave evidence of devising inter-departmental solutions.

The next level was defined by the question

Do solutions frequently cross Departmental boundaries but rarely organisational boundaries?

This was thought to be the situation for organisations 1,3,4,5 and 6. Only HACTL (see appendix 1.2) indicated that some systems were designed to interact with systems in other organisations. Partially this was through long standing industry specific messaging systems and partially the receipt of specific reference files. Although for HACTL there was some design beyond the organisation and activity with standardisation bodies, where this occurred the activity was limited enough to raise the question as to whether this dimension is a useful one in defining the model.

8.4.2 Facet 2 - Methodology

This facet has been split into three dimensions. The first concerns the rigour with which the methodology is applied as evidenced by delivery of milestone objects - reports, data dictionary entries and the enunciation of the development managers. It should be noted that ARC (see appendix 1.3) was not considered in this facet since the

development activity was outsourced and it proved impossible to contact the outsourcing organisation.

The question the researcher asked himself in order to discern the first level was

Is there no consistent methodology?

and only SHANCOM (see appendix 1.6) was thought to fit this description. The following was stated in interview.

“Methods are up to the project leaders. It is difficult to centralise because of resistance of the project leaders. Mostly they were recruited at the time of the change from (computer manufacturer A) to (computer manufacturer B).”
(my parentheses)

Asked about the utilisation of Data Dictionaries it was stated that

“Building a Data Dictionary would take too long and there is no observable payoff.”

Organisations 2 and 6 were deemed to fit the second stage ascertained by posing the question

Is there a very tacit application of the methodology with a high degree of deviance?

In the case of HACTL (see appendix 1.2) it was stated that standards similar to those used in airlines were adopted. However, the application of standards is through a conservative but contingent approach. Three quotations from the most senior

Information Technology manager are particularly revealing. Firstly, he conjures an image of the IT professional like a surfer on a sea of technology

“IT attracts people who thrive on the challenge of constant change”

and

“The basis of IT professional practice is like constantly moving sand. Refined practice is abnormal because by the time practitioners have grasped best ways of handling a particular technology the technology has moved on. IT attracts people who thrive on the challenge of this constant change.”

Then he asserts a conservative strategy of handling the turbulence

“... is in the business of high service reliability. Whilst we are aggressive in exploiting technology and successful in putting technology to use in so many areas of our operation we remain conservative in our choice of technology. We are no gamblers, being responsible for such an important chunk of the Hong Kong economy we are always cautious in not taking undue risks.”

This is an example of knowledgeable or enlightened deviance and illustrates the difficulty of using this dimension in assessing maturity. The deviance may be due to the virtuosity of the practitioner. On the other hand it may reflect the laxity of the management. While both forms of deviance appear at the same point on this dimension understanding the underlying cause is crucial to understanding the maturity of the practice. CSC (see appendix 1.1) gives an example of exactly the opposite form of

deviance. Here the company had stated that in 1987 combined methods were used in Analysis, Design and Implementation. However, by 1993 Data Flow oriented methods and Data Structure oriented methods were both selected for all four phases (Strategic Planning, System Analysis, System Design and Implementation) as well as Prototyping and Object-oriented methods being used for Analysis, Design and Implementation. Through interview it was discovered that the practitioners had a fair degree of freedom to select the methods that they used and that the actual method in use was contingent on a number of factors such as size of the task, methods used previously with the client and familiarity with specific methodologies of staff assigned to the task.

RHKJC (see appendix 1.4) might also have been classified in stage 2 on this dimension but has been put into the more "rigorous" stage 3 because

"Rather than define a standard set of IS development methodologies the club is developing a framework within which practitioners' methods should fit. For any given development the practitioner is expected to be able to define the methods to be used and to justify their selection to open forums consisting of his peers, managers and supporting staff. This is a tough test and project managers are as likely to have to defend decisions not to use particular methods as the opposite."

The most rigorous application of standards was found at CHEK (see appendix 1.5). Here a proprietary standard had been mechanised and adapted somewhat, to be rigorously enforced. As might be expected one of the senior development managers expressed doubts about its universal utility. He voiced the opinion that the documentation standard is rigidly applied stating that he finds it quite troublesome and that it doesn't really help the developer understand the whole system thoroughly. He

said

"It's really oriented to the Program and file level. Structured methods would be better but Object-oriented methods are not appropriate for commercial transaction processing systems such as most of the work at (this organisation) at the current stage but these methods may be appropriate in the future."

(my parenthesis)

Whilst this places the organisation at the highest point on this dimension clearly it is not a reflection of the most mature state. Simply reversing the dimension does not solve the problem. If the dimension is to be used it must be qualified with a consideration of the virtuosity of the practitioner.

The second dimension for viewing methodology is the sequence in which the various stages of the methodology will be visited. The review of the literature (Gilb, 1977; Boehm, 1988; Humphrey, 1989) suggested that the most mature situation would be where the answer to the protocol questions

Is the situation apparently chaotic with iterations forward and backwards? If so, is this because of great skill in meeting the exigencies of the situation or is it because of an inability to plan and assert the benefits of a more orderly approach?

were positive. None of the co-operating organisations were operating in this way. Most (organisations 1,2,3 and 6) deserved a positive response to the question indicating the other end of the dimension

Are stages visited sequentially in a single pass?

However, the development manager in HACTL (see appendix 1.2) expressed an occasional difficulty in differentiating development from maintenance. There is perhaps a cultural reluctance, stronger than is found in the West, to admit to backward iteration since there is an implication of someone having made a mistake. CHEK (see appendix 1.5) appeared to be locatable between the questions intended to ascertain placement at points 2 or 3 of this dimension i.e.

Point 2

Are stages visited sequentially with some backward iterations?

Point 3

Are stages visited sequentially with jumps forward to test feasibility of particular coding?

It was stated that normally the life-cycle was followed with iteration possible back one stage. For particular jobs, where there were technical unknowns that it was advantageous to resolve first, the “drop down” form of technical prototyping recommended by Gilb (1977) would be used.

The final facet of methodology to be considered was paradigm diversity. Here paradigm diversity is taken to mean diversity of the views used in planning, analysis and design. The protocol is stated thus

Point 1

Does a single paradigm (say objects, state-transitions, information flows or some other) dominate all phases?

Point 2

Is each phase dominated by a particular paradigm?

Point 3

Are multiple paradigms used and reconciled in some phases?

Point 4

Are multiple paradigms used and reconciled in all phases?

It is clear that RHKJC (see appendix 1.4) is operating at point 4. Whilst a standard methodology is recommended Rapid Application Development techniques are encouraged but deviations have to be approved in peer reviews. Combined structured and object-oriented methods are commonly used as appropriate in all phases. In CHEK (see appendix 1.5) an eclectic collection of techniques is in place (based on the NCC's earliest standards) but these can not really be described as a paradigm or even methodology so a classification of 0 has been recorded. organisations 3 and 5 are classified as "unknown". In the case of ARC (see appendix 1.3) the outsourcing organisation could not be contacted and in the case of SHANCOM (see appendix 1.6) the project leaders were said to be "too busy" to be interviewed. In SHANCOM (see appendix 1.6) as is reported above "methods are up to the project leaders" who were said to be too busy to be interviewed.

CSC (see appendix 1.1) has been classified at point 2. The practice in CSC is contingent mainly on the knowledge, held by the practitioner, of a particular method. However, because a pool project allocation situation pertains, various techniques,

especially those based on structured methods, are widely known amongst the project managers. In interview, none of the project managers referred to cross-checking amongst views. The most senior manager interviewed expressed a desire to introduce change. He said in interview that one of his first tasks was the introduction of more standardisation in the use of methodologies. He may consider introducing the methodology used in his previous organisation. However, he was also interested in the Structured Systems Analysis and Design Methodology (SSADM) developed for the United Kingdom's Central Computing and Telecommunications Agency (CCTA). This was because its adoption would better position the company to bid for Hong Kong Government contracts. It was believed that such contracts would shortly become a significant need to be satisfied.

In HACTL (see appendix 1.2), Dataflow methods and prototyping were stated to be the dominant methods but are applied in the contingent fashion described above possibly justifying a classification as 2 here rather than the 1 recorded.

8.4.3 Facet 3 - User Involvement

This facet concerns the practice of user involvement in the development of the systems. HACTL (see appendix 1.2) is placed at point 4 (deemed to be worthy of a positive response to the question below)

Are mechanisms for involving the user always invoked throughout the projects?

because the organisation is IT permeated - operational management of the company is management of the IT. The end-user is the IT management. The degree of involvement in RHKJC (see appendix 1.4) is similar so both these are defined at the high end of the practice of involvement dimension.

In CHEK (see appendix 1.5) the Senior IT manager said

“Projects are suggested both by user management and the EDP Department. All suggestions are put to the Computerisation Working Committee, convened approximately every two months and chaired by (the General Manager, EDP Department.) An accepted project will be handled by the “Project Officer”, typically one of the Managers reporting to (the General Manager, EDP Department) or a lower level staff member for smaller projects.”

(my parentheses)

Clearly user-management are not involved throughout the project justifying a grading of 3. This category is also used for ARC (see appendix 1.3) where outsourcing is used although a lower categorisation was considered. The manager responsible for IT said

“With the appropriate section head (e.g. the Food and Beverage Manager) and the EDP Supervisor we would search the market, perhaps getting demonstrations from appropriate vendors. Full analysis would be the province of the vendors.”

They would not be involved again until the running of acceptance tests. At CSC (see appendix 1.1) the end-users are external clients and there is significant emphasis on the sign-off of specifications. Again a 3 seems the appropriate point. The situation in SHANCOM (see appendix 1.6) was one of market forces. The interview respondent said

“The hardware vendor is trusted to suggest suitable changes in technology. We have to provide the same customer facilities as our competitors”

Point 1 is deemed appropriate since the end-user is not consciously involved.

8.4.4 Facet 4 - Automation of Development

This facet was discerned with respect to the answers to the following questions

Is there no automation other than compilers?

Are they using Word Processors, Drawing tools, etceteras in a disintegrated manner?

Is there a toolset integrated for development?

Is the toolset integrated with the operational databases, communications processors etc.?

In HACTL (see appendix 1.2) applications make use of a Data Dictionary integrated on-line. A CASE tool has been purchased for use in Systems Analysis. However its deployment is hampered somewhat by the steep learning curve implied by its interface with its user. The organisation is graded between 3 and 4. RHKJC (see appendix 1.4) uses its CASE tools for all stages of the Life Cycle including Strategic Planning but there is no integrated on-line data dictionary. Clearly the organisation is at stage 3 on this dimension. It was not possible to ascertain what tools were used by the developers for ARC (see appendix 1.3) since access was not available to the outsourcing company. All the others (organisations 3, 4 and 6) only automated by the use of Word Processors for Documentation. The respondent in SHANCOM (see appendix 1.6) said

“Projects are too small to consider the use of CASE tools. I wouldn’t expect project managers to acquire CASE Tools from their budgets. Building a Data Dictionary would take too long and there is no observable payoff.”

In CHEK (see appendix 1.5) moves to automation are planned. A senior management respondent said

“Changes in the pipeline are a move to RDBMS, introduction of CASE tools, introduction of more up-to-date methodology but these are subject to budget constraints.”

In CSC (see appendix 1.1) some experience with CASE tools had been gained and the Executive Director stated

“A CASE tool has been used for Analysis and Design in a major project for a Government Department where use of the tool was required by the client. Increased use of such tools, following this exposure is expected but is contingent on commercial opportunities.”

8.4.5 Facet 5 - Metrics and Quality Control

This facet is assessed in respect to the researcher’s answers to the following questions

Are there quality control procedures in place?

Are metrics collected?

Is management use made of metrics?

Is an ISO 9000 or similar scheme in place?

Once again, it was impossible to ascertain the position for ARC (see appendix 1.3), due to lack of access to the outsourcing organisation.

CHEK (see appendix 1.5) had a regular quality control system in place. It was described by one of the Senior Managers. Whilst there is no organised collection of metrics he stated that Quality Assurance was taking place. Each project's code was inspected by a Quality Assurance team of 4 - 5 of the most experienced programmers who examined the programs for clarity, efficiency, ease of maintenance, flexibility and correctness. Program testing was also carried out by teams other than the development team before system testing. Since no metrics were collected, this commendable activity only places the organisation at point 1 on this dimension.

In HACTL (see appendix 1.2) the senior development manager said

“Verilog - a code analyser - is widely used by programming supervisors to verify quality of code before system testing.”

justifying placing the organisation at point 1 on this dimension. Surprisingly no other quality control procedures were in place. A possible explanation of this is that management here are concerned to evaluate for their own purposes, new technologies, as they become available. Their goal is to maintain a transshipment processing system excellently, rather than maintain excellent code. The quality level of the code required is “reliable”, not necessarily “excellent” in dimensions other than reliable such as speed of

execution or compactness.

In CSC (see appendix 1.1) there was no evidence of control except by peer pressure. It was stated that, currently, very little attention is paid to the concept of metrics. The matrix management and pool situation means that when staff are reviewed they are likely to have been exposed to several problems under several managers. Although several Project Managers expressed concern about the subjectivity of the appraisal and reward system, devising more objective measures in the current situation would prove extremely complex, such that some of the measures would have to be arbitrary and hence introduce similar subjectivity. This might be regarded as being between 0 and 1 on the quality dimension. However, the pressure would appear to be more towards delivering on time than on the quality of what is delivered.

RHKJC (see appendix 1.4) had plans to introduce ISO 9001 and “Tick-it” and with the current processes in place this should be feasible. Currently, however, only pre-development peer pressure to adhere to, or justify deviation from, the standard methodology is in place justifying positioning on this dimension between 0 and 1.

Management in SHANCOM (see appendix 1.6) stated that they had no plans to introduce quality control or metrics placing them at 0 on this dimension.

8.5 Stage Assignment

Finally the identified points on the matrix are placed on the matrix shown in Figure 8.14 and a number of questions are raised.

Organisation		RHKJC	HACTL	SHANCOM	CHEK	ARC	CSC
Scope	Life-Cycle	4	3	2	3	3*	3
	Problem boundary	2	3	2	2	2	2
Methodology	Rigour	3	2	1	4	?*	2
	Sequence	1	1	1	2 - 3	?*	1
	Paradigms	4	1	?	0	?*	2
User Involvement		4	4	1	3	3	3
Automation		3	3-4 ~	2	3P	?*	2-3
Quality & Metrication		0-1	1	0	1	?*	0

* mostly carried out by external software house

~ Databases and Dictionary are integrated - problems are being experienced with integrating the CASE tool.

P means "planned"

Fig 8.14 Summary of dimension points discerned for each organisation

We may wonder whether all of the dimensions are useful. Although there is a strong suggestion (Boehm, 1988; Gilb, 1977; Humphrey, 1988) in the literature, of the growing importance of quality in Information Systems Development, there appears to be little uptake of quality control procedures amongst the organisations studied. The Scope/Problem Boundary dimension is not a good differentiator as only two points are represented amongst the cases. This is also true for the methodology sequence dimension - but one of the instances is between two of the identified types.

Looking at the clustering it must be asked whether any of the organisations exemplify a particular stage either wholly or partially. Simply summing the identified stage points we can derive a first-cut "maturity score". The lowest scorer is ARC (see appendix 1.3) but this is largely because for many dimensions the activity is undertaken

by the outsourcing organisations. On the dimensions where ARC (see appendix 1.3) is active it is assessed quite highly. This indicates that mature practice does not preclude outsourcing. The question arises as to whether outsourcing is a wise strategy where there is not a degree of maturity amongst Information Systems Development management. This supports the finding reported by Galliers et al (1996) who synthesised their result:

“Companies with the most developed IT skills and in-house experience gain most from outsourcing”.

This is counter to the wish that some management may fall prey to. The idea that abdicating responsibility for IS & IT will dispel current problems.

SHANCOM (see appendix 1.6) is the next lowest scoring. The following interpretation is tempered with the observation that access to the organisation was less than had been hoped since after the first interview access to further respondents in the organisation was not allowed. Triangulation could, therefore, only take place through comparison with the questionnaire responses and the interview executed. A political interpretation of this organisation's situation would notice the responding manager's anxiety. Concerning the future he was extremely pessimistic of the future saying,

“The future in Hong Kong is dominated by the political change in 1997. I have no idea what the future holds. The company is Hong Kong based and it is difficult to see the future of Hong Kong at this point in time.”

He enunciated low planning horizons and ad hoc “planning” saying,

“There is no Strategic Planning either by the (organisation) or in the IS function”

“We have to provide the same customer facilities...”.

Going on there was an apparent dissonance between the development management and another generation of developers. He said

“Techniques used are up to the Project Managers. Some maintain their project data structures but there is no corporate data model. Project managers are resistant to such integrative concepts.....Mostly they were recruited at the time of the change from (hardware vendor a to hardware vendor b)..... Projects Managers are resistant to change.”

(my parentheses)

Interestingly this organisation operates in an industry where many organisations of similar size to this one co-operate to compete with the market leader. There is an emphasis on customer retention rather than increasing market share. Another organisation in a similar position in this market was assessed somewhat higher but admitted to practitioner turnover problems at the lower levels of development practice. Whilst, the organisation is scoring at low levels on the model this is thought to be due to something of a management freeze. The 1993 questionnaire respondent selected “power-centred” from Handy’s (1976) organisational forms and the dissonance between development management and project leaders is noted above. Whilst no extremes were indicated in the responses to the section covering forms of change management, the only statement somewhat held was the one asserting that “the organisation is the victim of

external circumstance...”. Three statements were somewhat distrusted. These including that “organisational change is brought about through loosening of the controls...”, and “organisational change is brought about mainly and simply through the direction of management”. A picture of a severely restrictive management emerges.

The next lowest assessment is taken by CSC (see appendix 1.1) which is assessed with less than 2 only on “Quality” and “Methodological Sequence”. There are two dimensions at point 3 “Life-cycle Scope” and “User Involvement” and three at point 2 “Scope: Problem Boundary”, “Methodological Rigour”, “Methodological Paradigm Diversity.” Automation is held to be between 2 and 3 there having been a small exposure to the use of CASE tools. Whilst it was thought that organisations at a stage just beyond initiation would display characteristics similar to Nolan’s (1984) “control” stage this organisation displays characteristics more akin to Handy’s (1976) “task culture” with some areas belonging to the “person culture”. Control in the organisation appears to rely heavily on the Confucian work ethic, loss of face and actual benefits, from missed deadlines being a powerful deterrent

“Performance evaluation is mainly the province of the Senior Managers (project leaders) who base their judgement on the number of successful projects completed on schedule.”

(my parentheses)

The key word in this organisation is actually contingency. One manager is most concerned with the support of a sophisticated EIS system, uses a completely different methodology and toolset from another manager who is involved in the development of a large accounting system. What came across in interview with the project managers was

a culture of emphasis on delivering code on time, sometimes at personal cost - usually in the form of unremunerated long hours. To some extent this militated against careful updating of specifications.

A pool mechanism is operated especially at the Analyst/ Programmer level. Several of the Project Managers reported working on the same applications and several reported on working on a wide variety. One reported that the exposure to multiple applications and multiple platforms was the reason that junior staff might accept lower remuneration than they might be able to command through working for some other company. The challenge was keener and would pay off in the long run.

The capture of standard solutions through definition of the company's intellectual property at systems level does not appear to be in place. Currently the adherence to the company's methodology is tacit but this is an area of concern to the management. Until the emphasis of development centres on earlier stages of the life-cycle than implementation, this level of adherence will persist.

Appropriate reaction to the market is the pervading ethos of the organisation and this dominates decisions concerning the dimensions of the model. The concept that comes over is readiness.

When the numbers of the points on the dimensions were summed two organisations came up with the same number. They were assessed the same on "Scope: Life cycle" and "Quality" but differed on all other dimensions.

CHEK (see appendix 1.5) was assessed highly on “Methodological Rigour” because of the rigidity with which it applies a somewhat antiquated standard. This calls the sequencing of the points of the dimension into question. One enunciation from one of the senior managers in the organisation strongly reflected Lewin’s (1947) “unfreeze - change - freeze” model itself reflected in Greiner’s (1972) model of change from maturity stage to maturity stage

“....building pressures, sudden and sweeping change followed by long periods of apparent stability.”

There had been a long period of stability and he went on to say

“The organisation is very stable and does not undertake self re-organising without strong external pressure. Change is a top down process. New projects are determined by market forces or technical changes.”

In interview the questionnaire respondent had stated

“Both in the company and in Information Systems, change is incremental rather than radical”.

The same respondent said that

“New developments are assessed through attendance of seminars suggested by hardware and software vendors, attendance on tertiary courses and consultancies such as Graham Mead Associates. Also, there are formal monthly discussions amongst the

EDP management team and Systems Analysts where new techniques will be brought up.”

The situation is best summarised with the phrase “aware conservatism” - an extreme case of avoiding change for the sake of change.

HACTL (see appendix 1.2) was assessed at 3 on both “Scope” dimensions, 3 to 4 on “Automation” and 4 on “User Involvement”. As previously explained,, the organisation is so pervaded by Information Technology that the IT technology management is to a great extent, the management of the company. Further, one of the senior managers stated

“Throwaway prototyping with the 4GL has largely replaced feasibility studies” indicating a shift towards viewing user-acceptance as the main criterion of feasibility.

This organisation differs from HACTL (see appendix 1.2) in its attitude and activity with regard to change in Information Systems Development. Both keep a watching brief on appropriate technology as it becomes available. However, whereas HACTL (see appendix 1.2) seldom pays the price of change CHEK (see appendix 1.5) is more likely to select and implement changes which will be of continuing benefit. This is coupled to a long-standing feel for the systems approach. A senior manager said

“The approach to change is holistic and organismic rather than hierarchical or compartmentalised”

whilst another hinted at the hyperbole in the Information Technology suggesting that

sometimes IT products were oversold. While the metaphor that most easily springs to mind for the operation of the whole company is the machine this is not mechanisation for the sake of mechanisation. Operations are strongly mechanised but satisfactory automated support for Information Systems Design has not yet been found. The practice exemplifies a knowledgeable contingent approach.

RHKJC (see appendix 1.4) came out higher with three dimensions at point 4 “Scope: Life Cycle”, “Methodology: Paradigm Diversity” and “User Involvement”. “Methodological Rigour” and “Automation” were each evaluated at point 3. Low points were only placed on “Methodology Sequence” and “Quality” although there are plans in the latter area. This organisation markets its systems on an international basis, yet if we had been evaluating its practice using the Humphrey’s (1990) model it would be in the lower levels of that model.

It was thought that the differences between the organisations was sufficient to discern specific stages on the model. Further, it was thought that those differences concerned the ways that particular organisations went about deciding how to tackle specific projects. That is, what paradigms to use, how rigidly to process models and what kinds of resources to apply. The dimension points were summed for each case. Somewhat arbitrarily RHKJC (see appendix 1.4) was assigned the stage 4, organisations 2 and 4 (which had the same index when dimension points were summed) were assigned stage 3, CSC (see appendix 1.1) was assigned stage 2 and organisations 3 and 5 assigned stage 1. The difference between the actual dimension point and the assigned stage was then recorded in figure 8.15 below.

Organisation	RHKJC	HACTL	SHANCOM	CHEK	ARC	CSC	Difference
Stage	4	3	3	2	1	1	
Scope Life-Cycle	0	0	0	1	1	2	4
Scope Problem boundary	2	0	1	0	1	1	5
Meth. Rigour	1	1	1	0	0	1	4
Meth. Sequence	3	2	0.5	1	0	1	7.5
Meth. Paradigms	0	2	3	0	1	1	7
User Involvement	0	1	0	1	0	2	4
Automation	1	0.5	0	0.5	1	1	4
Quality	3.5	2	2	2	1	1	11.5
Count of "<1"	3	3	4	4	3	0	54
Count of ">1"	4	4	3	2	0	2	

Figure 8.15 Differences between dimension points and arbitrarily assigned stages.

The shaded cell above is the sum of the differences between the assigned stage numbers and the perceived points on the various dimensions. Next, a linear programming processor was used to find the minimum value of this cell, if the assigned stage values are allowed to vary, giving the results in Figure 8.16.

Organisation	RHKJC	HACTL	SHANCOM	CHEK	ARC	CSC	Difference
Stage	3	2	2	1	1	1	
Scope Life-Cycle	1	1	1	2	1	2	8
Scope Problem boundary	1	1	0	1	1	1	5
Meth. Rigour	0	0	2	1	0	1	4
Meth. Sequence	2	1	0.5	0	0	1	4.5
Meth. Paradigms	1	1	2	1	1	1	7
User Involvement	1	2	1	2	0	2	8
Automation	0	1.5	1	1.5	1	1	6
Quality	2.5	1	1	1	1	1	7.5
Count of "<1"	2	1	4	4	3	0	50
Count of ">1"	2	2	3	2	0	2	

Figure 8.16 Values for Stages found by testing all combinations minimising the summed difference

The analyses shows that in examining cases' positions on these points organisations can be grouped into three distinct sets. An interpretation of the significant features of these sets and its relation to the original model is proffered in Chapter 9.

8.6 Summary

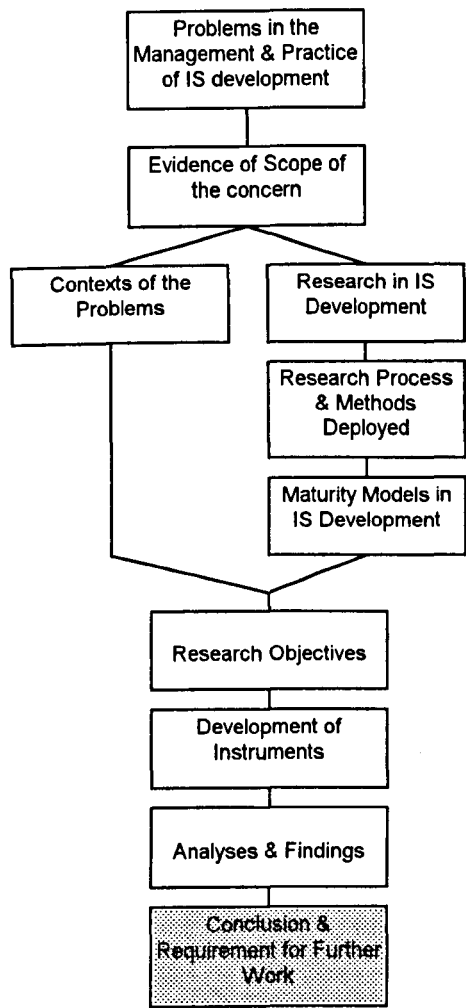
This chapter has presented detailed findings from the research. Firstly a number of observations have been drawn from the difference in response between the 1987 and the 1993 questionnaires. These findings indicate a significant change in the environment in which IS are being developed and operated in the six years between the surveys. Many of the changes are inter-related. There has been a significant shift away from "central and remote" processing of information towards "central and network" processing. This is accompanied by a move from file-based systems to database

systems, the drop in batch systems in favour of on-line systems, the acceptance of Fourth Generation Languages at the expense of Third Generation Languages and a major move towards database access languages. However, there has also been an increase in the percentage use of COBOL suggesting that the maintenance of legacy systems remains a significant activity or that it is finding a widened role with its ability to act as a host for database access.

Relationships between regression/progression and other factors were difficult to find except with respect to belief in the learning organisation where a significant cluster of organisations which accepted this concept also reported progression on Nolan's model.

The most interesting finding of course is the veracity of the proposed Maturity Model and this is weighed in Chapter 9.

Chapter Nine - Synopsis



This chapter outlines and explains the major conclusions arising from this research. An assessment of the research methods deployed is given together with implications. These implications include an analysis of what further research is desirable in both the short and medium term.

9. Conclusions and Future Research Directions

9.1 The major finding

The major finding of this research lies in the maturity model which has been reified from the literature surveys. Several assessments are required at this point. Firstly we must assess whether the model as a whole has been shown to be reasonable and useful. Next we must consider whether any elements of the model have been shown to be of limited use. Finally there is a requirement to show to what extent the data gathered supports the concept of the model.

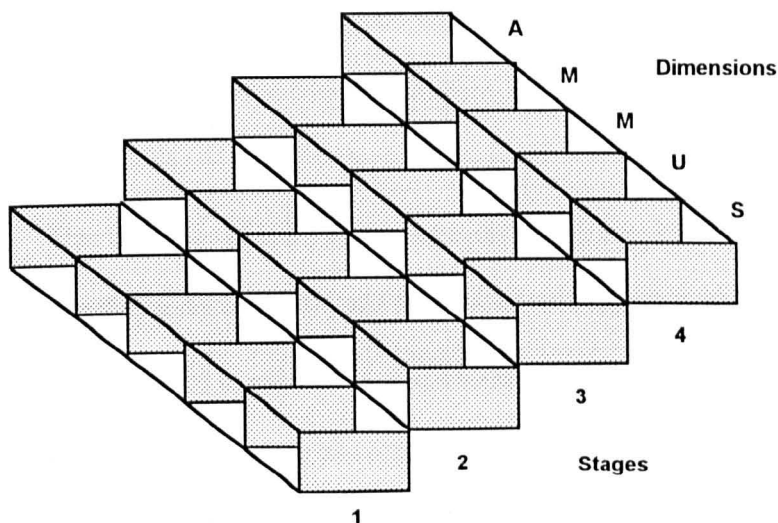


Figure 9.1 The Maturity Model of IS development. -Dimensions Automation, Methodology, Metrics, User Involvement and Scope.

9.1.1 How organisations fit the promulgated stages

In a recent paper (Wilson, 1993b), an argument was made that if it transpired that organisations were at the same stage on various dimensions of the model then there would be a strong case tending to support the veracity of the model. Figure 8.15 clearly

shows that such explicit indication is not available. In fact there is no organisation which has been consistently found to have the same score on all dimensions. A similarity is found here with the findings of Galliers & Sutherland (1991,p110). When they came to test their model of IS management they also did not find that organisations were at the same stage of growth on all dimensions. However, these stage models are useful because they prompt questions concerning why the organisation has grown in some dimensions but not others. The case investigation is useful because it highlights dimensions, suggested by the literature, which are not reflected in the practice examined.

Where there is a great deal of consistent scoring in organisations it is in the organisations where the scores on most of the dimensions are at the low end. The number of incidences of scores beyond stage 2 for any particular dimension is only three. These are spread over two organisations and three dimensions.

This incidence of low scoring indicates a dissonance between practice and theory since the model is constructed from recommendations in the Western literature. The question arises as to whether this dissonance is peculiar to Hong Kong or is more widespread. Replication of the research in the countries from which the theory emanates would be most instructive.

The technique used to derive figure 8.16 gives an adjusted, more holistic view of the data. We can see from this figure that three organisations are perceived overall to be at stage 1, two organisations at 2 and one organisation at stage 3. The three organisations labelled "1" comprise two relatively small operations and another organisation which is in fact run largely as a federation of small operations.

Management of information systems development in these three organisations takes a contingency approach. As would be expected most of the dimension scores recorded for these organisations is “1”.

The two organisations perceived to be at stage “2” might be regarded as having a tendency towards mechanistic attitudes and practices. One of those organisations is very dynamically successful in a fast growing industry. Because the leadership in the IS development area is far-sighted, sensitive and aware, they have been able, not only to cope over a long period characterised by sustained significant growth, but have maintained excellent performance. The key strategy underpinning this performance has been an on-going one of reducing the head count in the warehouse. This is said to be as much for safety concerns as financial concerns. However, whilst this has been the strategy in the handling of the cargo it is not mirrored in the development of the systems which are designed to enable the maximum mechanisation of the operation of the cargo terminals. Whilst the form of deployment of the development staff has not changed radically, they have scouted and adopted sound IS development technologies as they have arisen.

By contrast the other organisation scoring “2” adopted a “methodology” a number of years ago and show no signs of updating it. It has to be said that this second organisation operates in an industry where the market followers are largely forced to act in concert with other market followers in order to obtain economies of scale and retain their loyal clients in the face of fast changing product differentiation flowing from the market leaders. There is little scope in the organisation itself for envisioning market products and the concern of IS management is to keep in step with the other market followers.

The organisation scoring a 3 is a unique organisation in world-wide terms. IS transaction processing is characterised by a peaks and troughs situation of a severity not found in other industries nor in the same industry in other jurisdictions. The solutions devised to the problems are known to be excellent and are exported both as complete and partial systems to customers in advanced countries (e.g. Sweden, the UK, USA, Australia) as well as to regional operators in the same industry (e.g. Malaysia, Macao etceteras.) Whilst the organisation scored highly on the model in some areas (e.g. the handling of quality issues, flexibility in handling methodologies adopted), there were areas where very low scores were perceived (e.g. user involvement, Life-cycle Scope). Some of these can be explained by the nature of the industry of the organisation. A need for very high levels of security militates against open means of development, hence the low levels of user involvement. Others lead this researcher to consider inclusion of the dimension in the model.

So there is some fit between the early stages of the model and the cases examined. If we were to attach labels, rather than metaphors to these stages the first two might be “contingency” and “control”. The similarity to the early Stages Theory models (Gibson & Nolan, 1974; Nolan, 1979) is evident and there is also resonance with the first two stages of the capabilities Model (Humphrey, 1988). Since largely different criteria were used it may be asserted that, in the early stages of maturity in IS development the evidence brought not only tends to support the utility of those two models, but also tends to support the criteria used in developing this model. Next we will look at these criteria (dimensions) more closely.

9.1.2 Evidence of the utility of the Dimensions

The following analysis looks at each dimension in the sequence in which it appears to be most useful as a differentiator. A score representing the number of different points recorded for the dimension was derived with .5 being used where a point between two of the identified points had been recorded. Whilst this score should have indicated the utility of the dimension the commentary below shows that this was not strictly the case. The dimensions are taken in the sequence of the highest score first.

9.1.2.1 Methodology Rigour

This dimension exhibits a full spread of points (scoring “4”) including a “don’t know” against the organisation using outsourcing. However, several observations need to be made. The most rigorously applied set of methods was the least developed and not really worthy of the term methodology - rather a set of heuristically based aids. The next most rigorous situation was the organisation where, although there was a recommended methodology, other methodologies were tolerated but had to be justified to a peer review: hardly an encouragement to experimentation. The organisations against which 2 was recorded really allowed the team leaders to do what they thought best and 1 was recorded against the organisation where development management did not seem sure what the team leaders were doing.

9.1.2.2 Methodology Paradigm Diversity

This dimension scored “4” reflecting four levels of different paradigm diversity. The lowest level was not actually on the protocol scale “0” being recorded for the organisation which slavishly followed an early version of the National Computing Centre Methods (Daniels & Yeates, 1969.) Two other organisations had question marks recorded against them as the interviewees were unable to explain what methods were

being used. One of those was the organisation which out-sourced its development and the other the organisation in which there was extreme implementation focus, great trust being placed in the programmer/ analysts. The highly automated organisation was recorded as 1. Although there was great awareness of various methodologies, tools and techniques for any given task the most appropriate modelling technique would be used, if one was known, and not cross-checked with others. This was similar to the organisation for which a 2 was recorded except that through discussion and deeper questioning with the project managers, of the latter organisation, it became clear that they did use the paradigms espoused. There was no example of an organisation using multiple paradigms but reconciling them only piece-meal leading one to question whether this point should perhaps be dropped from the dimension. One organisation was, on a fairly regular basis, using a methodology which cross-checked one orthogonal view of a system with another. However, for many tasks less rigorous methods were used.

Whilst there is a spread of points the results are confused by the non-responses (see Appendixes 1.3 & 1.7).

It is true to say that this is probably the easiest of the dimensions to perceive and did give an indication over the spread despite the small number of cases examined.

9.1.2.3 Automation.

This dimension's score of "4" is somewhat confusing consisting of one 2, one 2.5, a 3 and a planned 3 and a 3.5. No organisation is reliant solely on compilers and all organisations are at least using word-processors for code maintenance. An exception to this was the organisation which out-sourced its code where a "?" (meaning "unknown") had been recorded. The organisation recorded as 2.5 (meaning between 2 and 3) was the

case of the organisation providing outsourcing services. The degree of automation was highly dependent on the team leader. One was, in effect, the territory marketing manager of a highly automated Decision Support System sourced from the United Kingdom. Another team leader reported having appraised some CASE and reverse engineering tools but having found nothing adequate to his task. Fourth Generation Languages were used by all teams on most projects and a CASE tool was stated, by a Senior Manager, to have been used for a particular job. At point 3 one organisation stated it was planning to introduce a CASE tool. This plan may be viewed with some scepticism as, although there was a rigid management structure enforcing meticulous “documentation”, there was no coherent methodology in place. One of the Senior Development Managers did, however, venture that the methodology would be chosen contingent on the CASE tool selected. The other organisation placed at 3 was making heavy use, largely in concert with a particular software house, of a Rapid Application Development strategy supported by a particular CASE tool and integrated Database. However, not all projects followed this integration development path and peer evaluation was used to decide the most appropriate methods and tools for any particular development. The organisation believed to be 3.5 (between 3 and 4) was the organisation whose philosophy was focused towards automating the operation of the company. There was extensive use of Fourth Generation Languages and Senior Management were well-appraised of the availability of Case tools and their integration into the development process. However, although there had been some trial purchases of some tools, and these were still in use, there was not a commitment to a particular automated IS development strategy.

Whilst, currently, this dimension would appear to be a fairly good differentiator, its use as such may not persist. As families of tools are eventually

adopted or eventually rejected wholesale then the same state may eventually become ubiquitous. Only if there is a constant flow of new technology to support IS development (other than hardware) could we anticipate that this dimension's utility will persist.

9.1.2.4 Life Cycle Scope

This dimension scored "3". The three points found on this dimension were contiguous. No organisation studied was found simply to take a wholly piece-meal approach although a great deal of contingency driven activity was found. Four organisations were found to be spreading IS development activities fairly evenly over Analysis, Design and Implementation. One organisation seemed not to pay much attention to analysis. Development was contingent mostly on changes in the technology identified by the vendors and change in the market need identified mainly through contact with other similar market follower organisations. Another organisation stated that there was a well developed strategic planning function. However, this appeared to be focused both on the business and long-range technical opportunities. The linkage between these "visions" and steps to translation into application architectures was not clear and believed to be a discontinuous, contingent process.

The dimension did serve to differentiate the particular organisations studied but the preponderance of those at point 3 raises a small question mark over its utility.

9.1.2.5 User Involvement

A score of "3" was also recorded for this dimension. However in this case it was discontinuous, no organisation having been found at point 2. In the organisation thought

to be at point 1 it is believed that the developers use a “priesthood-like” strategy to control the development strategy. The Senior Development Management seem to have abdicated responsibility to lower levels (programmer/analyst) who were recruited because of their familiarity with the new vendors’ technology. There is poor communication between development teams and development management and the focus of development is on the technical discontinuities rather than the user’s need. As stated above this is an organisation which is a market follower. The reliability of the overall system is more highly prized than innovative market strategy. However, the other case operating in this market seemed to have a closer relationship with end-users. This may have been simply doctrinaire rule following. As stated elsewhere this organisation was following a somewhat antiquated set of methods and whether the user involvement practised was actually effective in such an inflexible situation is open to question. The two organisations recording the highest degree of user involvement were the largest most complex and most successful of the cases examined. That speaks for itself.

9.1.2.6 Methodology Sequence.

This dimension recorded “2.5”, one organisation having been assessed as between points 2 and 3. Four of the organisations studied stated that development sequence was top-down, in a single pass with very little necessity to loop back and rework previous activities. One organisation could not state how the developers it commissioned behaved between receiving a specification and installing the system but they had not yet had to rework a specification. The other organisation stated that they mostly followed a top-down process, occasionally re-worked architectures and occasionally developed test implementations in areas where new technical ground was being broken. Since this was one of the organisations facing the greatest degree of

challenge amongst the cases it seems reasonable to assert that although only one instance of flexible practice is found that instance justifies the use of the dimension.

9.1.2.7 Scope of Problem Boundary.

The score for this dimension was also “2”. All the organisations studied except one were operating at point “2” on this dimension. That is to say they were devising solutions to problems across departmental or functional boundaries but not across organisational boundaries. No organisation was focused wholly on problems contained within single departments or functions. One organisation had some applications where solutions included on-line messaging functions to other organisations but this was not the focus of most of the development.

Again this may be an area where Hong Kong practice differs from the rest of the world. Some comparative studies are necessary to verify whether or not practice in Hong Kong is actually typical.

9.1.2.8 Quality and Metrication

The score for this dimension was “2” meaning only two particular stages out of the possible four stages are represented amongst the organisations studied. Only three organisations responded to questions regarding this dimension in a positive manner. One was “thinking about it” and the other two said they collected some information but could not categorically state how the information collected was consequently used. In our other contacts with IS developers in Hong Kong (which are wide and diverse) we have come across only one organisation which had an organised and enforced quality program. This was the local branch of a Multi-national computer manufacturer whose

operation in Hong Kong was purely marketing. The quality program in place was driven from the home community of the organisation and not thought to be particularly applicable locally by the staff with whom we were in contact.

It can be asserted that at the time of the research “quality” in development was only just becoming a topic of interest to IS developers in Hong Kong. The possibility exists that it is the contingent behaviour of business communities in the Far East “little tigers” which is a key factor of their flexibility and rapid growth. Whilst evidence of the utility of this dimension has not been found in this locale research in other locales may tell a different story.

9.1.3 Summary of Research Findings

It appears to be justified to claim that a maturity model of IS development practice is perceivable between the Nolan Model (Nolan, 1979), which mostly concerns the strategic decisions as behove IS management and the capabilities model (Humphrey, 1988) which sets objectives for developing systems of quality software production. The model proposed here may be used in both an audit or predictive mode. It proffers a number of dimensions along which an IS development concern may be perceived to be growing, stagnating or degenerating. It will be an invaluable aid to organisations in diagnosing problems with their IS development function. The model can be used to demonstrate dimensions in which the organisation’s practice is exemplary and to highlight dimensions on which the organisation would be well advised to question the current practice. The sequence of the utility of the dimensions is thought to be the same as the order given above. Some of the dimensions (i.e. Methodology Sequence and Methodology Rigour) can not be used solely by themselves and the virtuosity of the developer has to be perceived through the other dimensions in order to discern the

meaning of the reading from these dimensions. Hence, in practice, the model must be used sensitively by a consultant capable of perceiving the virtuosity of the practitioner through informed interaction. It is unlikely to be able to be used, remotely through devices such as a questionnaire. Another limitation of the model is its provenance. Chapter 2 explained some of the cultural and “geographical” limitations. Research in a city state is questionable because there are not many other city states. Hong Kong is a city where organisations of all types interact dynamically with both academia and commerce from both East and West. Some interesting and exemplary practices result but the population of organisations is not large and statistically based methods of research are not likely to be useful. The research needs to be replicated in an environment containing a greater number of organisations to whom the model would be useful if it is to widely accepted. A good way to approach this would be the creation of a research centre focused on IS development providing diagnostic and planning services to organisations with sizeable IS development requirements.

It is also recognised that the model is not a maturity model in the strict sense used by Kuznets (1965). However, this criticism has been raised to the Nolan (1974 & 1979) models by King & Kraemer (1984) and (Benbasat et al). As a pro-active model the capabilities model (Humphrey, 1988) also would not meet Kuznets (1965) criteria that the conditions growing in the previous stage create a crisis propelling the entity into the next stage. In the capability model (Humphrey, 1988) it is the will of the management, driven by market requirements, which carries practice from one stage to the next. Given the widespread use of the term “maturity model” both in IS management and Software Engineering of models consisting of a number stages it is not unreasonable to declare the model identified in this research as a maturity model of IS development management.

9.2 Findings concerning the Research Methodology

This research has assumed a hierarchical model (see figure 9.2) of philosophy, approach, methodologies, tools and techniques in the practice IS development.

However, it is not assumed that it is clear at all that there is semantic consensus that “approach” is truly separate from philosophy or methodology. Different enunciators may intend a meaning close to one or the other. Further, techniques and tools are thought to exist at the same level in this hierarchy.

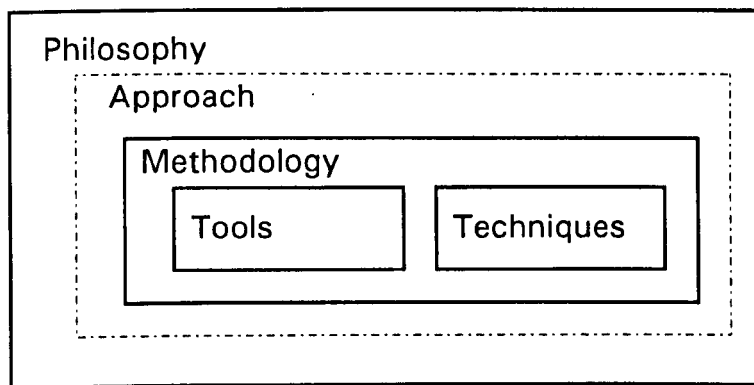


Figure 9.2 The hierarchy of Philosophy, Approach, Methodology, Techniques and Tools

It is believed that this hierarchical model pertains as much to research practice as the practice of IS development. The question of ontological stance is an unhappy one because its misunderstanding leads to heated dialectic and intolerance of differing stances. Worst of all it leads to assumptions that what cannot be perceived from a particular stance is not real and that the logic perceived from a given stance may be carried into another stance. It is the position of this researcher that all stances (internal, external and subjective) are valid but that they perceive different systems of reality. These systems are perceived from particular stances and imply different world-views. It is believed to be questionable whether the epistemology from one such world view is

usable in another. In the worst case, by the adoption of inappropriate methods, tools and techniques not only will the researcher miss the appropriate “realities” but will run the risk of reifying “unrealities”.

This research has sought to use longitudinal methods in a positivist manner - identifying what practitioners changed and what they actually did over a prolonged period and interpretative subjective methods to test a theory of conjectured cohesion in the behaviour of the practitioners co-operating in the research. The results are not starkly conclusive but neither have they dis-proven the theory.

A number of comments can be made about the methods and subjects used in the research. The research was carried out in Hong Kong for no other reason than the researcher had been living and interacting with practitioners there similar to the subjects of the research for 10 years prior to the commencement of the first phase of the research. The selection of the geographical location was no more “opportunistic” than that of any other researcher. Only researchers who have special reasons migrate to far-flung geographical locations. Having said that it is asserted that Hong Kong does provide a useful research vehicle for interpretivist research of an organisational nature. This is because it is a relatively small organisational community exhibiting organisations of various types and sizes and subject to a richer mix of cultural influences than possibly anywhere else on the planet. The subjects of interview were often people whose ethnic background may have differed from their educational background which may again have differed from the ethnic origin of the organisation in which they worked.

What was opportunist was the re-use of the data and respondents of the 1989 survey in which the researcher had previously been involved. As is noted elsewhere (Pettigrew, 1989; Vitalari, 1985) longitudinal surveys suffer severely from the problem of respondent attrition. Respondent attrition may occur because the respondent has left the particular population being polled or lost motivation to support the research. Others avoid this problem by polling similar populations but this is clearly not as satisfactory as observing change in the actual subjects of the original research. Quite apart from subjects who had left the population or lost motivation to support the research a great deal of effort is required to keep track of the respondents. A significant number of the organisations involved in the research had changed their addresses during the period between the surveys and some organisations had changed their names and ownership. Happily, Hong Kong's size and cohesion as a commercial community militated towards these changes being traced. It is very necessary to maintain a sound database during longitudinal research and it is recommended that this be done throughout the period of the research rather than at specific "polling" points as actually happened here.

Similar problems of attrition beset the case study work. Several of the co-operating organisations had not appreciated the amount of respondent's time that it was hoped would be made available. One strategy would have been to lay this out clearly at the outset. Had this been done it is doubtful if any of the respondents would have participated. With a few exceptions there was a constant cajoling and sometimes pleading for further interaction. The exceptions were interesting. One was a situation where the respondent had not originally replied to the second questionnaire. After a chance meeting between the researcher and the respondent, the questionnaire turned up and since then the most sustained relationship has developed with the responding organisation. In another case the original respondent was not available at the time of the

interviews and the “stand in” sought to form a relationship with the researcher which would have led more to “action research”. As is mentioned above this was handled by performing the requested task after the capture of the research data.

This leads into the next observation that in longitudinal and interpretative case study research the impact of the research can not be wholly discounted as an intervention. If a particular methodology was mentioned on Questionnaire 1 which the respondent had not heard of, by the time questionnaire 2 is being responded to it is unlikely that the respondent will not have appraised himself of it. Similarly in case interviews the researcher can not ignore requests from the respondents for the researcher’s opinions which will inevitably influence eventual outcomes. The researcher can only be vigilant to keep such responses to a minimum.

9.3 Reflections

9.3.1 Other Dimensions - a Wider Model

Whilst great care has been taken to assert and show the validity of pluralism in epistemology and ontology this same pluralism is not reflected in the maturity model devised. Whilst consisting of eight dimensions it can be accused of standing completely in the purview of a single ontological stance. This is not true of a model such as Multiview (Avison & Wood-Harper, 1990) whose very name suggests its ontological pluralism. The new maturity model has elaborated a number of facets of a single ontological perspective. As it is admitted that there are various valid ontological stances so it follows that there are various sets of facets that might be elaborated from these stances. In a softer perspective than that taken with the model explored it would be possible to construct a maturity model from other facets. These would include facets

such as the numbers of skill-sets available to a development situation; the sophistication inherent in the various skill-sets, the various levels of effectiveness and sophistication of the skill development environments, societal complexity explored through acts labelled “culture” and “custom and practice”. Since such concepts cannot be measured in the sense of knowing “how much” such understanding of them as is available is best derived through knowing their place on a linear dimension such as the facets developed in this maturity model. In other words we can seek to know “where”, in relation to each other on an ordered scale, without knowing “how much”.

Problems arise through the value judgements placed on the implied direction of the facets. In the question of culture clearly we can place various societies in an historical sequence of agrarian, industrial, informational. We can point to societies of each of these types extant in the 1990s. These might have differing cultural and philosophical roots. It would be at our peril that we assert causation between the cultural and philosophical root and the placement of the society on such a scale. However, whilst these areas and this softer perspective might be more difficult to perceive and differentiate from their contexts it is seen that the exploration of softer phenomena could well indicate a more informative model than that derived. The focus of the model explored in this research has been on the quality of the practice of IS development. It would have been possible to formulate dimensions examining the wider issues identified above. In such a case the research would have been amongst the Chief Executive Officers and their equivalents in the organisations studied rather than those directing the IS development activities.

9.3.2 Reflection on the Scores achieved by the case study organisations

As explained in Section 8.5 a numerical stage value was assigned for each case for each dimension of the Model. Next each case was given a tentative overall stage

number and the differences between this number and the assigned stage was plotted into a matrix. The sum of these differences was derived and a linear programming tool was used to derive final overall stage positions for each case. This gave the result shown in the table 9.1. The researcher has a deep faith in all the assignments shown below as a true reflection of the state of IS development practice in these organisation in 1993 except in the case labelled “SHANCOM” where access was not possible after the initial interview. The spread of the result is pleasing in that it indicates that the model is capable of differentiating diverse organisations in terms of their IS development practice.

RHKJC	HACTL	SHANCOM	CHEK	ARC	CSC
3	2	2	1	1	1

Table 9.1 Overall Stages assigned to each case

It might be charged that since 50% of the cases examined are assessed as being in an initial stage, no organisation is assessed as fully mature and only one organisation is at stage 3 then the model is of limited use. By examining the scoring on the various dimensions IS development management can see very easily where attention to their practice would pay dividends. It is believed that the model can be used as a tool for moving from re-active IS development management to pro-active IS development management.

9.3.3 Reflection on the Research Process

As to the process of the research, the benefit derived from the longitudinal approach in relation to the effort and cost is a cause for concern. It was possible to identify and categorise candidate respondents according to facets of interest to the research. This was largely due to data derived from the previous research. Without this data, preparation for the case studies would have been more laborious. If there is a relationship between adaptability and willingness to participate in research (and the evidence brought here for the existence of such a relationship is recognised as being

slight) then the longitudinal re-iteration of the questionnaires has saved some time from randomly contacting unwilling respondents. The results from the questionnaire which stood out starkly served to substantiate that the Information Technology revolution brought about by the widespread use of microprocessors had happened in Hong Kong as much as in the West. However, there had been little doubt that this was true. If one could step into the river of time at the same point as the outset of the research again it would be with a desire to look at people-relation, organisational centred and societal constructs rather than degrees of methodological prescription accepted. A reconstruction of the research process would flow from the questions found and the work already done, as it did for the actual enactment.

Firmer evidence might have been sought that the major organisational re-constructions (e.g. globalisation and downsizing), consequences of the IT revolution, which were happening to many organisations centred in the West were happening to far fewer organisations in Hong Kong.

9.4 Future research directions.

It is apparent that the evidence for the promulgated model is not strong. Whether this is because Hong Kong is a peculiar community where contingency more often holds sway over theoretically based practice is reasonable to question.. One of the first concerns then must be to replicate the research in IS development communities closer to the community producing the literature on which the model was based. It would be particularly instructive to replicate the case study research especially in organisations similar to the Hong Kong organisations elsewhere. Since the failure of the metaphors (which had found some resonance during presentation in the UK) is thought to have been partly due to the cultural barriers between the researcher and the observed community the metaphors will be tried again in the second pass. If they were found to

be evocative in a UK setting this would confirm the previously stated suspicion. It will be possible to approach organisations in similar industries but whether those are similar in other respects remains to be seen.

One way to strengthen the validity of the model would be to challenge it explicitly against the perceptions of the respondents originally used to construct it. Whilst the case study synopses (Appendices 1.1 to 1.6) were sent to the respondents and adjusted following their comments and feedback this was not done with the placements on the model. Challenging the model with the perceptions of the respondents may call forth a reaction from the respondents useful in further refining the model. It is anticipated that the researcher will have an opportunity to visit the respondents during December 1997. These visits will be preceded by sending the respondents a package of information explaining the model and their placement on it.

Further, it is proposed to take the model into an "Action Research" phase, in the United Kingdom, offering it as an auditing tool for organisations willing to assess their IS development practice through its dimensions possibly through the development of a specialist research centre for IS development. As this is done, further refinement or confirmation of the model will be sought. It is likely that refinement will take the form of additions and deletions of the dimensions. Further it may be that the dimensions need to be qualified with dimensions of their own as seems to be indicated in the problems explained above in using the "Methodology Sequence" and "Methodology Rigour" An understanding of the virtuosity of the practitioner is needed to qualify the placement at a particular stage on the dimension.

9.5 Summary & Conclusion

This chapter has reviewed the findings from the case studies against the promulgated maturity model. Whilst the evidence supporting the model is not conclusive it does indicate a gulf between the espoused theory and practice. It was possible to identify characteristics of organisations at the lower end of the model and those thought to be at stage 1 could justifiably be described as exhibiting a contingency approach. The organisations identified as at the second stage, although numbering only two, could both be described as having an “informed control” approach although for one of the organisations the informing had mostly occurred a number of years previously. It would be dangerous to assign a generalising label to the approach found in the only organisation thought to be at stage three of the model and no organisation was thought to be at a fourth stage. However, the approach of the organisation at stage three might be described as pursuing “constrained creativity” in its approach to the development of IS.

A resonance has, therefore, been found with the first two stages of both the Capability Model (Humphrey, 1988) and the Nolan model (1979). This was found through a different mode of investigation tending to verify the usefulness of those models which the promulgated model is believed to stand between in terms of the concerns which it addresses. Nolan’s model deals with the wide issues of management of investment in Information Technology. The Capability Model is centred on the development of software. The model developed here is concerned with the management of the development of organisational systems.

This chapter next treated the dimensions of the model in the sequence in which they had been found to be useful as differentiators amongst the case study organisations

in Hong Kong. The dimensions *metrication* and *methodology scope* were found not to differentiate the organisations studied at all. It is thought that a different result would be found in another location such as the United Kingdom where it is believed that there a number of organisations measuring their development practices and enterprise wide planning methods find some favour. *Methodology sequence* was a more useful differentiator and *life cycle scope*, *user involvement*, *automation* and *paradigm diversity* were all strongly useful in differentiating the cases studied. However, *methodology rigour* proved to be the most useful differentiator since there were organisations which fitted all four points identified for the dimension. The model might be refined recognising that not all dimensions exist at all four stages. However, further tests need to be conducted in environments more heavily populated with potential users of the model than Hong Kong. For this reason it would be unwise at this point to drop particular dimensions from the model.

The model is thought to have validity but needs to be approached with the following caveats.

It is a model rendering differentiating perceptions of dynamically changing organisations. The dimensions through which these perceptions may be obtained are subject to change themselves and each dimension of the model needs to be periodically reviewed as to whether it will render useful information. For instance the *metrication* dimension found not to be useful at the time of the study may yield a different result at a later date or in a different territory. Further, the dimensions cannot be taken at face value - the underlying reasons behind particular practices need to be known before an assessment of IS development practice in a particular organisation can be made. IS are subject to generational changes as evidenced in Chapter 8. Only models which are

adaptable over these generational changes (Couger et al, 1982) will persistently render meaningful perceptions. The Nolan model (Gibson & Nolan, 1974; Nolan, 1979 & 1984) was revised completely by Nolan himself three times in ten years reflecting the generational shifts in the technology and the movement in emphasis of management thinking about IS and IT. This emphasis movement is well typified by the IS Function focus (isolated / organisational / environmental) identified by Galliers & Sutherland (1990).

The research set out to show a difference between theory and practice in IS development; structure knowledge of IS development practice into a maturity model between two well known extant models, and demonstrate the turbulence in the IS development field between the time of the original questionnaire and the present day. This last item is held to have been well demonstrated with the differences flowing mostly from what has been termed the Information Technology revolution. This is shown to have been brought about by IS developers but not to have impacted their own practice as much as they have imposed its effects on the organisations they serve. The model has been promulgated and investigated with reference to particular organisations in Hong Kong. It has been found to be useful and it would therefore be interesting to investigate its usefulness in a larger and more diverse economy than Hong Kong. The difference between theory and practice in IS development has been perceived through the model. What is really interesting, however, concerns the nature of such models themselves. It has become apparent during this research that models such as this need to be viewed as evolving phenomena. The model user has the responsibility to understand the need to refine the model in light of the wider changing environment. This is thought to be a key insight of the research process described here.

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Appendices

Appendix 1.1 Case Study - A Computer Services Company

The company was formed over thirty years ago as a bureau service company and by the time of writing had become a wholly owned subsidiary of a major “Hong” providing a full range of outsourcing services.

In a trade press interview, the business is described by the Chairman as follows:

“(the company) pioneered the services business in the total sense. Although we were a “bureau” in the early days, we were far more than a bureau. What I knew to be a bureau before I came to Hong Kong was basically a computer facility that people used - the client knew what he wanted, knew what he was doing, and dialled into the bureau on a timesharing basis and used computer resources. What we did was build systems, we implemented systems. We acted as companies’ data processing departments. So we were actually managing the DP resource - we held the mainframe... But the reason that we’ve survived is that we were not just a bureau... we supplied the skills behind the computing requirements.”

In 1981-82 the company was listed in a local directory. Business was stated to be computer utility and facilities management. Applications were declared as commercial, banking and backup services. The 1991 the directory states the business as

being Computer Bureau/consultancy/ data preparation/software. Time sharing, accounting, service bureau, real-time banking, engineering, foreign exchange and trade enquiry have been added to the list of applications. In 1987 the value of all hardware (2 Univac 1106s, 1 Univac 1100, 6 PDP 11/70s and 3 Datapoint 2200 with their peripherals was put at US\$30 million . In 1991 the value of all hardware (2 IBM 4381s, an IBM 4361, a VAX 3600, a VAX 3900, 6 PDP 11/70s, a Unisys 1100 and a Unisys 1106) was declared to be US\$7.4 million. The drop in the capital tied up in hardware clearly illustrates the value of the move from mainframes to minis. Whilst the number of managers had remained constant (20) between these two reports the number of Analysts had grown by 20% (from 25 to 30) but the number of Programmers had almost doubled (from 31 to 60). However in the period between the questionnaire responses 1987 to 1993 the Anthony triangle remained almost exactly the same shape.

The questionnaires had both been completed by the Director and General Manager. However the General Manager was seconded to the parent company on a special assignment shortly after the completion of the second questionnaire and the first interview was held with the Director of Professional Services. Further interviews were held with the Project Managers reporting to the Director of Professional Services.

Both in 1987 and 1993 the General Manager reported that internal communications were informal and that the flow of decision making was mixed. In the new sections asking for views of Management Structure and the Management of Change the General Manager identifies the organisation as being managed as a matrix from the diagrams after Handy (1976). It is reported that the statement distilling Scientific Management (Taylor 1911) is somewhat distrusted as is the highly mechanistic statement. A central position is taken on the statement reflecting Lewin and

Schein's change model as well as the statement intended to distil the systems school and the concept of the learning organisation (Argyris & Schön, 1978 , Checkland, 1981 and Senge, 1990). The statement asserting that organisational change is determined by the availability of technology is somewhat trusted. The respondent agrees that the idea that organisational change depends on the shared understanding of the personnel of a desired change is widely held in the organisation. The idea that the organisation is the victim of external forces is said to be somewhat accepted.

In the realm of the organisation of development there is a 10% shift out of the 1987 position of 30% use of packages so that in 1993 80% of applications are stated as developed in-house. Whereas batch, on-line, real-time split 40%, 30%, 30% in 1987 by 1993 it is reported as 40% batch and 60% on-line. The situation between files and database reverses dramatically. 80% of applications were file based in 1987 but by 1993 80% were database grounded. There is significant growth in the use of Fourth Generation Languages in the period. In 1987 the split Third Generation Languages to Fourth Generation Languages was 80% to 20% but by 1993 it was 50% each. The amount of software developed in End-user departments is dropping. In 1987 40% was developed in End-user departments with professional help and this had dropped to 20% by 1993. The period also saw a move away from mainframes in favour of minis and micros, the Mainframe/ mini/ micro split being 50% /50% /0% in 1987 by 1993 it was 20% /60% / 20%.

Apart from the growth in Fourth Generation Languages there was little change in the languages and tools being used - COBOL, Basic and Mantis being mentioned in both questionnaires. Assembler was mentioned in 1987 and in 1993 interviews revealed that an Executive Information System was being marketed and supported by the

company.

The company was of greatest interest to the research because it appeared from the questionnaires that there had been great change in the methodologies in use. Where the 1987 response had asserted that combined methods were used in Analysis, Design and Implementation by 1993 Data Flow oriented methods, Data Structure oriented methods were both selected for all four phases (Strategic Planning, System Analysis, System Design and Implementation) as well as Prototyping and Object-oriented methods being used for Analysis, Design and Implementation. Through interview it was discovered that the practitioners had a fair degree of freedom to select the methods that they used and that the actual method in use was contingent on a number of factors. In 1987 the respondent had reported that the company's practice was at the integration stage in Nolan's terms. This had changed to being between control and integration by 1993 but since "between" responses had not been catered for in the questionnaire in 1987 it is reasonable to regard the company as having been in the transition state also in 1987.

In both 1987 and 1993 it was reported that in-house developed standards were available. However, the Director of Professional Services said in interview that one of his first tasks was the introduction of more standardisation in the use of methodologies. He may consider introducing the methodology used in his previous organisation but was also interested in SSADM since its adoption would position the company to bid for Government contracts which it was believed would shortly become a significant opportunity.

One of the Project Managers voiced recollection of building user manuals and

System Specifications by reading code. Some reverse engineering and CASE tools had been appraised but nothing competent for the task had been discovered.

Another stated that when a project is initiated there will be about 10 system study meetings over a 2 week period. Analysts will use their existing knowledge to grasp new requirements. They will brief the Analyst / Programmers on the requirements which will usually be an improvement on existing operating procedures. Seventy percent of development is for existing clients with new needs. Data Flow Diagrams may be used to explicate the requirement. The client will sign-off a statement of requirement.

The manager of a major new development for a single client said that following a proposal Requirements Specifications were signed off after a period of 4-5 months. Detailed Study Analysis took approximately 2 months for each of the 12 sub-systems which would involve the Senior Manager and 1 Systems Analyst. There were normally 3 subsystems in Development in parallel. The approach was felt to be bottom up as MIS specifications were elicited from the client as on-line reporting requirements. Implementation using Mantis is in progress. The respondent sees that the company will get more involved in strategic planning in future and expects a wider customer base. A belief that the right direction to more Professional Services and Complete Solutions is being followed was stated.

A CASE tool had been used for Analysis and Design in a major project for a Government Department where use of the tool was required by the client. Increased use of such tools, following this exposure is expected but is contingent on commercial opportunities.

What came across in interview with the project managers was a culture of emphasis on delivering code on time sometimes at personal cost - usually in the form of unremunerated long hours. To some extent this militated against careful updating of specifications.

A pool mechanism is operated especially at the Analyst/ Programmer level. Several of the Project Managers reported working on the same applications and several reported on working on a wide variety. One reported that the exposure to multiple applications and multiple platforms was the reason that junior staff might accept lower remuneration than they might be able to command working for some other company. The challenge was keener and would pay off in the long run.

How are the questions of the research protocol answered?

Clearly a contingency approach is being followed. Whilst most paradigms of Information Systems Development are in use for specific purposes, the most likely factor in selecting a particular method or model will be the developer's experience with the method or model. Solutions are always for a single company but elements of solutions for one company may re-appear because of the flexible pooling mechanism. The capture of standard solutions through definition of the company's intellectual property at systems level does not appear to be in place. Currently the adherence to the company's methodology is tacit but this is an area of concern to the management. Until the emphasis of development centres on earlier stages of the life-cycle than implementation this level of adherence will persist. As with most external providers of services some importance is placed on client signatures before the commitment of resources. This situation militates against iterative forms of the life-cycle - the provider being careful not to commit himself to that which he is not reasonably certain of being

able to deliver. Multiple paradigms are in use but the defining factor is more likely to be practitioner comfort than problem suitability.

It is somewhat surprising that with the emphasis on delivery of systems to clients more use is not made of CASE tools. However, there has been significant growth in the use of Fourth Generation Languages. Currently, very little attention is paid to the concept of metrics. The matrix management and pool situation means that when staff are reviewed they are likely to have been exposed to several problems under several managers. Although several Project Managers expressed concern about the subjectivity of the appraisal and reward system devising more objective measures in the current situation would prove extremely complex such that some of the measures would have to be arbitrary and hence introducing similar subjectivity.

This organisation has had an external focus probably since the day it was floated off as an independent bureau from the local facility of a major multinational operation. Its function prior to the float had been to utilise spare computing capacity so the float itself symbolises the change from a focus on internal concerns to a focus on environmental. Clearly there is an emphasis on serving the market and fully utilising the skills available. The organisation is run as a “tight ship” often at the expense of the practising developers. With little organisational slack tasks are attacked with a contingent approach. Attitudes appear to be changing to adapting to a planned future but the probability of change towards mature practice is contingent on attitudes in the owning group.

Appendix 1.2 Case Study - HACTL

The company, whose full title is The Hong Kong Air Cargo Terminals Limited, is a private franchisee operating and managing the temporary storage and movement of air freight between airside and landside currently at Hong Kong's Kai Tak airport.

Because of the monopoly granted through the franchise the company operates within a Hong Kong Government regulated profit control scheme and is jointly owned by five shareholders - Jardine Mathieson and Co. Ltd. (30%), Swire Aviation Ltd. (30%), Wharf Holdings Ltd. (15%), Hong Kong Whampoa Dock Co. Ltd (15%) and Hong Kong Government (10%). The company was incorporated in December 1971 and building commenced in early 1974. The terminal was opened in January 1976 and all airlines had transferred their cargo operations there by May of that year. The original terminal was designed for a capacity of 350,000 tonnes annually. The terminal was extended in 1984 and renovated in 1988. These changes improved the capacity by more than 100% to 720,000 tonnes per annum. Terminal 2 was commissioned in 1991 and consists of two sub-terminals with a further handling capacity of 720,000 tonnes. This is envisioned to meet Hong Kong's Air Cargo requirements till 1998. Whilst the tonnage handled by air cargo is only 1% of the port's capacity it is estimated to represent 21% of the value of cargo moved.

The company operates on a modular philosophy. The terminals together have 46 modules, each with similar equipment. All floors can be treated as ground floors because of the provision of truck ramps. In 1989 the original terminal handled 2000 vehicles a day on the landside. On the airside, with the use of 4 loading fingers, 2 high capacity bridge hoists for container distribution and the capacity to park 5 747 cargo freighters simultaneously the complex has, on occasion handled 20% of the world's Boeing 747 air cargo fleet in a single day as well as all cargo from the scheduled mixed

and passenger flights using Kai Tak. Dwell times average 19 hours for exports and 37 hours for imports comparing favourably with the leading international airports of the world. The company is particularly proud of its low mishandling rate which it measures at better than one consignment in 20,715 compared with a rate of one in 21 for mishandling originated from other airports. Clearly the company is delivering a quality operation.

Apart from the movement of cargo through the terminals the company also offers storage, palletization, courier baggage services, civil mail transshipment, pick-up and delivery, direct transshipment to China, container repair, license application and customs clearance. There are special facilities for dangerous goods, valuable cargo, small consignments, perishables and livestock.

The company's computer systems for Terminal 2 implement a philosophy of maximal automation. This is said to bring advantages in terms of space utilisation, speed of handling as well as staff safety. The Terminal 2 systems may be viewed at five levels. The top level is COSAC (the COmmunity System for Air Cargo) also used in Terminal 1. This integrates three basic record types - the flight, consignment and Unit Load Device or container). The basic functions of COSAC are Cargo Inventory, Individual Consignment records, Warehouse Handling functions, Cargo manifest production, customs control functions and container inventory, unit load device records, flight schedules, flight records and handling details, interline cargo message handling and operational statistical report production. COSAC is supported on the mainframes by the Terminal 2 Automation System - a suite of systems providing Logistic Control, Storage Planning and Scheduling as well as the communications bridge to Level 3. Level 3 is the Materials Handling Automation Systems which co-ordinates Level 2 the

Programmable Logic Controllers which oversee the Electro-mechanical control mechanisms at Level 1. The system is further supported by the Terminal 1 automation system which is however limited to the processing of bulk cargo, leaving the rest running in semi-automatic mode.

Both the 1987 and 1993 surveys were completed by Mr K. K. Yeung. Mr Yeung, currently Chairman of the Hong Kong Government IT committee, has a long history of voluntarily acting in an advisory capacity to the computing and information systems departments of the tertiary institutes of the territory and has also acted as the President of the Hong Kong Computer Society. He has firm views on the education of computing professionals and believes that :-

“IT attracts people who thrive on the challenge of constant change”.

He states that refined practice in Information Systems Development is abnormal because by the time practitioners have evolved best ways of handling a particular technology the technology has moved on. A clear echo from practitioner management of Couger's generational theory (1982.)

There has been some sharpening of the Anthony (1965) triangle as shown in figure HACTL1.

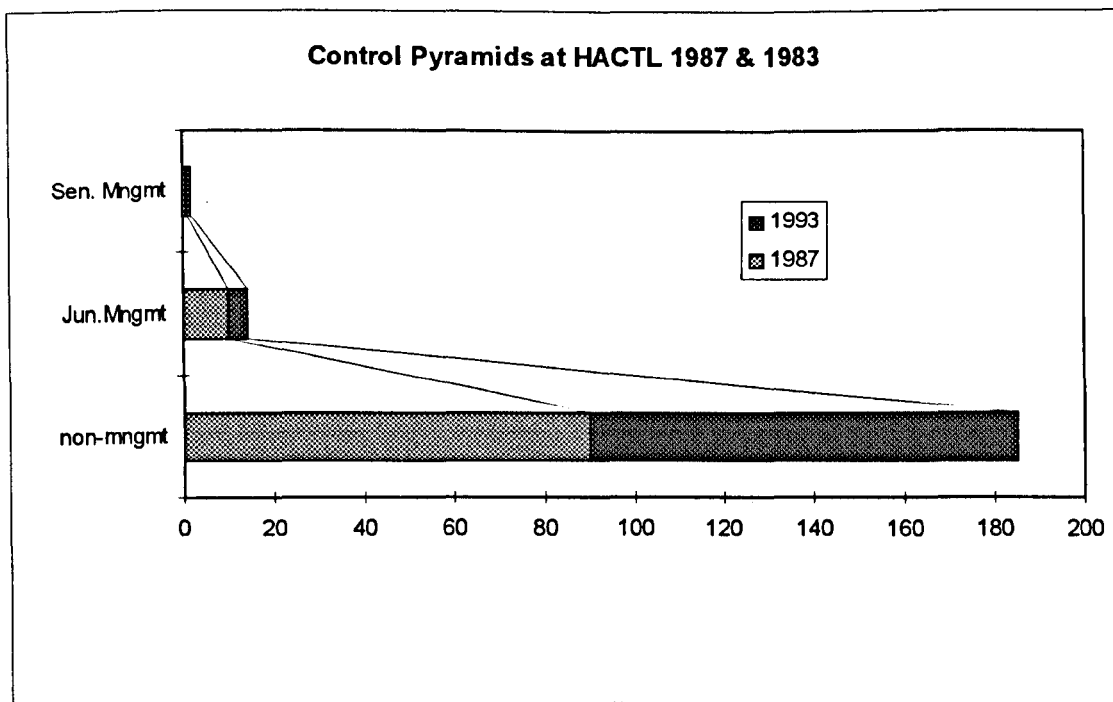


Figure HACTL1 - Control Pyramids at HACTL 1987 & 1993

While over the same period the central staff had grown from approximately 1100 to 2000. Together with the picture given above of rapidly growing capacity and throughput a scenario of improving management control and increasing productivity during rapid growth emerges.

Mr Yeung reports that internal company communications have moved from formal to informal. Since this is over a period when there has been increased automation of the operation of the company business it would be worthwhile investigating whether this phenomenon appears in other organisations. Similarly the emphasis on training had moved from very high to high. However, this might be explained through other factors in the economy such as the higher staff turnover believed to be associated with the increased phenomenon of emigration to countries such as Canada and Australia as well as a possible movement in the perception between

1987 and 1993 of the respondent as to what constitutes “very high” commitment to training.

In 1987 the Management Services Department had 50 staff whereas currently the Information Services Department has 100 staff. In interview Mr Yeung stated that “currently there are too many development staff”.

The increase in the DP Budgets is almost 83%. The distribution of computer resources had changed from central with networks of micros in 1987 to central and remote and it was reported in interview with Mr Mok that there would shortly be a switch over to a network of workstations. Mr Mok was at pains to assert that this “downsizing” was taking place for the purpose of increasing flexibility rather than cost cutting.

There was an decrease in the percentage of in-house software from 95% in 1987 to 70% in 1993. The difference being taken up by turnkey systems in 1993. The growth in movement to real-time systems was only 5% but it had already stood at 90% in 1987. There has been a movement into Database use at 30% from a 100% file position at 1987. There was no Fourth Generation Language use in 1987 but now 30% are developed with Fourth Generation Languages. In 1987 90% of development was in Assembler and this has dropped to 65%. Third Generation Language development has dropped from 10% to 5%. This appears to reflect a situation of legacy systems remaining in their original languages with new systems being developed in Fourth Generation Languages. The proportion of systems developed by users is still stated to be 5%. Interestingly in 1987 the other 95% was reported as “DP/User Developed” but

in 1993 it is reported as DP developed - a shift which may have come about through the re-organisation implied by the name change mentioned above.

In the new sections asking for views of Management Structure and the Management of Change Mr Yeung identifies the organisation as a bureaucracy from the diagrams after Handy (1976). It is reported that the statement distilling Scientific Management (Taylor, 1911) is neither widely held nor distrusted the central position being favoured. However the highly mechanistic view that "organisation change is brought about mainly and simply through the direction of management" is reported as widely held. The statement intended to distil the systems school and the concept of the learning organisation (Argyris & Schön, 1978; Checkland, 1981; Senge, 1990) is reported to be somewhat distrusted. The statement reflecting Lewin and Schein's change model is said to be widely distrusted. The idea that "organisational Change depends on the shared understanding of the personnel of a desired change" is reported as widely distrusted but a middle position is taken on the statement intended to reflect the views of Scarborough and Corbett (1992) and Wilson (1992). A central position is also taken on the statement asserting that organisational change is determined by the availability of technology.

In 1987 the main development Languages were Assembler, Basic and COBOL. By 1993 Assembler was still in the list but had been joined by C, Natural 2 and Foxpro at the expense of Basic and COBOL. These moves are reflected in the identified development tools which on mainframes changed from "in-house developed software" to "Natural, Adabas and Teamwork". Change is not so apparently radical, rather growth, at the micro level where in 1987 "DBMS" was reported whereas "Foxpro, Notes and Powerbuilder" are reported in 1993 - the addition of a tool for Computer

Supported Co-operative Working and a Fourth Generation Language. Outsourcing is being evaluated.

Strategic planning for Information Systems is performed in an unstructured manner by Mr. Yeung and Mr Mok. Whereas in 1987 methods of systems analysis were left “un-ticked” in 1993 prototyping and data flow oriented methods were selected. In 1987 system design was stated to use data structure oriented methods and program development was said to be hierarchical. By 1993 data flow methods and prototyping were in use for design and prototyping for implementation.

In-house documentation standards were stated to resemble airline standards in 1987 further elaboration was given in 1993 that they covered all life-cycle phases. A CASE tool, (Arthur Anderson’s Design 1) was in use as early as 1987 and in 1993 it was stated that CASE Tools are still used for Analysis. During interview Mr Mok enunciated a learning curve problem with Cadre’s Teamwork. In 1987 no answer was given to the Data Dictionary question but by 1993 a cross-project data dictionary integrated with the database software was in use.

HACTL was one of 10% of the set responding to both questionnaires which indicated a regression on the Nolan scale. In 1987 data administration was selected and in 1993 integration was selected. It would appear that the organisation has not moved backwards in terms of the maturity of its Information Systems Development. The change in perception has likely come about through an increase in complexity of the environments in which the development and operation take place e.g. closer ties with China, more choices in processing methods.

The application profile shows that operational applications have remained steady at 90% but that the split of the remainder between planning and MIS/DSS has switched over. The expected movement in emphasis towards MIS/DSS expressed in 1987 has not materialised. In fact there has been a proportional decrease, as can be seen from figure HACTL2. This is consonant with the decrease in junior management staff who would be the most likely users of such systems.

	Operational	MIS/DSS	Planning
1987 "now"	90	9	1
1987+5 year forecast	70	20	10
1993 "now"	90	2	8
1993+5 year forecast	80	10	10

Figure HACTL2 - Application type forecasts at HACTL 1987 & 1993

Interestingly in 1987 staff shortage was selected as the major problem. By 1993 this now appears to have been solved and the other two suggested items "Backlog" and "Maintenance" are ticked. No "other" problems are suggested by the respondent.

The respondents view of the preceding 5 years is shown in figure HACTL3.

Approximate % increase over the previous five years

	1987 response	1993 response
Total no of Employees	20	25
No of DP related Employees	100	100
Company Turnover	100	60
Investment in Hardware	100) 270
Investment in Software	5) included in above

Figure HACTL3 - Percentage Increases of Employment & Investment at HACTL over previous 5 years

We can see that the total work-force is relatively steady but growth in the number of DP related employees is steadily dynamic. Whilst growth in turnover declines growth in DP related investment is very dynamic pointing to DP related Investment as a major focus of Management concern.

In 1987 Mr Yeung identified as his major development concern for the next five years

“more emphasis on quality control and methodologies standards”.

In 1993 he is projecting forward to 1998 a scenario consisting of CASE, 4GL and some Object-oriented Development. In interview in 1994 he stated that at that time there were too many development staff. His basic approach to change in ISD is to note that Information Systems Development practice is constantly changing.

“The basis of IT professional practice is like constantly moving sand. Refined practice is abnormal because by the time practitioners have grasped best ways of handling a particular technology the technology has moved on. IT attracts people who thrive on the challenge of this constants change.”

Mr Yeung talks of chaos in the technology and the success of marketing in the industry. Clearly his operation has brought some order out of that chaos in the 20 years since the incorporation of the company. However, he is modest about this achievement. He states that the organisation manages a continual process. Goals to be pursued are high degrees of safety, security, integration, reliability and especially flexibility.

Mr Yeung describes the commitment to conservative reliability thus

“HACTL is in the business of high service reliability. Whilst we are aggressive in exploiting technology and successful in putting technology to use in so many areas of our operation we remain conservative in our choice of technology. We are no gamblers and being responsible for such an important chunk of the Hong Kong economy we are always cautious in not taking undue risks”

The organisations biggest ever project went live in December 1994. This is the move from centralised systems to a UNIX/workstation based network system. This change was made to improve the flexibility of the system rather than in the name of downsizing. Systems had moved from Assembler into CICS with VTAM, BDAM, COBOL etc. and now into Natural and Adabas. A major factor was the problem of retaining staff which became very apparent during the years of particular brain drain culminating in 1988/89.

The approach to change in Information Systems Development is holistic and organismic rather than hierarchical or compartmentalised. Strategic planning takes place through discussion between KK Yeung and Marcus.

Various philosophies are applied:-

1. as far as possible decisions are embedded in the computer system reducing the possibility of human error;
2. systems are designed to support rather than control the personnel;
3. using automata to remove people from the warehouse improves security and safety aspects.

Mr Marcus Mok, the General Manager of Information Services provided the following insights. Management are confident about the future of the company and Hong Kong. At the time of the design of Terminal 2 it was already anticipated that a move to Chek Lap Kok would be made within the time scales mooted by Hong Kong Government. Projects are of various sizes and duration, from several years to a few days. The division between development and maintenance is not always clear. Office Automation projects tend to be short but highly effective. There is a continuing concern to improve the operation of the terminals with respect to efficiency and accuracy of handling, security and safety.

How are the questions of the research protocol answered?

As stated above the approach to change in Information Systems Development is holistic and organismic rather than hierarchical or compartmentalised. Whilst standardisation and methodological conformity were seen as desirable some years ago contingency factors dominate decisions to deviate from the methods in frequent use. An all purpose standard methodology is not in use but structured methods have been used for legacy systems, object-oriented methods are seen as most use for areas where the user interface dominates and there is an integration of automation approach. Mainly structured views and prototyping are used and user involvement appears to have decreased but this is misleading because of the re-organisation. It would be true to say

that the developer is the end-user - the company is highly dominated by information technology to the point where it is close to the fact to say that management of the IT is management of the company. Evidence of this is that the Deputy Managing Director of the company has come from IT. There is a strong commitment to automation but this has only partially impacted the automation of Information Systems Development. They were early users of CASE tools but this automation has not spread far beyond analysis. However, in significant systems data dictionaries are integrated with on-line applications. More significantly there has been a move away from second generation languages (a high proportion of Assembler) into Fourth Generation Languages. Because of the emphases on contingency evaluation and flexibility the Information Systems Development practice may be viewed as in the initial stage of the ISD maturity model, able but not willing to adopt the practices of the village and factory levels except where imperative evidence is available. The difficulty of differentiating maintenance from development is strong evidence of this.

Mr Yeung wished to make it clear that the conservatism of the organisation was a considered stance. He said

“HACTL is in the business of high service reliability. Whilst we are aggressive in exploiting technology and successful in putting technology to use in so many areas of our operation we remain conservative in our choice of technology. We are no gamblers, being responsible for such an important chunk of the Hong Kong economy we are always cautious in not taking undue risks.”

The organisation's IS function is the greater part of the organisation. This is evidenced by the fact that the Deputy General Manager has acted as the President of the

Hong Kong Computer Society and has come from an IS career track. He actively encourages professional practice throughout the organisation it is hardly surprising that there is an active watching brief on sound practice in IS development. This is tempered with an awareness of the hyperbole rife in the field and a keen sense of responsibility to the community, shareholders and other stakeholders. Enunciation of these latter concerns justifies identifying the organisation's IS function as having an external focus. Few organisations more clearly demonstrate the enabling property of IS. Here IS are used to enable the organisation to achieve safe and accurate throughput of a fast growing volume of air cargo traffic.

Appendix 1.3 Case Study - A Recreational Club

The Recreational Club is a private recreation club limited by guarantee.

Sporting and dining facilities are provided to the membership which has grown in the period under study from 1700 to 1850. The Assistant General Manager, completed both the 1987 and 1993 questionnaires and agreed to be interviewed. He agreed with my assertion that the operation of the club might be viewed as similar to that of a first class resort hotel without the bedrooms. The Assistant General Manager takes responsibility for the administration of the club including the membership and accounting functions but food and beverage management was also a significant aspect of the operation of the club.

According to the Assistant General Manager strong economic growth in China with its implications for Hong Kong is a reason for optimism. As China is economically successful there will be stronger demand for the kind of services and facilities the Club provides.

He was justly proud of the club's Integrated Point of Sale "swipe" card operations. In Hong Kong Clubs, as presumably elsewhere, the use of cash is anathema to the membership and the culture of signing chits for all services and consumables pervades. This is a hang over from the times of the British raj in India - the word "chitty" from the Hindi "citthi", a pass, being in common use amongst the users of recreational clubs of this type. At the Recreational Club things are a bit more up-to-date. Each member has a magnetic swipe card, similar to other credit cards, and there are 22 point of sale terminals where services are provided such as in the restaurants and at the tennis courts. The terminals also provide paper copies of each transaction for both the accounts department and the members. Members have welcomed the

introduction of what they see as a modern system. The Assistant General Manager states that the system has greatly simplified membership billing and reduced paperwork considerably. It is believed to be amongst the first such club system in Hong Kong.

Procedures in the club are reported as being centralised. Staff tend to stay with the club much longer than is usual in the hospitality industry in Hong Kong. The Assistant General Manager states that he believes this is due to the quality of the environment and the membership. Turnover may also be avoided by the management style in place. He reports on both questionnaires that communications are informal and that while decision making was stated as top-down in 1987 by 1993 it had become mixed. Staff are viewed as valued company assets. Generally there is a "no redundancy" policy. The systems which have recently been introduced (Integrated Point of Sale) will result in some loss of clerical positions in the accounting area but this will be met through natural wastage.

"The Club operates an open management approach. Staff are given full and immediate access to information on impending changes. They are expected to understand the underlying reasons and necessity of change. Change is successful in the organisation because staff are psychologically prepared."

Turnover in non-service areas is reckoned to be closely linked to, but better than, local standards for respective functions e.g. Accounting, General Office Management.

The initial move into computerisation was brought about by NCR's announcement that they would no longer support the machines running the ledger card

based accounting and membership systems. The Assistant General Manager joined the organisation bringing valuable experience in defining Information Systems requirements for Computerised Systems in a Division of a major Hong³. There was an operational necessity to computerise.

A centralised system was considered comprising an IBM System 3 but it was seen that this would have entailed higher ancillary costs (such as for programming and physical environment) than the distributed system which was chosen. The first system consisted of 3 IBM PCs configured as a file server and two terminals linked by a 3com Ethernet. This supported Membership and Accounts Receivable applications coded in COBOL by a local software house - SystemPro.

The Assistant General Manager defined the specification and acceptance testing. At the time there was understood to be a no staff reduction policy in the club. With the new systems currently being implemented there is expected to be a 50% reduction in the Accounting clerical staff but this is expected to be met through natural wastage.

The respondent doesn't take any extreme positions in the new sections asking for views of Management Structure and the Management of Change. He identifies the organisation as a bureaucracy from the diagrams after Handy (1976). It is reported that the statement distilling Scientific Management (Taylor, 1911) is somewhat distrusted

³ Hong is a Hong Kong term which implies a large organisation formed as a federation of small diverse operations. Usually the company is owned by a single family. The structure is very common in Asia e.g. Daibatsu in Japan. Hutchison Whampoa, Wheelock, Jardines and Swires are regarded as the major Hongks in Hong Kong.

although the highly mechanistic statement is somewhat trusted as is the statement reflecting Lewin and Schein's change model and the statement intended to distil the systems school and the concept of the learning organisation (Argyris & Schön, 1978; Checkland, 1981; Senge, 1990). A central position is taken on the statement asserting that organisational change depends on the shared understanding of the personnel of a desired change although similar statements were later enunciated by the Assistant General Manager. The idea that the organisation is the victim of external forces is said to be somewhat accepted but the statement asserting that organisational change is determined by the availability of technology is somewhat distrusted.

The situation is classic outsourcing on a relatively small scale. Currently most systems are developed by a software house which is part of a large Hong with strong Hospitality management interests. Whilst not being a competitor they have deep exposure to similar activities - a good match of interest without threat. For large systems the Assistant General Manager may spend as much as a month preparing a requirements specification. With the appropriate section head (e.g. the Food and Beverage Manager) and the EDP Supervisor he would search the market, perhaps getting demonstrations from appropriate vendors. Full analysis, detail design and implementation would be the province of the vendors. Large projects might take up to six months prior to hand over for acceptance testing which would be supervised by the Assistant General Manager and the EDP supervisor.

How are the questions of the research protocol answered.

As is evidenced by the quotation above open management is practised in the administration of the club. The acquisition of complex Information Systems is approached in like manner to the acquisition of any other complex artefact. Because the supplier can tailor the artefact to specific needs the Club may be first in the market with

its way of doing things (as with the Point-of -sale cards). The reliability that this provides may be a great member satisfier.

It was not possible to inspect the methods used in development of the systems since they were carried out by another company. However, it was apparent that control was exercised both before and after the activities of the software house.

This organisation's IS function is also externally focused. Information Technology was seen as a differentiator in the well populated recreational club market. A lot of store was placed on the convenience for the customer of being able to log the use of club facilities at point-of-sale. In order to stay ahead of it's rivals the club had placed its faith in an outsourcing operation which mainly served luxury hotels, several owned by a sister company of the outsourcing operation. The scale of operation of the club posed difficulty in the area of retention of DP staff and this is the major justification of the outsourcing strategy.

Appendix 1.4 Case Study - The Jockey Club

The club, which is properly titled the Royal Hong Kong Jockey Club, enjoys a monopoly on gaming in the territory and should be viewed more as an institution of Hong Kong rather than simply as an organisation.

"The welfare of Hong Kong people continues to be one of our major concerns. No profit is made from racing and betting by the Jockey Club. All after-tax surpluses, after investments to improve racing and betting facilities, are given back to the community, through The Hong Kong Jockey Club Charities Trust."

Chairman, Royal Hong Kong Jockey Club in promotional brochure

"The Royal Hong Kong Jockey Club 1993-94"

Mr Robert Neely the Controller of Planning in the Information Technology Directorate of the Club reflects its ethos when stating:-

"The monopoly in itself creates a pressure on the club to strive for excellence and transparent accountability in all its dealings."

In the decade preceding the end of the 1992/3 financial year allocations to community and charitable projects totalled HK\$7,107 million of which HK\$1204 million was in the final year of that decade. Projects have included the funding and management of the construction of a new "national" stadium, the development of the Hong Kong University of Science and Technology, the Hong Kong Academy for the Performing Arts, and an "Ocean" Park which has become a regional tourist attraction. It is not an exaggeration to say that the Club is viewed by many in the community as a most fortuitous source of voluntary charitable donations. These amounts are largely

drawn out through billions of small transactions on only about seventy afternoons or evenings throughout a ten month racing season. The average betting turnover for a meetings in the 1992/3 season was HK\$871.64 million say approximately HK\$100 million per race. Given the punter's propensity for placing stakes in the last few minutes before the start of a race some idea of the difficulty of processing myriad transactions in small spaces of time may be grasped. The club prides itself that there has never been a failure on race day and the sight of the amounts being placed displayed on the diamond screen at Happy Valley or Shatin just before the start of a race is breathtaking both in terms of the amounts themselves but also in terms of the technology which interacts to, inter alia, accurately display the figures.

Although there were Horse and Pony races as early as 1845 the Club was not founded until 1884. The club installed its first computer systems in 1960, professional racing was adopted in 1971, night racing and off-course betting in 1973 and telephone betting in 1974. By 1987 the Club was arguably operating the most sophisticated betting systems in the world and this is evidenced by the fact that its systems were being used in several overseas territories.

In 1982 the Club had a sizeable installation of 26 PDP 11 systems, 6 Hewlett Packard 316s and 2 Pertec CMC XL-40s. There were 4 EDP Managers, 5 System Analysts and 17 Programmers (Barty, 1982). Eight years later he reports that the Pertecs were still in service (although they were replaced that year by Nixdorf Taragons(Barty, 1991)) but were now accompanied by 39 PDP 11s, 32 Vaxs, 13 Microvaxs, 2 Tektronix 2 Wangs and an Ericsson Telephone call and management distribution System (Barty, 1990). The explosive growth in hardware was matched to

some extent by a growth in staffing. Although 10 managers were reported only 9 Systems Analysts were reported whereas there were now 37 Programmers.

Our 1987 survey was completed by Mr John R Markwell the Information Systems Controller who reported 70 staff in the System Development Department and 235 staff in the Computer Utility Department. He also reported that 90% of applications were developed in-house with 10% being purchased as turnkey systems. 95% of the systems were reported to be real-time with only 5% batch but only 5% of systems were on databases as against 95% on files. In 1987 5% of systems were developed using third generation languages and the rest were reported to be developed with Fourth Generation Languages. 100% of applications were said to be developed by the DP department with only 1% running on Micros. In End-user departments there was a certain amount of Software Package implementation - always with DP Department help.

The methods used for System Analysis were unstructured, data flow and hierarchical. System Design used Data Flow and Hierarchical methods as did Program Development. There were formalised documentation standards but these were not supported by an automated Data Dictionary or automated tools for documentation, systems analysis or design. Mr Markwell reported that the Clubs information technology operation should be viewed as having reached a state of integration in terms of Nolan's maturity model. Maintenance was recognised as the most pressing current problem.

The Club response in 1993 was one of 10% of the 1993 responses where the 1987 incumbent had been promoted since the previous response. Not only had Mr

Markwell been promoted but the IT operations of the Club had grown considerably and spawned a separate Information Systems Development company based in Australia. The 1993 response was completed by Mr Robert Neely, Research and Planning Controller in the Information Technology Directorate. The number of Club locations had remained approximately the same. This is unsurprising in light of the fact that during these years attempts to open retail Club locations in housing estates were occasionally met with opposition from residents. Complaints ranged from a general antipathy towards gaming from a moral stance to enunciated fears that their presence encourages young people to become involved in gaming to the extreme that on race days the centres attracted undesirable loiterers.

Whereas Mr Markwell had identified Control procedures in 1987 as decentralised Mr Neely identified them as centralised. According to Mr Neely the management spans of control had become sharper as is barely discernible from figure RHKJC1.

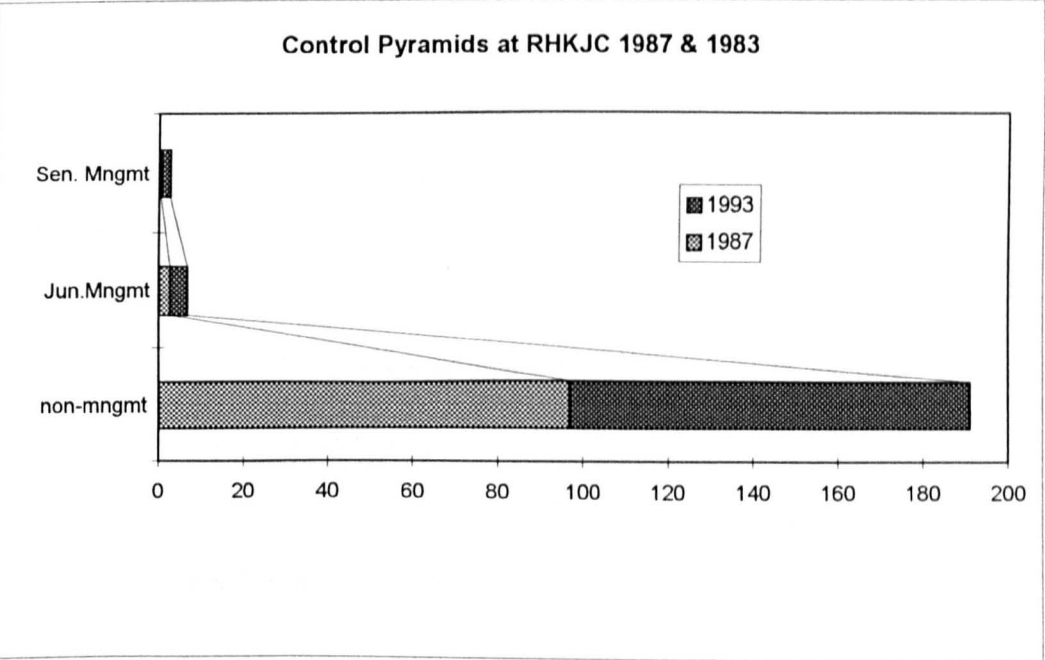


Figure RHKJC1- Control Pyramids at RHKJC 1987 & 1993

Similarly, whereas the 1987 respondent identified the communications within the organisation as formal they were identified as very formal by the 1993 respondent. The emphasis placed on training in the organisation was said to be very high whereas by 1993 it was described as high.

There was a marked change in the levels of central office staffing going from 1400 in 1987 to 2500 in 1993. The degree of this change (almost an 80% increase) was not matched to the same extent in the change of the System Development Department and the Computer Utility Department into the Information technology Directorate where the increase was slightly more than 30%. Whereas use of third generation programming languages had been mentioned together with Database Management System and Fourth Generation Language use by 1993 there was a new emphasis on Fourth Generation Languages and CASE Tools namely SAS and Corvision.

Unstructured and Data Flow and Hierarchical methods were no longer reported as being used but a revolution had taken place with Combined methods and Object-oriented methods being used in Analysis, Design and Implementation and Prototyping being used in Design and Implementation. In discussion with the support staff of the Club's CASE tool provider it was asserted that a Rapid Application Development technique was employed, projects were limited to a 90 day duration and where the task demanded more they were split into manageable 90 day projects. This is really the standard of an external contractor rather than the Club. On the subject of methodologies Mr Neely expounded an open framework approach:-

"Rather than define a standard set of IS development methodologies the club is developing a framework within which practitioners' methods should fit. For any given development the practitioner is expected to be able to define the methods to be used and to justify their selection to open forums consisting of his peers, managers and supporting staff. This is a tough test and project managers are as likely to have to defend decisions not to use particular methods as the opposite."

However, it was also stated that a proprietary documentation standard was in use. The Club has consciously considered and rejected the strategy of outsourcing and uses CASE tools for Strategic Planning, Systems Analysis and Design and Implementation although there is still no automated Data Dictionary support. The response was amongst 10% of the respondents to both questionnaires where the position on the Nolan model was reported as lower than in the previous survey. Mr Neely reported that the Club was between Control and Integration whereas in 1987 the box for Integration had been ticked. As explained in Chapter 7 the boxes between stages had not been included in the 1987 questionnaire but were included in 1993 because in 1987 many respondents had selected two contiguous boxes and this had been interpreted as an indication that they viewed themselves as being in a state of transition between stages. It is reasonable to assume that had the option of the transition been explicitly given the previous respondent may well have opted for it.

The scenario with End-users has not changed markedly since 1987 when it was reported that there was no End-user development but that some software packages were in use with professional support. This figure is now given as 1% and standardisation on the Microsoft Office Suite is indicated. Problems enunciated have grown somewhat

since 1987 when only "maintenance" was selected. The other suggested problems "backlog" and "staff shortage" are now selected and under "other", "transition to new technologies" is proffered.

In the new sections asking for views of Management Structure and the Management of Change it is reported that the statement distilling Scientific Management (Taylor, 1911) and a highly mechanistic view are widely held in the organisation. The statement intended to distil the systems school and the concept of the learning organisation (Argyris and Schön, 1978; Checkland, 1981; Senge, 1990) is reported to be widely distrusted. The statement reflecting Lewin and Schein's change model is somewhat distrusted and a middle position is taken on the statements intended to reflect the views of Scarborough and Corbett (1992) and Wilson (1992).

The differences between the 1987 and 1993 responses are numerous but mostly of a one place shift except for those concerning the practice of Information Systems Development in use where radical change has taken place. The minor changes are possibly best explained as occasioned by the change in respondent rather than reflective of shift in the practice or ethos of the organisation. While there has been growth and change in the organisation and its Information Systems Development method the essential philosophy that comes across is "steady as she goes". As stated above the change in practice has been quite radical - methodologies, and language generations and the form of the life cycle have all changed and is ongoing while the organisation is preparing to undertake adherence to ISO 9002 and Tick-it yet there is continuity in the staffing and the platforms on which systems are mounted.

How are the questions of the research protocol answered.

Superficially it would appear that a mechanistic application of Scientific Management is in place. However, it is noted that there is not radical change in the organisation except in the area of Information Technology. The organisation is very security conscious - the external threat of interference with races being readily understood. Such threats can support a highly mechanistic management style. Compliant attitudes extend into the Information Technology area but their management authority amongst the developers is bolstered by the shared vision that the Club is foremost in World-wide terms in its application area; practitioners may use the most advanced approaches, methods, tools and techniques if they can justify them; the necessity to reliably handle extreme peaks shortly before race times creates an extreme surplus of computing resources at other times making a peculiarly resource rich development environment.

The philosophy and ethos of the management of change was not specifically, voluntarily enunciated by the management. In order for the organisation to continue to use the method of developer satisfying they must continue to be at the fore-front of technological developments. A relaxation in this area will accelerate the staffing problems already beginning to appear. Currently they are able to attract and retain skilled competent staff because they offer the opportunity to become experienced in the latest approaches, methods, tools, techniques and technology - they would experience competition for the available skilled labour from other users in the community of state of the art technology.

Like the air cargo handling organisation IS and IT enable operation at levels which would be impossible otherwise and are peerless internationally. In the case of the

club phenomenal peaks in transaction processing are handled in the final few minutes before “the off” safely, reliably and accurately. The IS function, however, appears to be organisationally focused. The club operates at the most mature end of the scope dimensions. The research and planning division is responsible for translating the strategic plans into actions and the in appropriate circumstances the organisation may be restructured in solution solving. There is normally application of the approved methodology with only occasional deviance. When deviance is sought it is pre-approved through presentations to peers and management. Because of the limited time frame (90 days maximum) of the methodologies employed the Life cycle form is single pass. Multiple paradigms (combined structured and object-oriented) are used in all phases. Prototyping is used in all new work to involve the user. CASE tools are used for development but these are not integrated with databases dictionaries or directly with operational systems. There are plans to introduce metrics to facilitate ISO 9002 and Tick-it. Overall therefore the organisation is operating at the high end on most dimensions of the model.

Appendix 1.5 Case Study - The Chekiang Bank

The Bank is properly titled, The Chekiang First Bank Limited. Both the 1987 and 1993 questionnaires were completed by Mr C K Lim, the General Manager, EDP Department. Mr Lim reports to the Director and Deputy Chief Manager. On the 1987 questionnaire Mr Lim described the company as an International Subsidiary with Local Autonomy. During the strong yen days of the late 1980s (1987) the American and Chinese partners in the Bank were bought out by the Dai Ichi Bank who had obtained a major shareholding. Management methods had not noticeably changed according to Mr Lim. He himself had come into DP 22 years previously when the Bank had acquired its first computer. Several of the Senior Managers also had more than 20 years experience. Mr Lim described the operation of the company in conservative terms

“Both in the company and in Information Systems change is incremental rather than radical.”

Between the questionnaires the non-management proportion of the staff reduced by 5% in favour of Junior Management. This is shown in figure CHEK1 below.

Control Pyramids at Chekiang First Bank Ltd 1987 & 1993

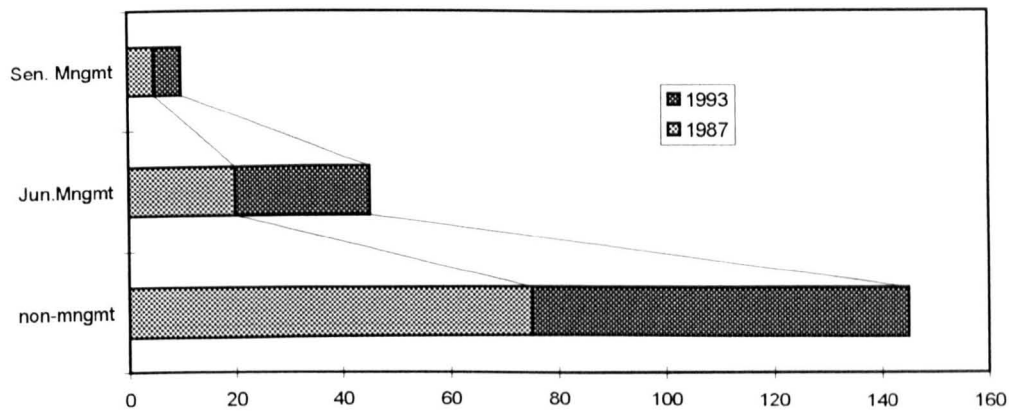


Figure CHEK1 - Control Pyramids at the Chekiang Bank 1987 & 1993

The emphasis on training in the organisation has moved from average to high.

Mr Lim said

“A watching brief is held on seminars being offered by vendors and consultancies and staff attending will be supported 100%. Staff are also encouraged to enrol on appropriate tertiary part time courses offered by the Universities and Polytechnics. If a staff members pursues such a course 60% of his fees are met.”

Communication in the organisation is described as top-down and formal. From the drawings after Handy (1976) Mr. Lim identified the organisation as a bureaucracy. The Scientific Management view is said to be somewhat held and the highly mechanistic statement was said to be widely agreed with. Lewin and Schein's view was said to be somewhat distrusted whilst the organisational learning view organisation (Argyris & Schön, 1978; Checkland, 1981; Senge, 1990) was said to be somewhat trusted. The statement asserting that organisational change is determined by the availability of technology is somewhat trusted. The idea that the organisation is the

victim of external forces is said to be somewhat accepted but a neutral position is taken on shared understanding as a condition of organisational change.

Mr Lim did not respond to breakdown of applications, in-house/ turnkey /package in 1987 but in 1993 stated that all applications were in-house. Although 60% of applications in 1987 were batch with the other 40% being on-line by 1993 all systems were described as either on-line or real-time.

“The most major recent project has been the conversion to IBM mainframe from NCR. This total re-write from batch to on-line working took place between 1988 and 1993.”

K. W. To, Assistant General Manager, E D P Department.

There has also been significant change in the file structure as 80% of data is now on databases as against 100% conventional file use in 1987. 15% of development is currently with Fourth Generation Languages from a zero position in 1987 and whereas in 1987 all systems were described as 100% DP developed in 1993 95% were said to be DP/User developed. It has to be said that the interviews revealed that this statement meant that the user managers were in touch with EDP management throughout projects as well as through the formal committee structure.

The organisation's processing has moved towards more mainframe processing as can be seen from figure CHEK2.

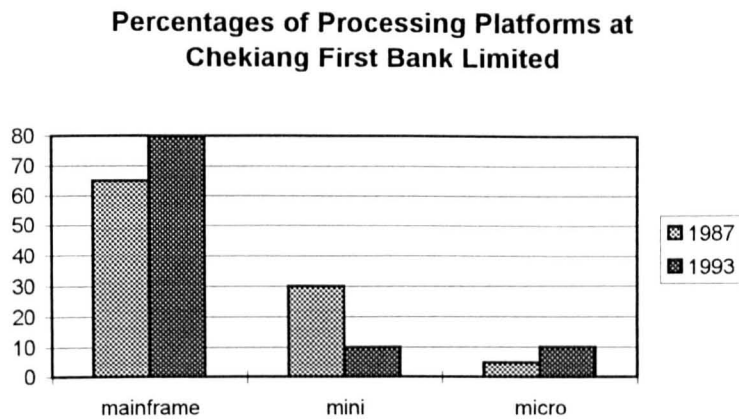


Figure CHEK2 - Percentage of Processing Platforms at Chekiang Bank

In 1987 the development methods for Analysis, Design and Implementation were described as unstructured whereas in 1993 they were described as hierarchical. Whether there had been significant change was debatable since the standard in place was a pre-structured version of the National Computing Centre's standard. Mr C K Yue, a Systems Analyst reporting to Mr Lim, voiced the opinion that the NCC (pre-structured methods) documentation standard is rigidly applied. He finds it quite troublesome and it doesn't really help the developer understand the whole system thoroughly. He said

"It's really oriented to the Program and file level. Structured methods would be better but Object-oriented methods are not appropriate for commercial transaction processing systems such as most of the work at Chekiang at the current stage but these methods may be appropriate in the future."

How are the questions of the research protocol answered.

Staff had a clear idea of Life-cycle considerations. Mr To provided a clear statement of activity on a typical project. He said that feasibility takes very little time and resources. The following table shows a typical resource usage of the remaining time.

Activity	Time in elevenths	No of People involved
Requirements Specification	3	2-3
High Level Design	3	2-3
Detailed Design	2	2
Implementation	2	2
Testing	1	4-5

Figure CHEK3 - Typical Life Cycle resource usage at Chekiang Bank

It was stated that normally the life-cycle was followed with iteration possible back one stage. For particular jobs, where there were technical unknowns that it was advantageous to resolve first, the “drop down” form of technical prototyping recommended by Gilb (1977) would be used.

User involvement was confirmed by all respondents. New requirements were often a consequence of membership of the JETCO and EFTPOS alliances and would be discussed at the weekly meetings with top management where Mr Lim would advise on feasibility. Mr Yue confirmed that it was not unusual for user management to be consulted regularly throughout projects. Prototyping has been considered for user involvement but is regarded as too much of a demand on the time of Senior Staff on both sides. As shown in the table at fig CHEK3 importance is given to all phases of the life-cycle. Most solutions will be within the Bank although there is interface with the previously mentioned alliance companies.

Although early NCC standards are in use they are not on paper but supported by Word Processors. Whilst there is no organised collection of metrics Mr To stated that Quality Assurance was taking place. Each projects code was inspected by a

Quality Assurance team of 4 - 5 of the most experienced programmers who examined the programmes for clarity, efficiency, ease of maintenance, flexibility and correctness. Program testing was also carried out by teams other than the development team before system testing.

The IS function might appear to be externally focused through the membership of the industry alliances. Such an interpretation is probably misleading. The bank is obliged, through the dominance in the market of the banking group which does not belong to these alliances to participate in these alliances. The focus is actually on facilitating the decisions of the committees of these alliances in least time and at lowest cost. There is no attempt to differentiate, using IS, IS based products within the alliance. The focus of the IS function is most properly described as isolated. IS management enunciate customer loyalty as the reason for customer retention. The bank depends on customer loyalty for Whilst there was awareness of up-to-date methods in the IS development field the organisation was remarkably loathe to grow into them. This is thought to be a chronic case of the avoidance of change for change's sake. At some point change is necessary simply to be in the same environment as suppliers and customers. However, Chekiang customers may be as conservative as those who serve them.

Appendix 1.6 Case Study - the Commercial Bank

The bank which is properly titled the Shanghai Commercial Bank is a private company which has been operating in Hong Kong for more than 40 years. There are 30 branches in Hong Kong and three Overseas Branches. Mr Tsui, the Systems Manager and the interview respondent stated that these had been opened to service customers who had emigrated to locations such as London. The 1987 and 1993 questionnaires were both completed by Mr K L Fung who is the Senior Manager (Computing) reporting to the General Manager of the Bank. In both questionnaires control procedures were identified as centralised but by 1993 the Anthony triangle had flattened considerably with significant increases of senior and junior managers as shown in fig SHANCOM1.

Control Pyramids at Shanghai Commercial Bank 1987 & 1993

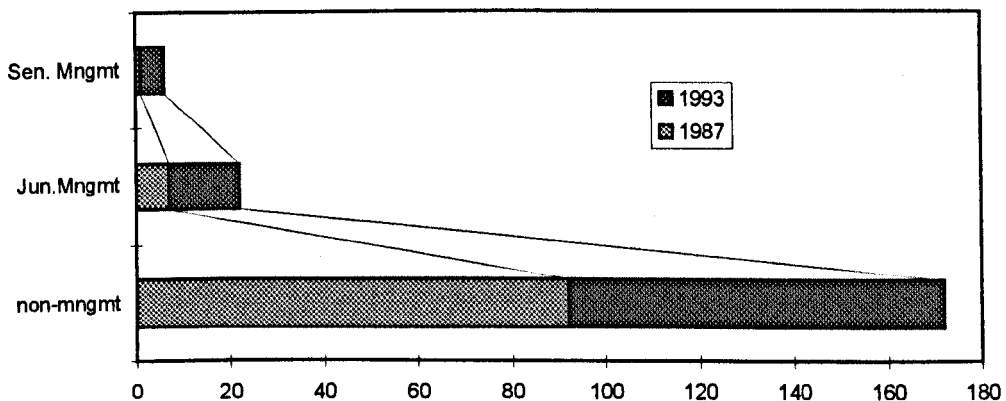


Figure SHANCOM1 - Control Pyramids at the Commercial Bank 1987 & 1993

This is supported by a change in the stated number of central staff from 40 to 450. However, whereas communications were described as formal in 1987 they were

described as very formal in 1993. Both responses stated the flow of decision making was top down and the emphasis on training was average.

In the new sections asking for views of Management Structure and the Management of Change Mr Fung identifies the organisation as power centred from the diagrams after Handy (1976). It is reported that the statement distilling Scientific Management (Taylor, 1911) is neither widely held nor distrusted the central position being favoured as it is for the statement intended to distil the systems school and the concept of the learning organisation (Argyris & Schön, 1978; Checkland, 1981, Senge, 1990) and the statement asserting that organisational change depends on the shared understanding of the personnel of a desired change. The highly mechanistic view that “organisation change is brought about mainly and simply through the direction of management” is reported as somewhat distrusted. The statement reflecting Lewin and Schein's change model is said to be somewhat distrusted. The idea that the organisation is the victim of external forces is said to be somewhat accepted but the statement asserting that organisational change is determined by the availability of technology is somewhat distrusted.

There has been some reorganisation in the provision of information services. In 1987 the Computer Department with 84 staff was reported as the sole provider. By 1993 the Computer Department Staff had grown to 115 the organisation and Methods Department had been created with a staff of 3 and the Credit Information Department had been created with a staff of 11.

In 1987 the company reported running four mainframes as against the 1993 configuration of 2 mainframes and 2 minis. Mr Tsui also mentioned that there had been

a change of supplier from NCR to IBM. The number of workstations had grown from 254 to 600 and the number of standalone micros from 3 to 80.

There has been a slight decrease of in-house sourcing from 85% to 80%. There is now use of 10% turnkey systems and 10% packaged systems as against 15% package use in 1987. Surprisingly there has been a growth in batch processing to 60% from 30%. 10% of this has come from on-line processing which was 20% in 1987. The other 20% has come from real-time processing which has fallen to 30% from 50% in 1987. The proportion of database use has remained constant at 40% but file usage (60%) now includes the 10% which was stated as other in 1987. The use of Fourth Generation Languages is stated to be 30% both in 1993 and 1987. In 1987 the main languages in use were Basic and Assembler whereas they are now stated to be COBOL and CSP. There is some dissatisfaction with the Fourth Generation Language. Mr Tsui stated :-

“CSP was tried but found to give poor response”.

There are no plans to evaluate outsourcing. All end-user computing is the use of packages on stand alone micros. This section was not answered in 1987. This is not surprising as the respondents are not involved in it. In the area of Development methods Hierarchical methods had been selected in 1987. In 1993 Implementation was stated to be unstructured with prototyping, data structure oriented, combined and hierarchical methods were being used for design, object-oriented methods were in use for analysis, Strategic planning was said to be performed with a combination of Data Flow methods, Soft Systems Methods and Rapid Development methods. However, Mr Tsui asserted that there was very little Strategic Planning in practice. Further, the variety of methods

in use at all phases was because project leaders were free to select the methods they considered appropriate

“Methods are up to the project leaders. It is difficult to centralise because of resistance of the project leaders. Mostly they were recruited at the time of the change from NCR to IBM.”

The perceived Stage in Nolan’s terms has moved back half a stage from “Integration” to between “Control” and “Integration”. Whilst “backlog” was the perceived problem in 1987 this has changed to “maintenance”. In the 5 years prior to 1987 total employees increased by 40% as against 100% in the five years preceding 1993. The situation is reversed with regards to DP related employees where the figures 200% prior to 1987 and 15% prior to 1993 are reported. Increase in company turnover was reported as 15% and 20% in the same periods.

How are the questions of the research protocol answered.

Clearly the major change in the organisation has been the change in hardware manufacturer. There has not been the same growth in DP related staff as witnessed elsewhere. The scope of Development activity is severely focused on the late stages of the life-cycle

“the projects are mainly focused on detail design and implementation”.

Early stages of projects are dominated by external actors

“The hardware vendor is trusted to suggest suitable changes in technology.”

“We have to provide the same customer facilities - telephone banking, ATM etc. as other banks”.

This latter quotation reflects the Bank's membership of a number of strategic alliances formed to provide the same cover on electronic banking services such as Automated Teller Machines and Electronic Fund Transfer at Point of Sale in the territory as the dominating provider - the Hong Kong and Shanghai Banking Corporation.

The strategy of small projects allows a single pass life-cycle approach.

"The systems Life cycle is usually visited serially in a single pass. However, it depends to some extent on the pressure from the End-user and the style of the Project Manager. If the End-user pushes too hard the project may be delivered on time but may be the subject of many change requests."

The user is decidedly in the driving seat but he is constrained often by what has been agreed through negotiation with the strategic partners. There is only room for competition on the external appearance of the products - hence the interest in user interface techniques.

"User Acceptance document is typically produced in 1/2 a day.

Following a meeting the project proceeds to screen design, file design, etc.

Techniques used are up to the Project Managers. Some maintain their project data structures but there is no corporate data model. Project managers are resistant to such integrative concepts."

The same "small project" approach is said to obviate approaches to Automation.

“Projects are too small to consider the use of CASE tools. I wouldn’t expect project managers to acquire CASE Tools from their budgets. Building a Data Dictionary would take too long and there is no observable payoff.”

The IS function may be described as isolated for the same reasons as the other bank studied which is a member of the same alliances for the same reasons. The bank’s loyalty to the customer is expressed in terms of setting up branches in territories to which the bank’s high net worth customers have migrated such as London and San Francisco. There is an atmosphere of change avoidance. Mr Tsui says that because of the run up to 1997 he has no idea what the future holds. The organisation is classed in the initial stages of the current model and there is no reason to suspect that a motivation to move out will appear. “Change for change’s sake” is avoided and maintaining the status quo is the most pressing concern.

Appendix 2 - the 1987 Questionnaire

Please Tick and Answer where appropriate.

1. ORGANIZATION DETAILS.

1.1 Name of organization :

1.2 Type of Organization (tick one only):

- | | |
|---|----------|
| A. government owned | A. _____ |
| B. international subsidiary (with local autonomy) | B. _____ |
| C. international subsidiary (with overseas control) | C. _____ |
| D. public company | D. _____ |
| E. public company (with group holdings) | E. _____ |
| F. public company (as group subsidiary) | F. _____ |
| G. public company (with private cross shareholdings) | G. _____ |
| H. private company | H. _____ |
| I. private company (with private group holdings) | I. _____ |
| J. private company (with public group holdings) | J. _____ |
| K. private company (with private & public group holdings) | K. _____ |
| L. private company (family owned) | L. _____ |
| M. other - specify _____ | M. _____ |

1.3 Ownership :

- | | |
|-----------------------|----------|
| HK | A. _____ |
| China | B. _____ |
| Asia | C. _____ |
| Japan | D. _____ |
| UK | E. _____ |
| USA | F. _____ |
| other - specify _____ | G. _____ |

1.4 No. of years established in Hong Kong:

- | | |
|---------|----------|
| < 5 | A. _____ |
| 5 - 20 | B. _____ |
| 20 - 40 | C. _____ |
| > 40 | D. _____ |

1.5 Total No. of employee in HK :

- | | |
|----------|----------|
| 5 - 20 | A. _____ |
| 20 - 100 | B. _____ |
| 100+ | C. _____ |

1.6 Sector of Industry (tick more than one where appropriate):

- | | |
|-----------------------------------|----------|
| A. manufacturing and construction | A. _____ |
| B. import/export | B. _____ |
| C. wholesale / retail | C. _____ |

- D. government & public sector
- E. finance
- F. computer hardware
- G. service
- H. other

D. _____
 E. _____
 F. _____
 G. _____
 H. _____

1.7 Annual gross turnover in HK (HK\$):

- A. <1m(million)
- B. 1 - 10 m
- C. 10 - 100m
- D. 100 - 1000m
- E. > 1000m

A. _____
 B. _____
 C. _____
 D. _____
 E. _____

ORGANIZATION STRUCTURE

2.1 Total no. of company locations (including HK): _____

2.2 No. of company locations in HK : _____

2.3 Control of Procedures :

- A. centralized
- B. decentralized
- C. shared

A. _____
 B. _____
 C. _____

2.4 Approximate % of Senior Management : _____

Approximate % of Junior Management : _____

Approximate % of non-Management staff: _____

2.5 Indicate the extent of formal communication within the organization:

- A. very formal
- B. formal
- C. informal
- D. very informal

A. _____
 B. _____
 C. _____
 D. _____

2.6. Indicate the flow of decision making:

- A. top down
- B. bottom up
- C. mixed

A. _____
 B. _____
 C. _____

2.7 Indicate the emphasis of training within the organization:

- A. very high
- B. high
- C. average
- D. low

A. _____
 B. _____
 C. _____
 D. _____

- E. very low
- F. none

E. _____
F. _____

2.8 Location of Central Office: _____

2.9 Approximate no. of Central Staff: _____

3. ORGANIZATION OF COMPUTER PROCESSING

3.1 How many departments are providing Information Services and Management: _____

3.2 List the names of concerned departments and their total number of staff:

name:	no. of staff
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

3.3 Is decision making for Information Technology:

- | | |
|-------------------------------|----------|
| A. autonomous to your company | A. _____ |
| B. group controlled | B. _____ |
| C. overseas | C. _____ |
| D. other - please explain | D. _____ |

3.4 Year of 1st computer acquisition if other than your own: _____

3.5 Year of 1st computer system use: _____

3.6 Annual DP budget: _____

3.7 Distribution of computer resources :

- | | |
|------------------------|----------|
| A. central | A. _____ |
| B. central & remote | B. _____ |
| C. central & network | C. _____ |
| D. network micros only | D. _____ |
| E. other | E. _____ |

3.8 List the main manufacturers who supply :

mainframes

minis

network processors

networks

stand-alone micro-computer:

3.9 No. of mainframes : _____

No. of minis : _____

No. of on-line workstations : _____

No. of stand-alone micros : _____

3.10 Does your company market any of its software?

A. Yes

B. No

A. _____

B. _____

4. ORGANIZATION OF DEVELOPMENT

4.1 Approximate % by category :

			total
in-house _____	turnkey _____	package _____	100%
batch _____	on-line _____	real-time _____	100%
files _____	database _____	other _____	100%
3GL _____	4GL _____	other _____	100%
DP develop _____	DP/user develop _____	user develop _____	100%

mainframe _____ mini _____ micro _____

100%

4.2 Main development languages

4.3 Main development tools (DBMS, TPMS, 4GL etc.) :

mainframe : _____

micro : _____

5. END USER COMPUTING

5.1 Percentage of applications in the organization that have been created by end users :

5.2 Of the applications that have been created by end-users, what percentage run on stand-alone micros in user's departments :

5.3 Methods that are used in end user's department :

	with professional help	without professional help
Software Package	_____	_____
Conventional Program Languages	_____	_____
Application Generator	_____	_____

Prototyping _____

Other _____

5.4 If possible, identify end user departments and the typical applications they are developing :

End user department :	typical applications
_____	_____
_____	_____
_____	_____
_____	_____

5.5 Do end users generate documentation to organizational standards?

A. Yes	A. _____
B. No	B. _____

6. DEVELOPMENT METHODS

6.1 Indicate the kind of development methods most commonly used:

	System Analysis	System Design	Program Development
Unstructured			
Data Flow Oriented (e.g. Yourdon)			
Data Structure Oriented (e.g. Warnier, Orr)			
Hierarchical			
Combined (e.g. SSADM)			
Other - please state below			

6.2 Are there formalised documentation standard? Please specify.

6.4 Is there an automated Data Dictionary? _____

If so is it

A. cross project	A. _____
B. throughout the company	B. _____
C. integrated with dB software	C. _____
D. other - specify	D. _____

7. EXTENT OF COMPUTERISATION

7.1 Attached is a brief description of NOLAN's theory, please refer to it and indicate where your organization might fit on this spectrum

- | | |
|------------------------|----------|
| A. initiation | A. _____ |
| B. contagion | B. _____ |
| C. control | C. _____ |
| D. integration | D. _____ |
| E. data administration | E. _____ |
| F. maturity | F. _____ |

7.2 Approximate % applications in category :

	Operational	Planning	MIS/DSS
-5 yr.	_____	_____	_____
now	_____	_____	_____
+5 yr.	_____	_____	_____

7.3 Current major problems, please tick :

- | | |
|----------------|-------|
| e.g. backlog | _____ |
| maintenance | _____ |
| staff shortage | _____ |
| other specify | _____ |
| | _____ |
| | _____ |
| | _____ |

8. DP GROWTH

8.1 Approximate % increase/decrease over last 5 years :

- | | |
|------------------------------|-------|
| No. of total employees: | _____ |
| No. of DP related employees: | _____ |
| Company turnover: | _____ |
| Investment in hardware: | _____ |
| Investment in software: | _____ |

9. FUTURE PROJECTIONS OVER THE NEXT FIVE YEARS:

9.1 Hardware environment :

9.2 Software environment :

9.3 Application areas :

9.4 Development methods :

9.5 Organization of DP functions :

9.6 Growth in IT related investment :

9.7 Most significant change areas :

10.1 Person contact : _____ Telephone : _____

10.2 Position : _____

Thank you for your assistance in completing the questionnaire.

Appendix 3 - The 1993 Questionnaire

Please respond to this questionnaire by facsimile or post. The researcher's facsimile number is shown on the reverse of the final page is a facsimile line currently dedicated to this project. Since we have encoded each sheet with the identifier we use for your organisation it is only necessary to re-transmit from the current page if a break in transmission occurs.

Alternatively your response is welcome by post to the address shown on the reverse of the final page.

Please ignore the question numbering - there are additions and gaps in the sequencing where questions have been added or dropped.

Section 0 - Respondent

0.0 Are you the person named on the envelope. A. ☐ Yes (go to Section 1)

B. ☐ No

0.1 The 1987 respondent has :

A. ☐ left the organisation;

B. ☐ left Information Systems work;

C. ☐ emigrated;

D. ☐ been promoted;

E. ☐ other - please indicate _____

(please tick as many options as apply)

Section 1 - Organisation Details

1.2 Ownership

A. ☐ Government

B. ☐ International Subsidiary - with local autonomy

C. ☐ International Subsidiary - with overseas control

D. ☐ Public company

E. ☐ Public company - with group holdings

F. ☐ Public company - as group subsidiary

G. ☐ Public company - with private cross share holdings

H. ☐ Private company

I. ☐ Private company - with private group holdings

J. ☐ Private company - with public group holdings

K. ☐ Private company - with private and public group holdings

L. ☐ Private company - family owned

M. ☐ other - please specify _____

1.5 No of employees in Hong Kong.

A. ☐ 5-20

B. ☐ 20 - 100

C. ☐ >100

1.6 Sector of Industry (tick more than one where appropriate.)

A. ☐ manufacturing & construction

B. ☐ import/export

C. ☐ wholesale/retail

D. ☐ government & public sector

E. ☐ finance

F. ☐ computer hardware

G. ☐ computer software

H. ☐ service

I. ☐ other- please specify _____

1.7 Annual Gross Turnover in HK (in HK\$)

- A. ☐ < 1 million
- C. ☐ 10 - 100 million
- D. ☐ > 1000 million

- B. ☐ 1- 10 million
- D. ☐ 100 - 1000 million

Section 2 - Organisation Structure

2.1 Total number of company locations (including HK) _____

2.2 Number of company locations in Hong Kong _____

2.3 Control Procedures

A. ☐ centralised B. ☐ decentralised C. ☐ shared

2.4 Approximate percentage of senior management _____ %.

junior management _____ %

non-management staff _____ %

2.5 Please indicate the extent of formal communication within the organisation.

A. ☐ very formal B. ☐ formal C. ☐ informal
D. ☐ very informal

2.6 Please indicate the flow of Decision making.

A. ☐ top down B. ☐ bottom up C. ☐ mixed

2.7 Please indicate the emphasis on training within the organisation.

A. ☐ very high B. ☐ high C. ☐ average
D. ☐ low E. ☐ very low F. ☐ none

2.8 Location of Central office _____

2.9 Approximate number of central staff _____

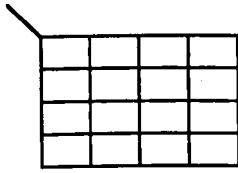
2.10 Would you describe the way in which your organisation is structured as:
(drawings after Handy C, "Understanding Organisations", 1986)



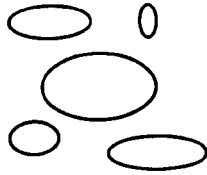
A. ☐ Power Centred



B. ☐ a collection of managed functions



C. ☐ a Matrix



D. ☐ a loose federation of semi-autonomous entities

2.11 On a scale of 1 to 5 indicate to what extent the following statements are believed and practised in your organisation.

A. There is one best way to perform any given task and the role of management is to find and enforce it. (Please circle the number 1 - 5 as appropriate)

widely distrusted 1 2 3 4 5 widely held

B. Organisational Change is brought about mainly and simply through the direction of Management.

widely distrusted 1 2 3 4 5 widely held

C. Organisational Change is brought about through the loosening of the controls Management exerts on the organisation and the development of leadership towards desirable goals.

widely distrusted 1 2 3 4 5 widely held

D. Organisational Change is best effected through a learning process, including explorative and feedback phases, possibly facilitated by external consultants.

widely distrusted 1 2 3 4 5 widely held

E. Organisational Change is determined by available technology : if we fail to utilise technology effectively we will lose ground to our competitors.

widely distrusted 1 2 3 4 5 widely held

F. Organisational Change depends on the shared understanding of the personnel of a desired change.

widely distrusted 1 2 3 4 5 widely held

G. The organisation is the victim of external forces such as market conditions, political eventualities et cetera. The role of management is to anticipate these conditions and formulate strategies and contingencies to best navigate the organisation through a turbulent environment.

widely distrusted 1 2 3 4 5 widely held

Section 3 - Organisation of Computer Processing

3.1 How many Departments are providing Information Services and Management_____.

3.2 List the names of concerned departments and their total number of staff:

Name of Department

No of Staff

3.3 Is decision making for Information Technology:

A. ☐ Autonomous to your company B. ☐ group controlled C. ☐ Overseas

D. ☐ Other - please explain _____

3.6 Annual DP Budget: _____

3.7 Distribution of computer resources:

A. ☐ central

B. ☐ central and remote

C. ☐ central & network

D. ☐ network - micros only

E. ☐ other - please describe _____

3.8 List the main manufacturers who supply: mainframes:

minis:

network processors	networks
--------------------	----------

stand-alone micros

3.9 No. of Mainframes _____ minis _____

workstations stand-alone micros

3.10 Does your company market any of its software? A. ☐ Yes B. ☐ No

3. 11 What percentage of your systems are run on computers or networks owned by other companies? _____

Section 4 - Organisation of Development

4.1 Please indicate approximate percentage by category:

in-house_____	turnkey (tailored - outsourced)_____	outsourced and/or package_____	100%
batch_____	online_____	real-time_____	100%
files_____	database_____	other_____	100%
3GL_____	4GL_____	other_____	100%
DP Develop_____	DP/User Develop_____	user Develop_____	100%
mainframe_____	mini_____	micro_____	100%

4.2 Main Development Languages:

4.3 Main Development Tools (DBMS, TPMS, 4GL etc.):

mainframe:_____

micro:_____

4.4 What is your organisation's situation concerning the concept of outsourcing?

- A. ☐ We have no plans for evaluating the strategy currently.
- B. ☐ We are evaluating the strategy.
- C. ☐ We have consciously rejected the strategy.
- D. ☐ We have adopted/will adopt the strategy for certain kinds of systems.
- E. ☐ We have adopted/will adopt the strategy for all of our systems.

Section 5 - End User Computing

5.1 What percentage of applications in the organisation have been created by end users? _____

5.2 Of the applications created by end users what percentage run on stand alone micros in user's departments? _____

5.3 Method's used in End user's departments:

	with professional help	without professional help
Software Packages		
Conventional Program Languages		
Application Generator		
Prototyping		
Other		

5.4 If possible identify the major end user departments and the typical applications they are developing:

End user Department	typical applications

5.5 Do end users generate documentation to organisational standards?

A. ☐ Yes B. ☐ No

Section 6 - Development Methods

	Strategic Planning	IS	System Analysis	System Design	Implem- entation
Unstructured	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data Flow oriented (e.g. DeMarco)	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data Structure Oriented (e.g. Warnier, Orr)	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hierarchical	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combined (e.g. SSADM)	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Prototyping	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Soft Systems Methods	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rapid Development Methods	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Object-oriented Methods	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other - please state below	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6.2 Are there formalised documentation standards? - Please specify.

6.3 What automated tools (if any) are used to support documentation, systems analysis and design:

- A. ☐ Case tools
- B. ☐ Automated Data Dictionary
- C. ☐ Word processors/Desktop publishing
- D. ☐ Diagramming aids

6.3.1 What is the situation with regard to CASE:

- A. ☐ We have not considered using CASE tools.
- B. ☐ We have considered them but rejected them.
- C. ☐ We are using CASE tools for Strategic Planning.
- D. ☐ We are using CASE tools for Systems Analysis
- E. ☐ We are using CASE tools for Systems Design.
- F. ☐ We are using CASE tools for Code Generation.

6.4 Is there an automated Data Dictionary A. ☐ Yes B. ☐ No

If so is it :

A. ☐ cross project

B. ☐ throughout the company

C. ☐ integrated with DB software

D. ☐ other - please specify below

Section 7 - Extent of Computerisation

7.1 Attached is a brief description of Nolan's Maturity Model of Information Systems in Organisations. Please refer to it and indicate where your organisation might fit on this spectrum.

- A. ☐ initiation
- AB. ☐ between initiation and contagion
- B. ☐ contagion
- BC. ☐ between contagion and control
- C. ☐ control
- CD. ☐ between control and integration
- D. ☐ integration
- DE. ☐ between integration and data administration
- E. ☐ data administration
- EF. ☐ between data administration and maturity
- F. ☐ maturity

7.2 Approximate percentage applications in category:

	Operational	MIS/DSS	Planning
now	_____	_____	_____
+ 5 years	_____	_____	_____

7.3 Current major problems, please tick:

- e.g. A. ☐ backlog B. ☐ maintenance C. ☐ staff shortage
- D. ☐ others - please specify _____

Section 8 - DP Growth

8.1 Approximate percentage increase/decrease over last 5 years:

Total no. of employees :	_____
DP related employees:	_____
Company turnover:	_____
Investment in hardware:	_____
Investment in software:	_____

Section 9 - Change over the last five years and projections for the next five

	Since 1988	By 1998
Hardware environment		
Software environment		
Application areas		
Development methods		
Organisation of DP functions		
Growth in IT related Investment		
Most Significant Change Areas		

Section 10 - Contact information

We are holding the current information regarding the person who kindly responded in 1987. Please correct the information if it is outdated or incomplete

10.1 Person to contact: «Contact_Name» should be _____

10.2 Telephone: «Telno» should be _____

10.3 Facsimile: «Fax_no» should be _____

Thank you for your continued support in completing this questionnaire.

If you would like a copy of the analysis from this questionnaire and its predecessor simply tick this box. ☐

Section 11 - Instruction on outer envelope label.

Important Research : The enclosed is a short follow-up questionnaire to a questionnaire that the person named below kindly completed in 1987. If the person named below is no longer in the position shown we would be grateful if the person in that position - or its nearest equivalent would complete the questionnaire. If you are the person named below and fulfilling or supervising the function shown below we would be very grateful of your assistance again.

(Chinese Translation of the above to facilitate internal messengers responsible for directing mail)

(the original respondent's name and the current address of the post)

Please respond to this questionnaire by facsimile. The researcher's fax number is shown on the reverse of this sheet and is a faxline currently dedicated to this research project. It is only necessary to transmit those pages on which you have made a response. Since we have encoded each sheet with the identifier we use for your organisation it is only necessary to re-transmit from the current page if a break in transmission occurs.

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Protocol

Management of Change

How does this organisation manage change - generally?

- amongst IS developers?

Are they aware of an underlying guiding model?

Is the process “Asian” i.e. markedly different from models found in the western literature?

What conditions have to pertain for a trouble free future?

Placement on Dimensions (Spectra) of IS development practice

Scope of IS Development Concern

S1 (Scope in extended systems development life cycle terms)

1. Do they take a piece-meal contingency approach, solving problems as they arise with little planning, analysis of the immediate problem only and design without regard to foreseeable change. Is the focus mainly on Implementation? Are existing problems likely to be carried forward to new systems?
2. Is most attention paid to Design and Implementation? Are implications of designed change identified catered for?
3. Is the focus mainly on Analysis, Design and Implementation.
4. Does the activity flow from a process of strategic planning?

S2 (Scope in problem boundary terms)

1. Are solutions usually contained in one Department or Organisation?
2. Do solutions frequently cross Departmental boundaries but never organisational boundaries?
3. Do solutions frequently cross organisational boundaries?

Methodology

M1 (rigour with which methodology is applied evidenced by delivery of milestone objects - reports, data dictionary entries etc.)

1. Is there no consistent methodology?
2. Is there a very tacit application of the methodology with a high degree of deviance?
If so is this because the practitioners are highly skilled and make frequent sound decisions to relax the methodology or is it failure to appreciate the downstream benefits of consistent practice?
3. Is there normally application of the methodology with only occasional deviance?
4. Is the methodology rigorously enforced? If so what are the mechanisms of enforcement? What is the source of the desire for rigour? A particular toolset? A strong personality? A shared belief in the downstream benefits?

M2 (sequence)

1. Are stages visited sequentially in a single pass?
2. Are stages visited sequentially with some backward iterations?
3. Are stages visited sequentially with jumps forward to test feasibility of particular coding?
4. Is the situation apparently chaotic with iterations forward and backwards? If so is this because of great skill in meeting the exigencies of the situation or is it because of an inability to plan and assert the benefits of a more orderly approach.

M3 (paradigm diversity - views used in planning analysis and design)

1. Does a single paradigm (say objects, state-transitions, information flows or some other) dominate all phases?
2. Is each phase dominated by a particular paradigm?
3. Are multiple paradigms used and reconciled in some phases?
4. Are multiple paradigms used and reconciled in all phases?

User involvement

U1 (practice of user involvement)

1. Does the developer dominate the design process making most decisions after commissioning?
2. Is user involvement tacit? (Evidence would be displayed by attitudes to the user / enunciated user dissatisfaction)
3. Are mechanisms for involving the user (e.g. prototyping, walkthroughs) frequently invoked or invoked only in part of the life-cycle?
4. Are mechanisms for involving the user always invoked?

Automation

A1

1. Is there no automation other than compilers?
2. Are they using Word Processors, Drawing tools in a disintegrated manner?
3. Is there a toolset integrated for development?
4. Is the toolset integrated with the operational databases, communications processors etc.?

Metrics and Quality Control

Q1

1. Are there quality control procedures in place?
2. Are metrics collected?
3. Is management use made of metrics?
4. Is an ISO 9002 scheme in place