

Title An Examination of Information Systems and Technology Maturity and it's relationship to Methods of Contributing Information to the Information Systems Planning Process in National Health Service Acute Trust Hospitals

Name Ivan John Mitchell

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AN EXAMINATION OF INFORMATION SYSTEMS AND TECHNOLOGY MATURITY AND ITS RELATIONSHIP TO METHODS OF CONTRIBUTING INFORMATION TO THE INFORMATION SYSTEMS PLANNING PROCESS IN NATIONAL HEALTH SERVICE ACUTE TRUST HOSPITALS

Ivan John Mitchell

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Errata

The author wishes to refer the reader to two errors of nomenclature which have been drawn to his attention since the compilation of the final draft of the following thesis. Firstly, the author has made reference to a specific information management and technology strategy formulated by the Government. Throughout the thesis, the author has referred to this as 'IM and T' strategy which should, in fact, read 'IM&T' strategy to correspond with the nomenclature used by the Government. Secondly, the National Health Service Management Executive has, since the thesis was first written, changed its name to the National Health Service Executive. Consequentially, the abbreviation, 'NHSME' should now read 'NHS Executive'.

In memory of William Arthur Mitchell (1923-1980) who both studied and taught at the institution now known as the University of Luton

Abstract

As a result of the use of Nolan's six Stage model of IS and IT maturity in a number of consultancy studies in the early 1980s, managers felt they could maximise the contribution of the IS and IT portfolios to the achievement of business strategy by becoming more IS and IT mature. Despite the development of a further eight models since 1979, empirical tests exist only of the Nolan model and one other, McFarlan, McKenney and Pyburn's model of IT assimilation. This research has sought further empirical evidence of IS and IT maturity in National Health Service (NHS) acute Trust hospitals. Survey method was used to collect data from over seventy top and middle managers representing four Trust hospitals. Statistical analysis of these data provided evidence that six of twenty-three maturity characteristics identified in existing models can currently be used to differentiate the maturity of NHS acute Trust hospitals. These six characteristics had been identified both in models which considered a range of IS and IT issues and in models which had concentrated on a single aspect of IS and IT management. This indicated that further insight is gained by combining these approaches when modelling IS and IT maturity. Managers also placed different emphasis on the use of specific methods of contributing information to the IS planning process in hospitals which exhibited greater IS and IT maturity than in hospitals which exhibited lesser IS and IT maturity. This indicates the existence of a further IS maturity characteristic, further evidence of which can now be sought in other industry sectors.

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Preface

This research had been carried out in pursuit of the degree of Master of Philosophy. It constitutes the results of a project commissioned by the Faculty of Management, University of Luton, focused on the contribution made by the middle manager on the information technology (IT) strategy of the an organisation. It was intended that this research would provide vital underpinning for a new course in information management leading to the degree of Master of Science. The bulk of this research was undertaken while the author was a member of staff of the University, and funded by a scholarship of two years duration. The research was completed on a part-time basis.

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Chapter One Research Aims and Outcomes

1.1 Chapter Overview

Chapter One consists of the rationale, aims, intended outcomes and possible implications of this research. The chapter commences with definitions of information systems (IS), IS planning and information technology (IT). This is followed by arguments supporting the value of IS research based on its contribution to the achievement of business strategy. It is then explained why managers perceive a benefit to their organisations of being more IS and IT mature. The three aims of the research are detailed. The selection of National Health Service (NHS) providers which are operating as Trusts is explained using evidence from Government reforms undertaken in the last decade. These reforms illustrate the potential benefit that can be gained by the managers of such organisations and by those involved in the formulation of Service-wide Information Management and Technology (IM and T) strategy, as it is termed by the National Health Service Management Executive (NHSME), from an examination of IS and IT maturity in this context. How the research aims were fulfilled is explained in a summary of the research design. The chapter concludes with a statement of anticipated outcomes and their implications for the NHS and for future research.

1.2 Definition of Terms

This research was focused on IS, IS planning and IT. For the reader to fully understand its rationale, conclusions and implications, a working definition of these terms was needed. Consultation of text books and journal articles revealed an overall consensus amongst practitioners concerning what they understood by IS and IT. The following definition is typical of textbooks aimed at managers with very little knowledge of the IS or the IT fields.

An information system consists of people, procedures and equipment which work interdependently to generate and store data about the organisation. It also allows managers to manipulate that data in order to generate information from which to make decisions. Information technology, however, usually centred around the microchip, makes the information system more efficient (Reynolds, 1990).

Research has indicated a need to observe the distinction between IS and IT noted by Reynolds, when planning the development of these resources, to avoid wasted investment in IT which does little to assist in the provision of information needs which have been, themselves, poorly defined. Consultancy work by Earl in the late 1980s and his discussions with business strategy-makers in United Kingdom (UK) organisations revealed that where business managers had been given the task of procuring IT to facilitate the functioning of IS, their lack of technological expertise had caused them to buy technology which ultimately made no contribution to

the more effective provision of information. Where IT specialists had been given the task of defining information needs, their lack of knowledge of business strategy and objectives had prevented them from producing a sufficiently detailed picture of what those needs were (Earl, 1987). Taking on board the experiences of these UK organisations, the distinction made by Reynolds and other IS practitioners has been observed in this and the chapters which follow.

Consultation of IS literature has shown researchers to have identified three critical characteristics of a successful IS planning effort. A combination of these characteristics provided the definition of IS planning used in this research. The first characteristic is the identification of computer-based applications needed to satisfy present and future information needs (Lederer and Gardiner, 1992; Remenyi, 1990). The second characteristic is the formulation of a program which establishes how best to implement new systems and changes to existing systems (Remenyi, 1990; Baets, 1992; Earl, 1993). The third characteristic is the formulation of a program which increases the contribution of the existing IS portfolio to the achievement of business strategy (Remenyi, 1990; Earl, 1989).

1.3 The Organisational Importance of IS and IT

The fields of IS and IT remain important areas of management research due to the considerable contribution which managers perceive IS and IT to

make to the achievement of business strategy. These conclusions have been drawn from the results of research undertaken in the United States (US) in which managers, when assessing the performance of their companies IS and IT portfolios using eleven measurement criteria gave the highest weighting to the extent to which IS and IT contributed to the achievement of business objectives. The credibility of these findings is strengthened by the fact that, while confined to fourteen organisations from which thirty executives were surveyed, organisations varying in size from a single plant to multinational corporations were sampled from eight industry sectors (Saunders and Jones, 1992). The reason for the high priority which is now placed on IS and IT is the competitive advantage they have provided since the early 1980s. This can be inferred clearly from evidence unearthed in the mid 1980s by Porter and Millar (1985). They found evidence of a number of organisations which had realised substantial increases in profit as a direct result of investment in new IT. Again, although the sample was confined to fifteen organisations, all of which had a multimillion dollar annual turnover, these findings indicated that competitive advantage from IT was realisable by organisations representing a cross-section of industry sectors such as media, manufacturing, healthcare, leisure, mining and the IT industry itself.

1.4 The Importance of IS and IT Maturity

This research is focused on the IS and IT maturity of organisations. The IS and IT maturing process is important because by becoming more IS and IT mature, organisations increase the potential contribution of their IS and IT portfolios to the achievement of business strategy. The IS and IT maturity concept owes its paternity to Gibson and Nolan who, from the late 1960s until 1979, examined the data processing (DP) function of US companies and found that these companies moved through a series of distinct stages of maturity over time. These stages could be identified using a set of IS and IT characteristics. Gibson and Nolan first presented their findings as a four, and after substantial revision, a six stage model of IS and IT maturity (Gibson and Nolan, 1974; Nolan, 1979). Nolan used the model in over 200 consultancy assignments in organisations who had expressed concern over apparent poor return-on-investment in IT. With it, Nolan, Norton and Co. examined each maturity characteristic and used the results of this examination to establish with respect to which characteristics, an organisation demonstrated greater and indeed lesser IS and IT maturity in comparison with other organisations. By addressing the characteristics in which their organisations were less mature, managers perceived an opportunity to increase the potential contribution of IS and IT to the achievement of business strategy. This opportunity was perceived largely because the Nolan model so accurately reflected the IS and IT-related changes which had taken place in their organisations in recent years.

Following on from the benefits managers felt they had gained from applying the Nolan model to their organisations, derivative models were later developed which focused on specific issues such as the assimilation of IT into the organisation, (McFarlan, McKenney and Pyburn, 1983) and IS planning (Earl, 1988; 1989).

There is a marked lack of support, however, for the existence of specific stages of maturity from the results of empirical tests. Of four independent attempts to validate the stage hypothesis published since 1979, only one found substantive support in the research data for the existence of stages (Raho *et al.*, 1987). However, three revealed evidence of changes over time to IS and IT characteristics in organisations, consistent with a progression from immature to mature (Drury, 1983; Benbasat et al., 1980; Goldstein and McCririck; 1981). This evidence provides some justification for examining organisational maturity with respect to individual, if not combinations of IS and IT characteristics. However, despite Nolan's success, two limitations of existing models should be considered. Firstly, it is by no means certain that all the twenty-three characteristics identified by the nine models to date are characteristics in the IS or IT maturing process at all, or if they were at the time the models were published, that they remain so at present. As early as 1977, Lucas and Sutton found evidence that IS and IT expenditure did not rise and fall in relation to sales growth as Nolan had predicted, but rose in a linear fashion from year to year (Lucas and Sutton, 1977). Nolan's technological

breakdown of the IS and IT portfolio is demonstrably technology-based. Due to the rapidity of technological advances which have taken place since 1979, it is unlikely that this remains a valid measure of IS and IT maturity in the 1990s.

Secondly, there remains the possibility that different sets of characteristics differentiate the IS and IT maturity of different industry sectors. This is because a lack of detailed accounts of research method used in the development of existing models prevents the formation of any assumptions concerning the generalisability of maturity characteristics to more than one environment, and, if so, to which. Empirical tests, while they provide support for the existence of a maturing process, are also of little assistance in pinpointing maturity characteristics for specific environments because they are confined to examinations of the models by Nolan (1974 and 1979 versions) and McFarlan *et al.* (1983). These tests take no consideration of additional maturity characteristics identified in the other seven models. Given the limitations discussed above, the first aim of this research is to make a contribution to knowledge by examining existing IS and IT maturity characteristics in an environment which has received no published attention in treatment of the concept so far. This will seek to establish how many characteristics, if any, differentiate the IS and IT maturity of the organisations operating within it.

1.5 IS and IT Maturity and NHS Trust Providers

The environment selected for this research is NHS providers operating as Trusts. The environment has been chosen because both managers of such providers and those responsible for the IM and T strategy for the NHS as a whole may benefit from knowing with respect to which IS and IT maturity characteristics, some units are more and less mature than others. Such knowledge, it is anticipated, would furnish managers of NHS providers with specific issues of IS and IT management on which to focus in order to improve their response in comparison with other providers to the demands placed on their IS and IT portfolios by Government reforms. Similarly, such knowledge would provide those who formulate national IM and T strategy with the opportunity, if necessary, to expand the focus of existing strategy to include those characteristics with respect to which some units are demonstrably less mature. By expanding the focus of national strategy in this direction, the Government has the opportunity to increase the degree of exploitation of IS and IT in the NHS as a whole. The importance of the IS and IT maturing process to NHS providers is discussed in more detail below.

IS and IT have become increasingly important resources to managers of NHS providers due to changes in information needs set in motion by a series of Government reforms made since the mid 1980s. Concern over the perceived underexploitation of resources within the NHS led the Government to set up the Körner Steering Group on Health Services. This

group established a minimum set of activity-based data concerning the day-to-day operations of a provider unit. It became a requirement for such providers to supply the Department of Health (DoH) with these data which were intended to allow the Government to compare the performance of providers from one to another (Dreachslin *et al.* 1991). This requirement placed additional demands on provider-based IS and IT portfolios.

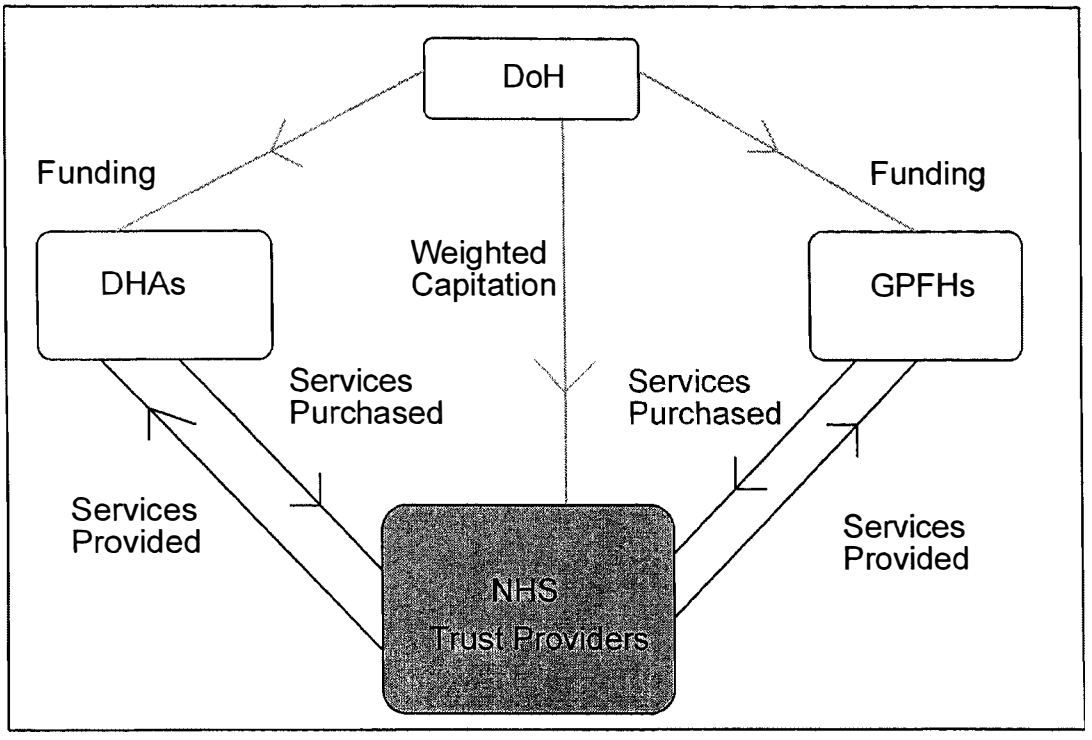
To assist providers in the supply of 'Körner' data, a management information system (MIS) known as 'case-mix' was to be developed. This would bring together data from existing operational systems such as pathology, theatre management and patient administration (P.A.S)[1]. Douglas (1990) offers a succinct definition of 'case-mix' as a common management information database for clinicians and managers based on individual patient record, recording details of all events occurring to the patient. In a project known as the 'Resource Management Initiative' (RMI), a 'case-mix' system was piloted in six acute general hospitals. In 1989, the Government declared these pilot schemes a success and announced plans to implement 'case-mix' systems in a further 200 provider units by 1992 (Hackney and McBride, 1993).

The demands placed on IS within provider units intensified further, however, when the NHS and Community Care Act became law in 1991. Replacing a system in which one hospital provided most if not all the

[1]A patient administration system contains all details of consultant episodes for in-patients and out-patients.

services required in one District Health Authority (DHA) and was run by that authority as a directly managed unit (DMU), DHAs or 'purchasers' now entered into contractual agreements for services from any number of hospitals regardless of geographical location. Since 1991, hospitals, now known as 'providers' have been encouraged to obtain Trust status from the DoH and operate as self-contained financial entities competing with others for the services they provide (Hackney and McBride, 1993). Each Trust is allocated yearly funds and permitted to borrow money for capital expense projects. However, upon consistently failing to break even at the end of the financial year, a Trust can be dissolved at the discretion of the Secretary of State for Health (Tilley, 1993). This relationship has come to be known as the 'purchaser/provider split'. It is illustrated in Figure One.

Figure One The Provider and its Relation to Other Institutions



Adapted from Tilley, I., (1993) 'The Main Institutions of the Internal Market' *Managing the Internal Market*, UK; Chapman, pp.5

It is this Act in particular which has placed new demands on IS and IT. Empirical evidence indicates considerable variation in the ability of existing IS and IT portfolios to meet the information needs of managers operating in the 'internal market'. The inability of some portfolios to provide the data needed for survival in the 'internal market' has put pressure on managers to plan further IS development. A principal role for IS since 1991 is the provision of data to facilitate the business planning process. Interviews and questionnaire responses from clinical and non-

clinical managers representing four London providers operating as Trusts revealed a perceived need for data from which to make the decision whether to seek revenue from further contracts with purchasers or to cut the cost of providing existing services (Salt, Tilley and Baeza, 1993). Responses from the same study and from interviews with twenty-four Unit General Managers of acute hospitals, soon to become Trusts in the former West Midlands Regional Health Authority, revealed that managers gave a higher priority to business planning and to the development of IS and IT when the perceived level of competition with other units was higher. (Baeza, Salt and Tilley, 1993; Appleby *et al.,* 1993). In the former study, managers from one inner London hospital perceived intense competition from district hospitals in elective care, a judgement evidently shared by the four Thames Regional Health Authorities who released forty-six million pounds, known as the Regional Transition Monies, to be divided among similarly placed provider units in compensation for anticipated losses in revenue. In the latter study, intense competition was anticipated by managers in one provider which served over 120 districts with specialities with higher than average costs and a small resident population in its local area.

Whatever the perceived level of competition faced by providers, evidence in available research indicates that the business planning process is considered to be dependent entirely on the provision of accurate, current and historical data to calculate the cost of and potential demand for service

provision. This data are critical because Trust providers win contracts on the basis of their ability provide accurate information to purchasers such as DHAs concerning the cost of each service provided. Available research constitutes a mixture of empirical studies and inferences drawn by individual managers with extensive experience within the NHS based on their examination of Government publications. Examples of the former research are both the survey of providers undertaken by Touche Ross and the National Association of Health Authorities (Manuel, 1991) and of the results of case studies in four acute providers in which computer software was used to simulate the 'internal market' (Burns, 1990). An example of the latter research is the implications drawn from examination of the Government paper, 'Working for Patients', in a study made by Mills, Kwo and Catchpole (1990), the first named of whom was at that time, a member of the NHSME.

Available research which indicates variation in the ability of providers, now operating as Trusts to respond to the demands which Government reforms have placed on IS and IT usage are again divided into the results of case studies and of inferences drawn from literature published by the DoH. Of those providers whose IS and IT portfolios were found to be inadequate, the following difficulties were encountered. A business planning exercise carried out in Scotland in 1991 involving ten strategy-makers representing three acute providers revealed that data were often presented in a format which prevented business planning from taking place

(Edmonstone and Havergal, 1992). The most significant benefit managers perceived from a case-study in the use of decision-support systems in two RHAs was the use of software to summarise data, the volume of which had, prior to the commencement of the study, prevented their use in the decision-making process (Forte, 1994). Opit, in his 1993 study of Government statistics in Scotland found numerous errors which led him to the conclusion that misinformation could pose an additional barrier to the use of data to inform the business planning process (Opit, 1993).

Studies which show a more promising view of the ability of existing IS and IT portfolios to cope with demands of the reformed NHS consist principally of case studies in the application of specific software from which managers perceived some assistance in the tasks which this software was designed to facilitate. This was the case in Humberside Health Authority where teams of managers used a decision-support model to help them to formulate strategies for service provision. Other studies focused on the use of a similar model to forecast demand for services from provider units serving a total in excess of fifteen DHAs and the development of a human resource planning model which was, however, confined to a single acute provider (Cross, 1993; Millington and Shelton, 1990; Dawson, Barnett and Ross, 1991).

To formulate IM and T strategies for the NHS, the NHSME has created an Information Management Group (IMG). This group has formulated a number of generic strategies to maximise the contribution of IT to

healthcare provision. Detailed examination of these published strategies indicates a recognition on the part of the IMG of the need to address some of the maturity characteristics identified in existing research in order to exploit IS and IT to the full. The content of these strategies lead to this conclusion despite no published evidence to the effect that members of the IMG had been influenced in strategy formulation by the content of existing maturity models. It was inferred from this that the IMG may perceive a benefit from knowing with respect to which characteristics providers differ in IS and IT maturity. The IMG may then consider expanding its strategic focus to those maturity characteristics not already addressed by existing IMG strategies. Such an expansion can assist providers in the process of becoming more IS and IT mature. Examination of the booklet, 'Substantial Information Management and Technology Investments' (DoH, 1994) reveals that the IMG considers the following maturity characteristics to be critical success factors in the planning and implementation of IS and IT: the use of IS in the achievement of business strategy, the training of staff in the use of IT, the involvement of business managers in the planning and implementation process and the assessment of the extent to which existing systems satisfy current and future information needs. These characteristics are key components in the use of PRINCE, (Projects in Controlled Environments), the project management method, and of POISE (Procurement of Information Systems Effectively), the IT procurement method proscribed by the NHSME.

To facilitate the implementation of IM and T strategy, the NHSME has, with effect from 1995, set up a number of regional offices in England. Eight major projects have been commissioned by these offices which have investigated information needs considered by the NHSME to be critical to the provision of quality healthcare. (NHSME, 1996) Examination of the objectives and the achievements of a selection of these projects to date shows that the IMG has, in addition to those noted above, begun to address maturity characteristics such as the use of IT-driven IS in management decision-making, to provide data for use in business planning, to share information between departments and units, and the integration of IS and IT. Healthcare Resource Groups (HRGs) have been developed to categorise inpatient episodes in terms of diagnoses, procedures, age and method of discharge. Having completed the refinement of these HRGs, software was developed to analyse such data, the results of which allow providers to monitor and predict changes in demand and revenue from contracts when categorised in this way. Another project is focused on the development of a system for monitoring the quality of data for use by acute providers in business planning. This follows on from work undertaken at the Royal Free Hospital in London in which a series of quality measurement criteria were defined.

A number of projects have been commissioned to promote the sharing of information using IT-driven IS. A three year project has examined the use of electronic patient record systems (EPRs). The results from two

demonstrator sites are scheduled for publication in December 1996. Another project is focused on developing electronic links between General Practitioners (GPs) and providers. The integration of systems continues to be addressed by the development of Hospital Information and Support System (HISS) which, since 1989, has involved the implementation of one IS in which, it is intended, systems such as pathology, pharmacy and patient administration are effectively interconnected. The Information Technology Standards Programme has encouraged the implementation of local area networks (LANs) to link groups of microcomputers within individual departments and wide area networks (WANs) to link departments located at different sites within a single provider and to link systems across providers. Work is also underway to standardise operating systems across units and on the development of communications standards for the transfer from system to system of large data files.

1.6 A Combination of Approaches to Modelling IS and IT Maturity

This research was also focused on contrasting approaches to modelling IS and IT maturity that researchers had adopted in the development of existing models. Existing models have been developed using two contrasting approaches. The first approach consists of developing an all-embracing model by consideration of a range of IS and IT-related

issues. The second approach consists of concentrating in detail on a single aspect of IS or IT management. The second aim of this research was to seek evidence that further insight can be gained into IS and IT maturity by combining these two approaches than by exclusive use of the first approach. The achievement of this second aim had implications for future attempts to model IS and IT maturity. If, when maturity models were examined in relation to NHS providers operating as Trusts, additional maturity characteristics were revealed by models which concentrated on a single aspect of IS or IT management, this would constitute evidence that it was still worth pursuing such an approach. If, however, maturity characteristics were contained exclusively within all-embracing models, this would indicate that researchers in the future would benefit more from concentrating resources on the first of the two approaches to modelling IS and IT maturity.

There are currently nine models of IS and IT maturity published from 1979 to 1991. In four out of the nine models, researchers examined a range of IS or IT-related issues in an attempt to provide all-embracing models of which Galliers and Sutherland's 1991 model is one example. In the other five, researchers concentrated on maturity in a specific aspect of IS or IT management. McFarlan *et al.* (1983), for instance, concentrated specifically on the introduction of IT. Existing research provided considerable justification for supposing that combining these two approaches to modelling IS and IT maturity provides greater insight into

the maturity concept than exclusive use of the first approach. Sixteen characteristics are identified by models in which multiple IS or IT-related issues are examined. However, a further seven, or nearly half as many again, are identified in models which concentrate on a single issue. This research tested this supposition in the context of NHS providers, operating as Trusts.

1.7 Methods of Contributing Information to the IS Planning Process as a Maturity Characteristic

The third aim of this research was to seek evidence that methods of contributing information to the IS planning process were a further characteristic in the IS maturing process. Examination of existing models shows that researchers who have investigated the maturity concept consider the contribution of business managers to the IS planning process to be a key maturity characteristic. The substance of managerial contributions feature in six of the nine published models. Earl has, in fact, devoted his entire model to maturity in IS planning. He considers it particularly important that business managers at all levels should involve themselves both in assessing the ability of current systems to satisfy current and future information needs and in generating ideas for competitive advantage from IT (Earl, 1988; 1989).

Other research efforts have revealed a variety of methods used by managers to contribute information when IS planning. These include minuted group or one-to-one meetings, written documents and oral presentations. Empirical evidence from these studies has shown that in organisations whose managers were, on the whole, satisfied with the results of their IS planning processes, the selection of methods of contributing information was influenced by other organisational characteristics such as its size, the complexity of the IS and IT portfolio and the physical proximity of IS strategy-makers to the Board of Directors. In order for IS planning efforts to be successful, different combinations of methods were required in organisations with small as opposed to large numbers of employees, for example (Pyburn, 1983). Given that the choice of methods of contributing information has an impact, at least in the perception of managers, on the effectiveness of an IS planning effort, there has been little attempt to explore the relationship between such methods and the comparative level of organisational IS and IT maturity. Of those attempts that were made, Nolan suggests that managers use steering committees to co-ordinate organisation-wide planning, but gives no indication of how steering committees might function or how managers might feed information into them (Nolan, 1979). Earl's model concentrates only on what goes into an IS plan, and who is involved in the process at different stages of maturity (Earl, 1989). Ward *et al.* (1990) have made an indirect connection between three contrasting categories of

methods identified in US organisations by Pyburn (1983) and Earl's IS planning model. Ward *et al.* have, however, have made a connection neither between Earl's IS planning model and their own more detailed recommendations concerning methods of contributing information to the IS planning process, nor between Earl's IS planning model and work by Zmud (1984), or by Earl (1993). The lack, therefore, of detailed examination of the relationship between methods of contributing information and IS and IT maturity left scope for further investigation.

1.8 Research Design

The research aims presented in the preceding paragraphs were achieved using the following research design. To establish which IS and IT characteristics differentiated the maturity of NHS providers operating as Trusts, a survey method was employed in the collection of data from managers in a sample of providers concerning the maturity characteristics identified in existing models. Statistical tests were carried out to detect and locate differences in the maturity exhibited by each provider. The characteristics with respect to which providers showed differences in maturity were then compared with existing models to see whether they were contained within all-embracing models or whether additional characteristics had been identified by concentration on a single IS or IT issue. Having used these results to place providers in order of overall IS

and IT maturity and presented this placement as a Positioning Framework, data were collected from the same sample of managers concerning the methods they employed in contributing information to the IS planning process. Statistical tests were then performed on these data to detect and locate differences between providers in the methods used. The results of this analysis were then combined with or 'mapped' onto the Positioning Framework. From this mapping, it was seen whether methods used do vary between hospitals of differing IS and IT maturity.

1.9 Anticipated Research Outcomes

When this research was commenced, it was anticipated that the following outcomes would be generated. By establishing with respect to which characteristics a sample of providers operating as Trusts differed in IS and IT maturity, the managers of such units would be presented with a specific set of factors to address in order to improve the response of their units in relation to other units to the demands placed on IS and IT portfolios generated by Government NHS reforms. Knowledge of the characteristics with respect to which some units were less mature than others would provide the authors of national IM and T strategy with characteristics on which to focus future strategy designed to assist less mature units achieve parity with their more mature counterparts. Were evidence found that more mature providers differed from less mature providers in the methods

used to contribute information to the IS planning process, such evidence would provide support for the hypothesis that such methods are an additional characteristic in the maturing process.

This research was also intended to establish whether further insight could be gained into maturity by combining attempts to develop an all-embracing model with more detailed concentration on a single aspect of IS or IT management. If this were the case, a combination of these two approaches could be recommended in future examinations of IS and IT maturity.

Chapter Two Literature Search

2.1 Chapter Overview

The aims, outcomes and potential benefits of this research have been explained in Chapter One. Chapter Two explains how existing IS literature was used in carrying out the research and to add further weight to the research rationale presented in Chapter One. Chapter Two is divided into two sections. The first section consists of summaries of all nine existing maturity models. Work to date on methods of contributing information to the IS planning process is the focus of the second section. While this reveals some investigation into a relationship between methods and maturity in IS planning, there remains scope to further existing knowledge by seeking further empirical evidence.

The purpose of the summaries of existing models featured in the first section is fourfold. Firstly, they provide the complete set of characteristics from which, those, if any, that differentiate the maturity of a sample of NHS providers operating as Trusts will be identified. Secondly, they illustrate the possibility that greater insight can be gained into IS and IT maturity using an approach which combines consideration of multiple IS and IT issues in an all-embracing model with concentration on a single aspect of IS or IT management. Thirdly, a critique of the models serves to

highlight a number of limitations to their usage. One such limitation is the inability to determine whether all of the characteristics from existing models differentiate maturity in all industry sectors or whether sets of characteristics vary from one sector to another. Fourthly, they show a degree of consensus concerning the contribution of business managers to IS planning as a key characteristic in the maturing process. While other studies have shown that the choice of methods of contributing information is perceived to influence the success of an IS planning effort, this choice has received little attention in the development of existing maturity models.

2.2 IS and IT Maturity Models

The acceptance of Nolan's model in commercial environments has motivated other researchers to develop models which focus on more specific issues such as the assimilation of IT into the organisation, (McFarlan *et al.* 1983) IS planning, (Earl, 1988; Earl, 1989) the contribution of IT to business strategy formulation (Bhabuta, 1988) and the role of the IS department (Hirschheim, Earl, Feeney and Lockett, 1988). These are summarised as follows:

2.2.1 Nolan

Gibson and Nolan, and ultimately Nolan, revised their model several times between 1969 and 1979 to keep pace with the technological advances which took place in that period. The final revision was published by Nolan as a six stage model of IS and IT maturity. During the first stage, batch processing systems are developed in order to reduce costs and increase output. The DP function is centralised in one department with no input at all from the end-user except to request data. Management allows the DP staff to invest as much as they need in technology in order to make the DP function as efficient as possible and to broaden their personal knowledge of IT capabilities. This laxity in relation to budgetary control leads to a rapid rise in expenditure.

In Stage Two, managers in other functions of the organisation increase their knowledge of new database technology and begin to recognise the potential of IT to assist in the decision-making process. They then become frustrated at their own DP department's apparent inability to exploit it for this purpose. The solution to this is perceived to be the investment of more money in database technology. The DP department is therefore given a free budget for the development of new applications. However, inexperience can lead to the breakdown of links between systems at different levels of the organisation.

The fragmentation achieved at the end of Stage Two leads management to the conclusion that the DP department needs to be rebuilt to restore its credibility. In Stage Three, therefore, tight control of systems development and expenditure is established and maintained, and functional departments are held accountable for the DP expenditure that they incur. This process is facilitated by the further exploitation of database technology. It is at this stage that management realises that the effective use of new information technologies cannot be achieved solely by high investment in computers, but requires also the use of data as a resource in itself.

In Stage Four, the rebuilding of the DP function dramatically increases its ability to satisfy user requests. The development of systems to suit specific departmental needs is critical to this increased satisfaction. Once users see that real value can be gained from IT, there is an increasing demand in Stage Four for specialised systems. In order to manage this change, controls are designed to match the development of systems to the needs of users.

In Stage Five, the move towards the management of DP activity outside the DP department continues and is now stimulated by the growth of personal and mini-computing technology. As a result, more data are in the hands of users who are held more accountable for the quality and integrity of those data. In order to achieve this, management of information as a resource is extended to 'external'

bodies, such as steering committees, which co-ordinate DP activity at an organisation-wide level.

The continuous growth of decentralised DP leads to a recognition by top management of the need in Stage Six, to balance centralised and decentralised DP activity. To this end, the sophistication of the planning and control mechanisms for DP activity increases and is facilitated by the allocation of responsibility for information management at appropriate organisational levels. The structure of information systems themselves is tailored to suit the information flows of the organisation. The combinations of characteristics at each stage are detailed in Figure Two.

Figure Two Nolan's Six Stage Model

STAGE ONE	STAGE TWO	STAGE THREE	STAGE FOUR	STAGE FIVE	STAGE SIX
IT-DRIVEN	SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY →				
	IT-DRIVEN SYSTEMS TO SUPPORT DECISION-MAKING →				
		SYSTEMS INTEGRATION →			
		END-USER CONFIDENCE IN IT →			
LOOSE CONTROL OF IS & IT EXPENSE	VERY LOOSE CONTROL OF IS & IT EXPENSE	VERY TIGHT CONTROL OF IS & IT EXPENSE	LOOSER CONTROL of IS & IT EXPENSE	TIGHTER CONTROL OF IS & IT EXPENSE	LOOSER CONTROL OF IS & IT EXPENSE
			INVOLVEMENT OF BUSINESS STAFF IN IS PLANNING		
EXPENSE = RATE OF SALES GROWTH	EXPENSE > RATE OF SALES GROWTH	EXPENSE < RATE OF SALES GROWTH	EXPENSE > RATE OF SALES GROWTH	EXPENSE < RATE OF SALES GROWTH	EXPENSE = RATE OF SALES GROWTH
100% BATCH	80% BATCH 20% REMOTE JOB ENTRY	70% BATCH 15% DB 10% ENQUIRY 5% TIME SHARING	50% BATCH AND REMOTE JOB ENTRY 40% DB 5% PERSONAL 5% MINI & MICRO	20% BATCH AND REMOTE JOB ENTRY 60% DB 5% PERSONAL 15% MINI & MICRO	10% BATCH AND REMOTE JOB ENTRY 60% DB 5% PERSONAL 25% MINI & MICRO

Adapted from Nolan, R.L., (1979), 'Managing the Crisis in Data Processing' *Harvard Business Review* **March-April** pp.115-126

2.2.2 Galliers and Somogyi

Galliers and Somogyi published an alternative to Nolan's model in the form of three 'eras' in 1987. 'Era One' is characterised by fragmented data processing systems controlled exclusively by the data processing department. Systems are developed primarily to sustain operational activity and reduce costs. In 'Era Two' systems are integrated by data processing staff but controlled by business management. New systems are developed to satisfy the decision-making needs of business users. Systems integration is completed in 'Era Three' and further IS development is orientated towards supporting the achievement of business objectives. Systems are now flexible enough to cater for the unpredictability of decision-making. The combinations of characteristics exhibited in each stage are detailed in Figure Three.

Figure Three Galliers and Somogyi's Three Era Model

STAGE ONE	STAGE TWO	STAGE THREE
IT-DRIVEN SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY →		
	SYSTEMS INTEGRATION	
	INVOLVEMENT OF BUSINESS STAFF IN IS PLANNING	
	IT-DRIVEN SYSTEMS TO SUPPORT DECISION-MAKING	
		ALIGNMENT OF IS WITH BUSINESS STRATEGY

Adapted from Galliers, R.D., and Somogyi, S.K., (1987), 'From data processing to strategic information systems-a historical perspective', *Towards Strategic Information Systems,* Abacus Press, pp.5-25

2.2.3 Galliers and Sutherland

Galliers and Sutherland examined IS and IT in Australian organisations and developed a six stage model. Strategy in Stage One is concerned with the purchase of hardware and software, in the control of top management, by those staff who feel they need it. Systems that are developed are unconnected, operational in nature and supportive principally of the finance function. The functioning of technology dominates the activity of the small number of

predominantly programming staff. In order to increase user dependency upon their skills, they develop user hostile systems.

Demand increases in Stage Two for applications which serve other areas of the business. A separate IT section within the company is recognised as a way to satisfy this demand and, as a result of this, IT staff begin to feel a greater commitment to guiding the direction of IT. A DP manager is then appointed to match user requirements to systems development. Emphasis is placed on technical quality and speed in the delivery of systems which, in turn, increases the credibility of a separate IT function in the organisation.

The concentration of IT management in the hands of IT personnel and an overemphasis on delivery at the expense of defining information needs pervades the first two stages of the model and leads to a number of systems which do not fulfil user needs. The perceived solution is formalised planning directed from the top of the organisation. This is the principal characteristic of Stage Three. Control of IS and IT is firmly placed in a central department with an adequate return-on-investment (ROI) as the main priority. The more computer literate users are frustrated by this and develop their own unrefined systems without the benefit of the expertise of IS staff, who, alienated from this apparent user rebellion, do nothing to curb the growth of these systems.

The largely uncontrolled move towards end-user computing in the previous stage stimulates the need of senior management in Stage Four to co-ordinate the activities of IS personnel and users. To achieve this, the IS manager, who has both business and IS experience, is promoted to ensure he/she is given the authority to lead the change towards co-operation between all interested parties and enable IS staff to acquire business management skills.

The successful implementation of systems which are essential in the daily functioning of the business by the end of Stage Four stimulates top management to seek other, strategic opportunities for IT. Stage Five is therefore characterised by the formation of ad-hoc coalitions between IS staff and business functions in order to discuss and implement new uses of IT. The use of such coalitions leads to a tendency for more de-centralised systems co-ordinated from the centre. These are developed by a product champion who combines IT knowledge with entrepreneurial skills.

The success of the ad-hoc coalitions of Stage Five leads to harmonious working relationships between the user and the IS function in Stage Six. By now, senior management is concerned with integrating planning throughout the organisation and sustaining competitive advantage through IT. To this end, views of the individual business unit are integrated with those of corporate management in strategy formulation. This is facilitated by the direct input of the Head of the

IS function who has joined the Board of Directors. The combinations of characteristics exhibited at each stage are detailed in Figure Four.

Figure Four Galliers and Sutherland's Six Stage Model

STAGE ONE	STAGE TWO	STAGE THREE	STAGE FOUR	STAGE FIVE	STAGE SIX
IT-DRIVEN SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY →					
	IT-DRIVEN SYSTEMS TO SUPPORT DECISION-MAKING →				
	END-USER CONFIDENCE IN IT →				
		IMPLEMENTATION OF SYSTEMS BY BUSINESS STAFF →			
		INVOLVEMENT OF BUSINESS STAFF IN IS PLANNING →			
			SYSTEMS INTEGRATION →		
		VERY TIGHT CONTROL OF IS & IT EXPENSE			
			IS STAFF WITH BUSINESS MANAGEMENT SKILLS →		
			COMMUNICATION BETWEEN IS AND BUSINESS STAFF		
				COMPETITIVE ADVANTAGE FROM IT	
					ALIGNMENT OF IS WITH BUSINESS STRATEGY
					INVOLVEMENT OF HEADS OF IS DEPARTMENTS IN BUSINESS PLANNING

Adapted from Galliers, R.D, and Sutherland, A.R., (1991), 'Information systems management and strategy formulation: the 'stages of growth' model revisited,' *Journal of Information Systems* **1**, pp. 89-114

2.2.4 Ward, Griffiths and Whitmore

Ward, Griffiths and Whitmore published an alternative three 'era' model and a model of development of the systems portfolio in 1990. The first of these is summarised as follows.

In 'Era One', data processing is the primary function of information systems. As more data are stored by computers, management realises the opportunity to use these data for control, planning and decision-making. Database technology is seen as the method by which this opportunity can be exploited. However, existing systems architectures are designed for data processing requirements and, for this reason, are unable to accommodate the unpredictability of data requirements for decision-making. Extensive re-structuring of systems is then undertaken to build management information systems (MIS) alongside data processing systems. Users become frustrated by the greater amount of time they need to spend on database preparation. In spite of the completion of MIS development, IS staff in Stage Two still spend a long time on data analysis. Fourth generation languages allow applications such as spreadsheets to be developed and used on personal computers. End-users then use such applications to perform a large proportion of data analysis for which they previously relied on dedicated IS staff. IS staff support end-user computing by continuing to develop new software and co-ordinating centralised and user-based IS. Planning is undertaken to co-ordinate data processing and MIS.

The third stage is characterised by the search for competitive advantage from IT. To achieve this, Ward *et al.* suggest that for planning purposes the systems portfolio be divided up using McFarlan's 'Strategic Grid'. McFarlan made one of the earliest attempts to assess the impact of IS and IT on the competitiveness of the organisation and found that in this respect, systems could be divided into four distinct categories. He represented these in a framework thenceforth known as the 'Strategic Grid' (McFarlan, 1984). Since its publication, the 'Strategic Grid' has become a widely used tool by which the importance of specific systems to the business success of the organisation can be identified. The summary by Ward *et al.* is presented in Figure Five.

Figure Five 'IS Business Contribution-Application Portfolio'

STRATEGIC Systems which are critical for future success	**TURNAROUND** Systems which may be of future strategic importance
FACTORY Systems which are critical to sustaining existing business	**SUPPORT** Systems which improve management and performance but are not critical to the business

Ward, J., Griffiths, P., and Whitmore, P., (1990) *Strategic Planning for Information Systems,* Chichester, UK; Wiley, pp. 30

IS planning should be tailored to the contribution the application makes to the business. 'Factory' and 'support' systems should be planned using a 'bottom-up' approach which places most of the planning responsibility on middle managers and IS staff. 'Strategic' and 'turnaround' systems should however be planned using a 'top-down' approach which places most of the responsibility on top management and senior IS staff. Ward *et al.* stress in addition, that systems need to be classified by the function they perform and not the technology used to perform it. The combinations of characteristics exhibited in each stage are detailed in Figure Six.

Figure Six Ward, Griffiths and Whitmore's Three Era Model

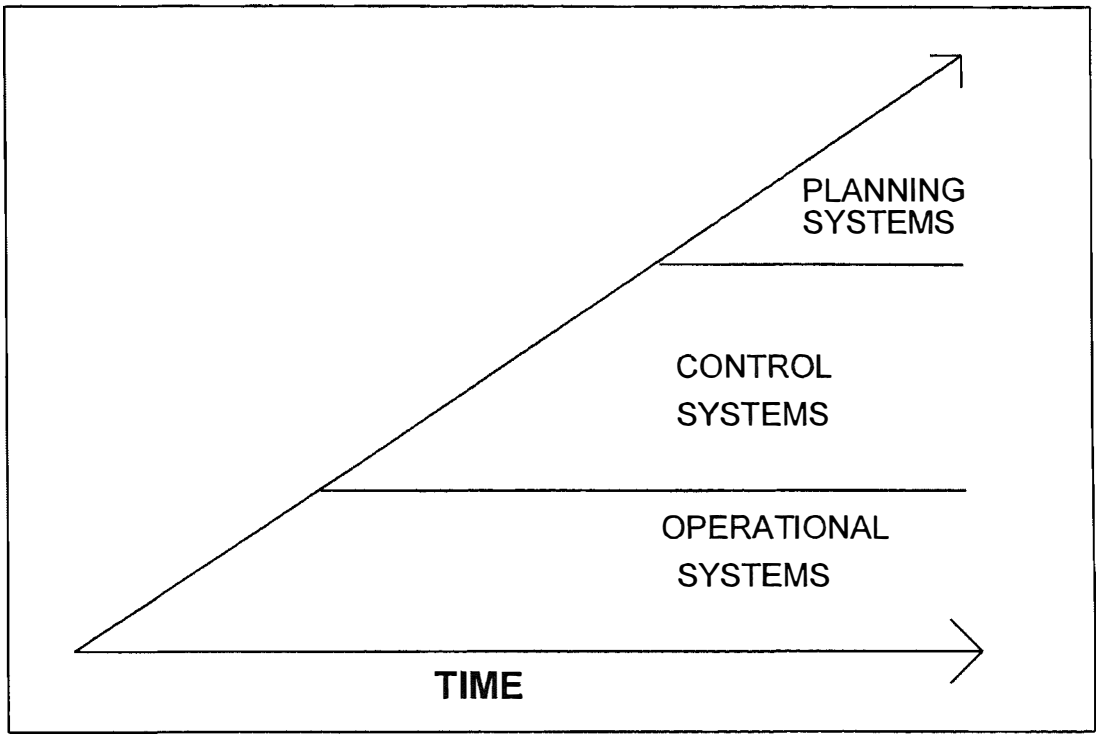
ERA ONE	ERA TWO	ERA THREE
IT-DRIVEN SYSTEMS TO	SUPPORT OPERATIONAL ACTIVITY	→
IT-DRIVEN SYSTEMS TO	SUPPORT DECISION-MAKING	→
	IMPLEMENTATION OF SYSTEMS BY BUSINESS STAFF	
		ASSIGNMENT OF SPECIFIC ROLES FOR SYSTEMS IN SUPPORT OF BUSINESS OBJECTIVES
		INVOLVEMENT OF TOP MANAGEMENT IN IS PLANNING
		INVOLVEMENT OF BUSINESS STAFF IN IS PLANNING
		COMPETITIVE ADVANTAGE FROM IT

Ward, J., Griffiths, P., and Whitmore, P., (1990) *Strategic Planning for Information Systems,* Chichester, UK; Wiley, pp. 12-19

The second of those developed by Ward *et al.* is a model of maturity in the development of the systems portfolio based on Anthony's taxonomy of management activities (Anthony, 1965). Anthony examined the nature of the activities performed by managers and divided them into three categories. The first, 'strategic planning' is concerned with the process of deciding the objectives of the

organisation and the resources used to attain them. The second, 'management control', is centred on the use of resources to accomplish objectives and the third, 'operational control,' on the process of assuring that specific tasks are carried out effectively and efficiently. Ward *et al.* extend Anthony's work by defining which elements of the systems portfolio sustain or support the management activities he defined. Anthony does not hypothesise any change over time to the emphasis placed on each of these activities. Ward *et al.*, however, hypothesise that operational control systems will be built first, followed by management control systems. These latter systems will help managers to decide where to allocate resources to support the achievement of business objectives. Management control systems are built by accumulating data obtained from operational systems. Ward *et al.* offer at this point, a redefinition of 'management control systems' as 'management information systems'. When 'management information systems' are completed, 'management control' information is then used to build systems which allow information for strategic planning to be fed to top management. This model is illustrated in Figure Seven.

Figure Seven 'Typical Planning, Control and Operational Systems. A Traditional Hierarchical Systems Portfolio Model Based on Anthony's Structuring of Management Activities.'



Ward, J., Griffiths, P., and Whitmore, P., (1990) *Strategic Planning for Information Systems,* Chichester, UK; Wiley, pp. 3

2.2.5 McFarlan, McKenney and Pyburn

McFarlan *et al.* examined the process of technology assimilation in the organisation and presented their conclusions in the form of a four stage model (McFarlan *et al.*, 1983).

In Phase One, management concentrates on learning about the capabilities of the technology, how best to apply it and on how to

solve short term problems in the implementation of operational systems. Because of technical difficulties, users become exasperated at the inability of IT to make routine tasks easier and indeed feel that IT has an apparent ability to make tasks more difficult.

Using the experience gained in Phase One, user-supported pilot schemes help to instil confidence in users in the problem-solving capabilities of IT in Phase Two. In an atmosphere of experimentation, the full potential of the technology can then be explored.

In order to consolidate the effectiveness of the applications begun in Phase One, management in Phase Three pays detailed attention to problems that have arisen from systems development dating from Phase One. With the perfection of earlier systems imminent, staff at all levels are trained in the use of IT. The experience of Phase Two pilots is used to ensure that new systems development takes account of technological strengths and weaknesses.

IT is exploited more widely in the organisation in Phase Four. Managers look at technological trends to forecast new possibilities for IT arising in the future. The combinations of characteristics exhibited at each stage are detailed in Figure Eight.

Figure Eight McFarlan, McKenney and Pyburn's Model of IT Assimilation

PHASE ONE	PHASE TWO	PHASE THREE	PHASE FOUR
BUSINESS STAFF EXPERIMENTATION WITH IT			
	IMPLEMENTATION OF PILOT SCHEMES		
		STAFF TRAINING IN THE USE OF IT	
			COMPETITIVE ADVANTAGE FROM IT
		END-USER CONFIDENCE IN IT →	
IT- DRIVEN SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY →			

Adapted from McFarlan, F.W., McKenney, J.L., and Pyburn, P., (1983), 'The information archipelago-plotting a course' *Harvard Business Review* **January-February,**pp. 145-156

2.2.6 Hirschheim, Earl, Feeney and Lockett

During the mid 1980s, Hirschheim *et al.* concluded that too little was known about the future direction of the IS function in the light of the dramatic advances in technology which were taking place at that time (Hirschheim, Earl, Feeney and Lockett, 1988). To rectify this gap in current knowledge, senior management and IS staff were interviewed in order to explore the past and future role of the IS function in the UK. They presented their findings in a three phase model.

In Phase One, top management is concerned about the current performance of the IS function and is aware of the importance of IS to the business. Special attention is given to the completion of projects and the satisfaction of end users. The existing DP manager is replaced by a more experienced external recruit whose brief is to restore credibility to the function and convince users and management that it supports current needs.

Satisfied with the capability of the IS function to cater for tactical and operational needs, senior management turns in Phase Two to the search for uses of IT as a competitive weapon and the alignment of IS with business strategy. An IS director is appointed over the DP manager. The IS Director will use business experience to interpret business strategy and find strategic opportunities for IT. The IS Director will also create organisational devices to ensure that the rest of the organisation can communicate IS-related ideas to top management and that top management remains committed to IS development.

The growth of end-user computing leads the IS director in Phase Three to redesign the IS function to enable it to relate to the rest of the organisation, taking into account the balance between centralised and decentralised IS activities. The combinations of characteristics exhibited in each stage are detailed in Figure Nine.

Figure Nine 'The New Age'

PHASE ONE	PHASE TWO	PHASE THREE
IT-DRIVEN SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY	→	
IT-DRIVEN SYSTEMS TO SUPPORT DECISION-MAKING	→	
END-USER CONFIDENCE IN IT		
	COMPETITIVE ADVANTAGE FROM IT →	
	ALIGNMENT OF IS WITH BUSINESS STRATEGY	
	COMMUNICATION BETWEEN BUSINESS AND IS STAFF	
		IMPLEMENTATION OF SYSTEMS BY BUSINESS STAFF

Adapted from Hirschheim, R., Earl, M., Feeney, D., and Lockett., M (1988), 'An exploration into the management of the information systems function: key issues and an evolutionary model' *Information Technology Management for Productivity and Strategic Advantage,* IFIP, **TC-8,** Open Conference.

2.2.7 Bhabuta

Bhabuta examined the role IT plays in the formulation and achievement of business objectives. His model relates the role played by IT in strategic planning to Gluck's generic model of maturity in strategic planning (Gluck *et al.*, 1980). In the following summary, the business strategies are those of Gluck and the IT strategies are those which, according to Bhabuta's model, are used to support their implementation.

Strategic planning in Phase One is the responsibility of top management and is focused on financial planning. The role of IS is to monitor the performance of the company in relation to specified budgetary constraints. This is achieved using internal data generated by internal applications which are focused around operational tasks, and are controlled by middle management.

As the business grows to include multiple market segments, social political and economic forces make it more difficult to set realistic annual budgets. Therefore, the focus of strategy changes in Phase Two from yearly financial plans, to forecast-based planning and concentration on the medium term. To achieve this, senior management uses formal planning techniques to encourage the use of shared data systems and the processing of external and internal data.

The move to Phase Three comes as a result of the ultimate inaccuracy of forecasts because of the rapidity of market changes. The focus of planning therefore places more emphasis on understanding the dynamics of such change in order to make a timely response. IT is used increasingly to analyse external data. To assist in the implementation of business objectives, IS strategy is aligned with business strategy and new IT based products and services are developed in response to the need for a competitive edge.

Companies move into Phase Four when top management uses data from day-to-day business operations in strategy formulation by

absorbing and responding to the ideas of all employees at all levels of the organisation. IT activity is extended from the role played in Phase Three to providing operational data for use in business strategy formulation. The combinations of characteristics exhibited in each stage are detailed in Figure Ten.

Figure Ten Bhabuta's Model of IT and Business Strategy Formulation

<table>
<tr><th>PHASE ONE</th><th>PHASE TWO</th><th>PHASE THREE</th><th>PHASE FOUR</th></tr>
<tr><td colspan="4">IT-DRIVEN SYSTEMS TO SUPPORT OPERATIONAL ACTIVITY →</td></tr>
<tr><td colspan="4">IT-DRIVEN SYSTEMS TO MONITOR FINANCIAL PERFORMANCE →</td></tr>
<tr><td></td><td colspan="3">IT-DRIVEN SYSTEMS TO SHARE INFORMATION →</td></tr>
<tr><td></td><td></td><td colspan="2">COMPETITIVE ADVANTAGE FROM IT</td></tr>
<tr><td></td><td></td><td colspan="2">ALIGNMENT OF IS WITH BUSINESS STRATEGY</td></tr>
<tr><td></td><td></td><td></td><td>IT-DRIVEN SYSTEMS TO SUPPORT BUSINESS PLANNING</td></tr>
<tr><td></td><td colspan="3">TOP MANAGEMENT INVOLVEMENT IN IS PLANNING →</td></tr>
</table>

Adapted from Bhabuta, L., (1988), 'Sustaining productivity and competitiveness by marshalling IT,' *Information Technology Management for Productivity and Strategic Advantage,* IFIP, **TC-8,** Open Conference.

2.2.8 Earl

During the 1980s, Earl undertook research in UK companies in order to look specifically at maturity in the planning of the systems portfolio. IS planning in Stage One is undertaken using a 'bottom-up methodology'. Managers with business management experience assess the contribution of current systems to business success, while IT specialists with technical expertise assess technical quality of current IT platforms in making the existing IS portfolio function effectively. Typically, the ability of managers to understand the potential of IT to satisfy information needs is also appraised.

As a result of the 'bottom-up' planning undertaken in Stage One, senior management is now more aware of the IT capability of the organisation and is anxious to ensure that IS is aligned with business strategy. To achieve this, a 'top-down critical success factor methodology' is adopted in Stage Two. This methodology consists in business managers, top managers and IS managers clarifying the business objectives of the organisation and what IS are required to achieve them. From this exercise it also becomes clear which systems are more important to future business success.

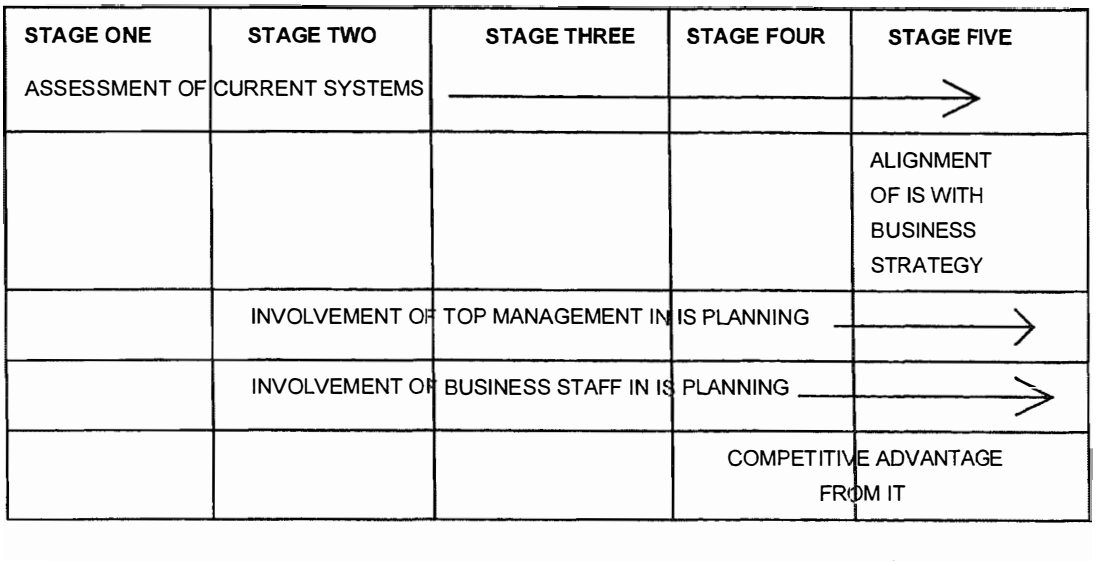
More detailed planning is undertaken in Stage Three involving a greater number of users than previously. Attempts are made to match the more long term 'top down' with shorter term 'bottom up' IS needs. Due to the apparent complexity which the IS plan needs to

accommodate, a balance is sought between the maintenance of existing systems and the development of new ones.

Users at all levels feel that IT remains under exploited in the organisation and seek new ways in Stage Four to use IT to obtain competitive advantage. Such 'project champions' are more experienced with IT than their colleagues. They plan to develop new systems and exploit existing systems more fully. 'Project championsò are sponsored by staff who are sufficiently senior to release the necessary resources. Assistance from the IT department is confined to informal advice. Earl describes this approach as 'inside out methodology'o

Stage Five is reached when business managers, including top managers and IS professionals work together to ensure that IS plans are tailored to the IS needs of the organisation and are fully aligned with business strategy. This alignment is achieved by combining 'bottom-up', 'top-down' and 'inside-out' planning 'methodologies'. The combinations of characteristics exhibited in each stage are detailed in Figure Eleven.

Figure Eleven Earl's Model of IS Planning



Adapted from Earl, M.J., (1989) *Management Strategies for Information Technology,* Hemel Hempstead, UK: Prentice Hall.

2.3 IS and IT Maturity Characteristics

The maturity characteristics identified in each model summarised in section 2.2 are presented in Table One. Most of these characteristics were used in this research to measure the relative IS and IT maturity of a sample of NHS providers operating as Trusts. Table One shows that researchers have taken two contrasting modelling approaches and also, the number of models in which each approach has been taken. Researchers have considered either a wide range of IS and IT issues in an all-embracing model or concentrated in more detail on a single aspect of IS or IT management. Models developed by Nolan, Ward *et al.* and Galliers and

Sutherland are examples of the former and those by Bhabuta, McFarlan *et al.* and Earl, of the latter approach. Table One provides a firm indication that further insight can be gained into IS and IT maturity by combining these two approaches. Sixteen maturity characteristics were identified using the former approach. However, a further seven, or almost half as many again which had not been identified by researchers who had examined a range of issues, were added to this total by models in which researchers had concentrated on a single aspect of IS or IT management.

Table One also illustrates the degree of consensus concerning the contribution of business managers to IS planning as a maturity characteristic. This is a feature of five out of nine existing models. Examination of these five reveals, however, that in spite of this consensus, the methods managers used to contribute information to the IS planning process have received little attention in comparison with the content of IS plans. Nolan is the only researcher who has considered methods as such, and suggests that managers use steering committees to co-ordinate organisation-wide planning. However, he gives no indication of how steering committees might function or how managers might feed information into them. (Nolan, 1979)

Table One IS and IT Maturity Characteristics

IS Maturity Characteristics	All-embracing	Single Aspect	Total No. of Models
Use of IT-driven IS to Support Operational Activity	4	4	6
Use of IT-driven IS to Support Decision-making	4	2	6
The Search for Competitive Advantage from IT	2	4	6
Business Management Involvement in IS Planning	4	1	5
The Alignment of IS with Business Strategy	2	3	5
End-user Confidence in IT	2	2	4
Top Management Involvement in IS Planning	1	2	3
Systems Integration	3	0	3
Business Management Involvement in IS Implementation	2	1	3
Communication of IS Needs between IS Business Management	1	1	2
Control of IS and IT Expenditure	2	0	2
IS and IT Expenditure in Relation to Sales Growth	1	0	1
Proportion of Batch, Remote job entry, Database, Personal, Mini and Micro Computing	1	0	1
Assignment of Specific Roles for Systems in Support of Business Objectives	1	0	1
Business Management Skills of IS Staff	1	0	1
Involvement of Heads of IS Departments in Business Planning	1	0	1
Use of IT-driven IS to Support Business Planning	0	1	1
Use of IT-driven IS to Monitor Financial Performance	0	1	1
Use of Pilot Schemes	0	1	1
Management Experimentation with IT	0	1	1
Use of IT-driven IS to Share Information	0	1	1
Managerial Assessment of the Current Systems Portfolio	0	1	1
Staff Training in the Use of IT	0	1	1

2.3.1 Limitations of the Models

The result of examining the research methods used in the development of existing models and empirical tests of those models are presented in Figures Twelve and Thirteen.

Figure Twelve IS and IT Maturity Models

Researcher(s)	Sample Size	Sample Profile	Relationship to Other Models	Research Method	Empirical Tests
Bhabuta (1988)	Not reported	Not reported	Considers models by McFarlan *et al.* and Nolan inadequate for his research aim	Not Reported	None
Earl (1989)	Not reported	Not reported	Independent study	• Action research • Other unspecified methods	None
Galliers and Sutherland (1991)	• Four organisations • Four representatives from each	• Heads of Divisions • Chief Executive • Head of Strategic Planning • Head of IS	Used models by Bhabuta, Hirschheim *et al.* and Earl to develop their own improved version	Tested and refined a model using existing research	None
McFarlan *et al.* (1983)	Not reported	Not reported	Independent study	Not Reported	One
Galliers and Somogyi (1987)	Not reported	Not reported	Independent study	Not Reported	None
Ward *et al.* (1990)	Not reported	Not reported	Incorporates Earl's and Nolan's model	Not Reported	None
Hirschheim *et al.* (1988)	• Ten Organisations • Number of respondents from each not reported	• Financial services • Manufacturing • Retailing • Transportation • Board Members • Heads of IS • IT sponsors	Reference is made to a perceived gap left by Nolan and McFarlan *et al.*	Semi-structured face-to-face interviews	None
Nolan (1979)	over 200	Organisations which used Nolan, Norton and Co. and IBM for IS consultancy	N/A	Model revised four times though the 1970s	Five

Figure Thirteen Empirical Tests

Researchers(s)	Sample Size	Sample Profile	Relationship to other Models	Research Method	Model
Raho *et al.* (1987)	412	• Average of fourteen years experience • IS staff of varied levels of responsibility • Forty per cent heads of IS	Independent study	• Questionnaire • Statistical analysis	• McFarlan *et al.* (1983) • Microcomputers only
Drury (1983)	144	• Senior data processing executives	Independent study	• Questionnaire using five point Likert scale • Statistical analysis	Nolan (1979)
Goldstein and McCririck (1981)	273	• Canadian private and public sectors • Monthly data processing budgets between 1200 and 3 million dollars	Independent study	• Questionnaire • Statistical analysis	Nolan (1979)
Benbasat *et al.* (1980)	• Fifty-Three organisations • Seventy respondents in total	• IS managers, systems analysts • Experience ranging from two to twenty years • High variation in IS budget	1984-re-examination of 1980 research data and that of Goldstein and McCririck revealed evidence of stage-based move to maturity	• Survey Questionnaire • Self-selecting sample • Statistical analysis	Nolan (1979)
Lucas and Sutton (1977)	Twenty-Nine	• Local Government departments, California, USA • Organisations with a wide range of expenditure on IS and IT	N/A	Not Reported	• Gibson and Nolan (1974 version) • IS and IT expenditure in relation to sales growth

It can be seen from this examination that in only three of the nine models has any attempt been made to document the research method used, sample size or sample profile. Hirschheim *et al.* are the only researchers to have reported the involvement of organisations from a range of industry sectors in the development of their model. The characteristics identified in this model are, therefore, the only ones which might be generalised, with any degree of confidence, at all to more than one environment. Empirical tests also provide little assistance in establishing which characteristics differentiate the IS and IT maturity of which industry sectors. Goldstein and McCririck (1981) report the sampling of organisations from both private and public sectors, but their research, as in four of the five tests of maturity models published since 1979, are confined to those characteristics identified by Nolan. One way, therefore, to be more confident that characteristics from existing models do differentiate the more from the less mature organisations, is to use these characteristics to compare the IS and IT maturity of organisations within a specific operating environment.

There are three additional limitations which need to be taken into consideration when using these characteristics to determine organisational IS and IT maturity: the first is the possibility that organisations choose to outsource their IS and IT operations to third party vendors on the basis of a perceived reduction in expenditure

from that incurred by in-house IS or IT departments. It is, in such cases, the outsourcing vendor whose maturity would need to be considered. However, further attempts to quantify a trend towards outsourcing on the part of current NHS providers, operating as Trusts, are required before the extent to which outsourcing makes the issue of IS and IT maturity redundant in such organisations can be assessed.

The second limitation is the focus of some maturity characteristics on specific software or hardware. Technological advances in the IT industry lock such characteristics into the period in which a particular model is developed, rendering their usage unrealistic when such advances are sufficiently major. This fact effectively invalidates technologically-dependent maturity measures. Examples of such characteristics can be found in the models by Nolan (1979) and Ward *et al.* (1990) where technology such as database, minicomputer, microcomputer ('personal' in Nolan's terminology) and fourth generation programming languages are used to distinguish stages of IT maturity. It is especially noticeable that the last of these technologies is fixed within one period of IT history.

The third limitation is the apparent lack of weighting of maturity characteristics in order of importance in the maturing process. By knowing which characteristics had the greater role to play, recommendations could be made as to which of these characteristics less mature organisations would benefit from giving first and foremost

consideration. Such recommendations would, of course, be made subject to establishing which characteristics differentiated the maturity of a particular environment.

2.4 Methods of Contributing Information to the IS Planning Process

Methods of contributing information have been revealed by four independent studies undertaken in US and UK organisations from 1983 to 1993 by Pyburn (1983), Zmud (1984), Ward *et al.,* (1990) and Earl (1993). These studies found evidence that in order to achieve a successful IS planning effort, the methods managers would use to contribute information differed between organisations which differed in size, in the complexity of the IS and IT portfolio and in the physical proximity of the IS department to the offices occupied by strategic managers. No direct attempt has been made to link methods of contributing information with IS maturity, however. Ward *et al.* have combined Pyburn's work with McFarlan's 'Strategic Grid', and in a separate section of their 1990 study of strategic planning for IS, combined the 'Strategic Grid' with Earl's model of maturity in IS planning. These combinations imply a relationship between methods of contributing information and IS maturity. Other maturity models, Zmud's, Earl's and Ward *et al.*'s own work on methods of contributing information to the IS planning process, however, are

excluded from Ward *et al.*'s analysis. This exclusion left scope for gaining further insight into this relationship by seeking further empirical evidence.

Two distinct approaches have been adopted by researchers investigating methods of contributing information to the IS planning process. While Pyburn places the methods he found in a set of mutually exclusive categories, Zmud and Ward *et al.* frame their methods as a set of recommendations to be followed by organisations who wish to gain maximum benefit from IS planning and implementation.

2.4.1 Pyburn

Pyburn noted an over-emphasis in IS literature on the content of managerial contributions to the IS planning process at the expense of investigation into how that contribution is made. He interviewed between four and six senior IS managers in each of eight US organisations and identified three distinct categories of method.

The 'personal-informal' category is characterised by verbal and informal interaction between the Head of IS and directors. Social gatherings are a widely used forum for discussing IS opportunities and needs. Formal documentation is used as a method of informing key stakeholders of decisions.

In the 'personal-formal' category there is still a heavy reliance on personal communication between the Head of IS and the Board of Directors. However, well defined forums such as steering committees are used although it is the schedule which is regulated and not the content of the discussion. These forums are regarded as general management meetings in which IS needs are discussed as part of business plans. Documentation fulfils the same function as in the 'personal-informal' category. Formal presentations of plans to the Board of Directors are also a regular feature.

IS planning undertaken using the 'written-formal' category is based almost entirely on written communication undertaken according to procedures understood by all members of the organisation. Meetings are held to discuss plans formulated elsewhere and communicated to key individuals in the form of written documents. Plans are often presented formally to the Board of Directors by members of the IS department.

Based on the perceptions of IS managers concerning the relationship between the choice of methods and the success of an IS planning effort, Pyburn also suggested some selection criteria for these three categories. In organisations where the IS department is located near to the Board of Directors, a 'personal-informal' category is the most appropriate. If these two groups are physically further apart, formal communications, a central feature of the 'written-formal' category, are

required in order to keep IS strategy aligned to business objectives. As the size of the organisation and complexity of the systems portfolio increases, there will be a greater need for formalised categories, based on written documents, in order to provide necessary systems integration across functional divisions or departments. The 'personal-informal' category succeeds only if the status of IS managers is high and they are called upon to initiate discussion of, as well as to contribute to, the evaluation of IS strategic alternatives.

2.4.2 Pyburn and McFarlan's 'Strategic Grid'

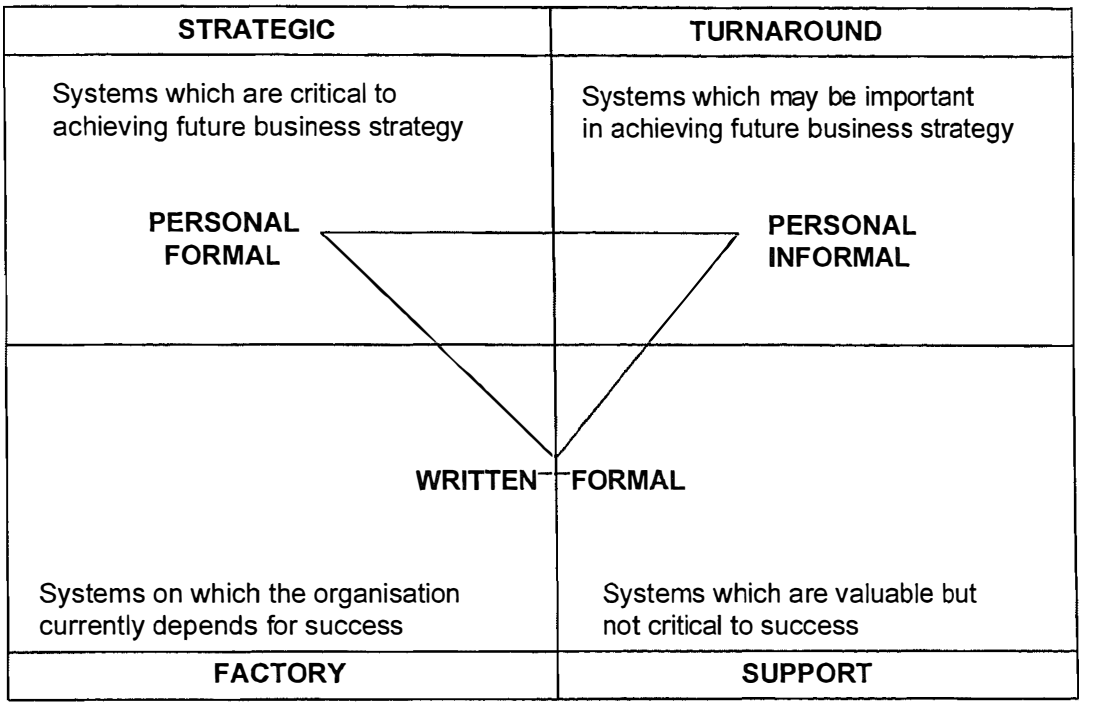
Ward *et al.* have combined Pyburn's 'categories' with McFarlan's 'Strategic Grid'. Ward *et al.* recommend that 'factory' and 'support' systems are managed using strategies which place the highest priority on maximising return-on-investment and operating efficiency. They see the 'written-formal' category, which emphasises written documentation, as the best strategy with which to ensure the discipline and conformity needed to achieve such objectives.

A high degree of personal initiative from individual functional managers is involved in developing the ideas for 'turnaround' systems from which competitive advantage might be derived. Ward *et al.* consider that the emphasis placed on informal discussion and personal contact in the 'personal-informal' category makes this the most suitable

in which to develop ideas for such systems and communicate them to top management.

The identification of 'strategic' systems involves the integration of contributions from top management and heads of departments which use those systems. The authors see steering committees, a key characteristic of the 'personal-formal' category, as the most effective in co-ordinating and discussing such input. The relationship between Pyburn's findings and the 'Strategic Grid' are illustrated in Figure Fourteen.

Figure Fourteen Pyburn and the 'Strategic Grid'



Ward, J., Griffiths, P., and Whitmore, P., (1990) *Strategic Planning for Information Systems,* Chichester, UK; Wiley, p 274

2.4.3 Earl

Earl examined IS planning in twenty-seven UK organisations and, by interviewing both IS staff and end-users, identified two distinct methods used to contribute information. Multidisciplinary teams were used to integrate end-users with the IS department. Departmental managers formulated IS plans which were then evaluated and prioritised by dedicated IS planning committees.

2.4.4 Zmud

Zmud found that organisations whose managers felt they gained most from IS planning used organisation-wide standards of communication and were controlled by a rigid management hierarchy. Although common standards of communication were employed, the processes by which managers interacted to produce IS plans were predominantly 'organic', a term originally used by Burns and Stalker, (1961) involving a large degree of employee discretion with respect to work policies and procedures. Ad-hoc planning groups were also set up to investigate specific areas of IS development and then voluntarily disbanded when their task was completed. These groups appointed others which formed and disbanded in a similar fashion. Permanent steering committees took an overall responsibility for monitoring the progress of ad-hoc groups to ensure desirable outcomes from the planning process.

2.4.5 Ward *et al.*

Ward *et al.* used their experience of IS consultancy to recommend that organisations plan their IS development as follows. A management steering group agrees an overall IS plan, directs the activities of other planning groups and ensures the business relevance of all applications developed. Reporting to the Management Steering Group is the IS Planning Group whose main task is to examine the resource

implications of strategies put together by business planning groups. The IS Planning Group also interprets the implications of external technological developments for the organisation. Reporting simultaneously to the Management Steering Group and the IS Planning Group are the functional business planning groups. They formulate the IS plan for their business functions, ensure all project proposals are accompanied by vigorous cost-benefit analyses, set up applications management groups to assess information systems needs in specific departments and manage project implementation.

Ward *et al.*, identify the following methods by which these groups interact with each other. Verbal presentations of material are usually accompanied by some form of visual aid. The authors refer to this mainly in the context of the Board of Directors and suggest thirty minutes as the maximum time in which to put the content forward to top management. In the technique known as 'brainstorming', group members verbally present their ideas, no matter how impracticable they seem at first, before they are evaluated by the group as a whole (Osborn, 1960). It is suggested that this technique is most usefully employed at the fact-finding stage of the planning process. Structured meetings are held using pre-set agendas. Written minutes and written reports are used when details of decisions made by one group need to be communicated to other groups for information or evaluation.

Ad-hoc meetings are unstructured, may involve any number of managers, are often spontaneous and not recorded in writing.

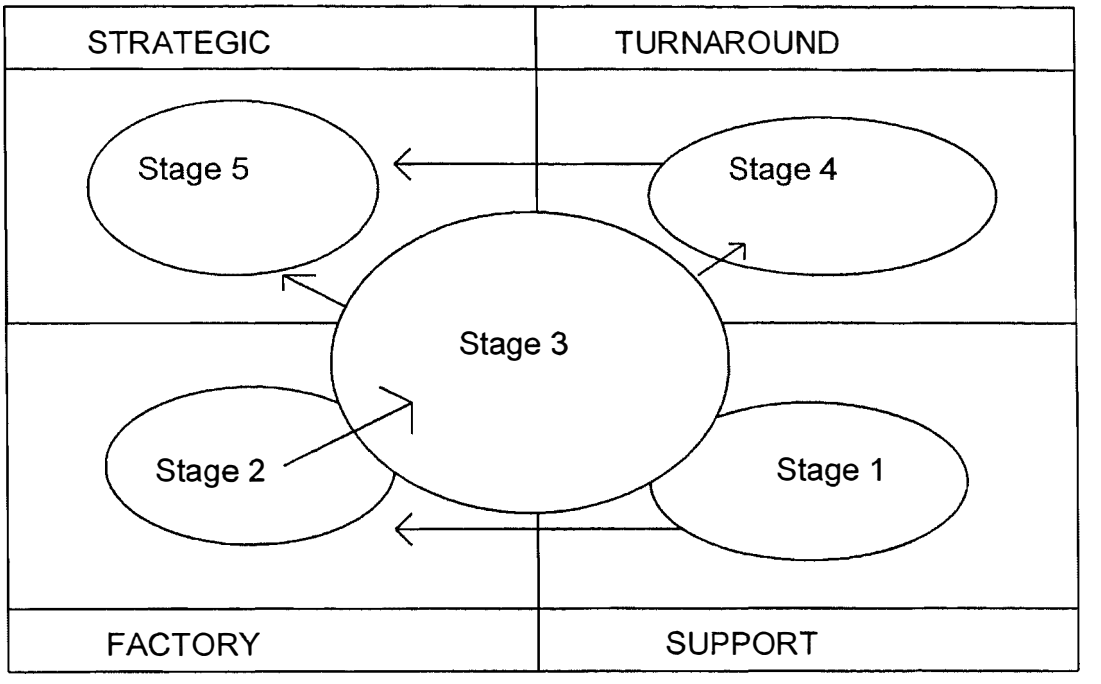
2.4.6 Maturity in IS Planning and Methods of Contributing Information

Ward *et al.* have combined Pyburn's work with McFarlan's 'Strategic Grid', and quite separately, combined the 'Strategic Grid' with Earl's model of maturity in IS planning. This implies a hypothesised combination of Pyburn's methods and Earl's IS planning model. Ward *et al.* formulated the following hypotheses from the first of these combinations:

In Stage One of maturity in IS planning, top management is unsure of the extent of the contribution of IS to the business. Planning is, therefore, concentrated on operational systems which merely 'support' existing business processes. As top management becomes more aware of the importance of IS, the focus moves in Stages Two and Three towards 'factory' systems, critical to the maintenance of existing business. When, in Stage Four, users actively seek competitive advantage from IT, the planning process begins to embrace 'turnaround' systems, which show potential for use as a competitive weapon. When an advantage is realised from such systems, top management fully appreciates the need also to plan the development of 'strategic' systems which are critical to the future success of the

organisation. This is the main thrust of the planning effort in Stage Five. This process is illustrated in Figure Fifteen.

Figure Fifteen Mapping the Evolution of IS planning on to the Application Portfolio Model



Ward, J., Griffiths, P., and Whitmore, P., (1990) *Strategic Planning for Information Systems,* Chichester, UK; Wiley, pp.33

If this analysis is combined with that of paragraph 2.4.2 the following conclusions can be drawn. In the early stages of maturity, emphasis will be placed on 'written-formal' methods. As organisations move to Stage Three, this will be combined with the 'personal-formal' and 'personal-informal' methods. Emphasis then changes in favour of the 'personal-informal' and again to the 'personal-formal' method. These

relationships are only inferred, as they are not stated explicitly by Ward *et al.*, but nonetheless constitute a treatment of the relationship between methods of contributing information to the IS planning process and IS maturity. As there was no attempt to connect the work of other researchers with IS maturity, there remained scope for further research into this relationship.

Chapter Three Research Method

3.1 Chapter Overview

Chapters One and Two have been concerned with aims, rationale and outcomes of this research. Chapter Three is devoted to how these outcomes were achieved. This involved consideration of issues such as the selection of a method, sampling strategy, the development of a reliable research instrument and data analysis. The research method considered most likely to fulfil the aims of this research was selected from one of the 'interpretivist' or 'scientific' paradigms. A two stage strategy was developed in which firstly, a sample was taken from the population of NHS providers operating as Trusts, and secondly, as representative a sample of managers as possible was taken from each provider selected. A research instrument was developed with which to detect differences between hospitals both in IS and IT maturity and methods of contributing information to the IS planning process. The instrument was then piloted and revised in preparation for the main study. The chapter concludes with statistical tests of reliability, *i.e.* the accuracy with which maturity characteristics were measured.

3.2 Selection of a Research Method

A desired outcome of this research was the development of an instrument that could be used by others to establish the extent to which results were shared with alternative samples of organisations. To develop such an instrument, it was necessary to minimise, as far as possible, the influence of the researcher on the environment of interest. Of those methods currently employed in IS research, survey method was selected as the most likely to facilitate this process.

An examination of journal articles and conference proceedings dating from 1972 to 1982 has revealed that IS research has been conducted in the last fifteen years by practitioners and academics from disciplines such as decision-theory, economics and psychology which are only weakly related to IS (Culnan, 1986). The diversity of backgrounds from which researchers emanate has led to the employment of a corresponding variety of research methods. Researchers such as Checkland (1981) see this situation as inevitable and desirable in a socio-technical field. These researchers argue for the importance of 'interpretivist' approaches because these approaches recognise and indeed exploit the fact that multiple interpretations of phenomena are made by both researcher and subject. In this way, they consider that deeper understanding is gained than if the researcher attempts to remain detached from the phenomenon in question. Other researchers such as Klein and Lyytinen (1985) argue for a more conservative 'scientific', approach. They suggest that research findings can

be validated only by testing them in other contexts, which is possible only when research instruments used are made repeatable by freeing them as far as possible from the influence of participants in the study. Galliers has made the most recent attempt to capture the essence of the methods used in IS research which are most often associated with these contrasting research 'paradigms'. In so doing, he argues, as has been the case with this research, that the appropriateness of a method should be assessed in relation to the desired outcomes of the research effort (Galliers, 1992). Methods associated with each paradigm are presented in Figure Sixteen and constitute the selection from which a method was chosen for this research.

Figure Sixteen Information Systems Research Approaches in the Context of the Scientific and Interpretivist Philosophies

Scientific	**Interpretivist**
Survey	Subjective/Argumentative
Laboratory Experiments	Action Research
Field Experiments	Descriptive/Interpretive
Simulation	Futures
Forecasting	
Case Study	

Adapted from Galliers, R. *Choosing Information Systems Research Approaches*, in Galliers R. (ed.) *IS Research, Issues, Methods and Practical Guidelines*, Henley-on-Thames, UK: Alfred Waller, (1992)

3.2.1 Survey

According to Galliers, surveys are 'snapshots' of practices, situations and views at one point in time. Survey method has been selected for this research because it affords greater possibility of minimising the influence of the researcher than other methods. Structured interviews or questionnaires, key characteristics of a survey-based approach, solicit responses which are not influenced by the questioner, rendering such instruments repeatable by others in alternative contexts. The reasons for rejecting alternative methods examined by Galliers are given in the following paragraphs.

3.2.2 Case Study and Action Research

Case studies are a method of describing the relationships existing in a particular situation. This method is often used to gain insight into phenomena about which little is known. To obtain greater depth of understanding, case studies typically focus on a single or very small group of organisations: the researcher interacts with the object of interest and draws conclusions from data generated by this interaction. Action research is distinguished from other methods by the interaction between researcher and subject where this relationship is, in itself, a phenomenon of interest. It has most often been used in a problem-solving situation, such as the development of an information system, where useful insight is gained from the process which the

researcher undergoes in solving it (Bryman, 1989; Avison and Wood-Harper, 1990). As these methods maximise rather than minimise the influence of the researcher on the phenomenon of interest, their use would prevent other researchers from testing findings in alternative environments using the same instrument, and for this reason, were not selected for use in this research.

3.2.3 Descriptive/Interpretive and Subjective/Argumentative

Research using the subjective/argumentative method involves forming opinions about a phenomenon based on the individual experiences of the researcher. In the descriptive/interpretive method, conclusions about a phenomenon are continuously refined by the researcher until he/she is satisfied that further enquiry can yield no greater insight. These methods have been rejected because of the difficulty of constructing an instrument which is repeatable by other researchers in other environments. This difficulty caused by the absence of any independent measure of the variables of interest. This absence precludes the separation of facts about a phenomenon from the opinion of the researcher.

3.3 Sampling Strategy

Having selected a research method, a sampling strategy was formulated. In so doing, the researcher is presented with a choice

between 'random' and 'purposeful' sampling. Samples must be random to permit generalisation to a wider population (Mason and Lind, 1993). It was possible to take a random sample of NHS providers operating as Trusts from which to compare IS and IT maturity. However, obtaining enough data from which to seek differences between providers in the methods managers use to contribute information to the IS planning process was dependent not only on the level of utilisation of IS, but also on the amount of IS planning taking place. There was a risk for these reasons that a random sample may yield too little information for this purpose. In order to guarantee as far as possible, that sufficient data could be collected, 'purposeful' sampling strategies were used. In contrast to random sampling, these techniques consist of sampling cases which are likely to yield sufficient data with which to examine the phenomenon of interest (Patton, 1990).

In selecting 'purposeful' sampling strategies for this research, two units of analysis were taken into consideration. The first was NHS providers operating as Trusts of which a sample of Trusts was taken. The second was the individual provider from which a sample of managers was selected. The strategies employed in both units of analysis are explained below.

Providers were selected based on the likelihood that they would yield sufficient data to examine the phenomenon of interest. Patton gives

this the term 'intensity' sampling. At this stage, the researcher was faced with the task of selecting from providers which, while equally likely to be operating as Trusts, and as such, have all been affected by the Government reforms of recent years, provide healthcare of varying degrees of specialisation. Some Trusts, such as paramedic and ambulance services and mental health are highly specialised in the type of care they provide. Community healthcare Trusts specialise by virtue of geographical location. Acute general hospitals operating as Trusts, by and large, provide a wider range of emergency and elective treatment than the aforementioned Trusts although there are, by necessity, strong links between them. Acute general hospitals form the focus of this research. This is based on the assumption of a need for an especially intense involvement in IS planning necessitated by the wider range of treatment provided by such Trusts.

Five acute general hospitals were, therefore, sampled on the basis of their current or recent involvement in IS planning, either at Trust-wide or departmental level or both. The five hospitals and their involvement are summarised in Figure Seventeen. This selection method ensured that sufficient data were gathered to seek differences in methods of contributing information to the IS planning process.

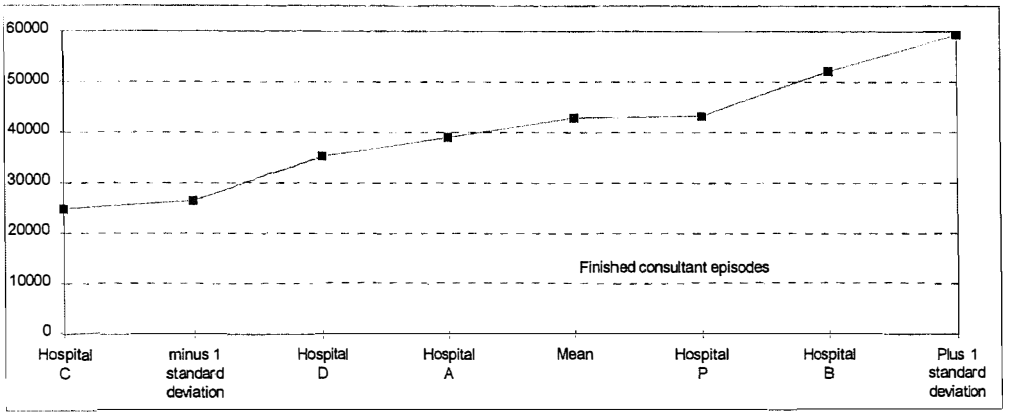
Figure Seventeen Involvement in IS Planning and Implementation

Hospital P	Implementing a new patient administration system. (P.A.S.)
Hospital A	Planning the computerisation of IS on two main sites
Hospital B	Recent purchase and implementation of nurse management and radiography systems. Recent revision of Trust-wide IS strategy.
Hospital C	Implementation of multi-million pound hospital information support system. (HISS)
Hospital D	Imminent revision of Trust-wide IS strategy

However, so that results obtained from these hospitals were not atypical of the wider population, this strategy was combined with what Patton terms 'typical-case' sampling (Patton, 1990). Survey data from the population were used to take a sample which was not in any way extreme, deviant or intensely unusual. These data were used to illustrate that, while the sample could by no means be taken as statistically representative, the results might equally be replicated in an alternative sample with similar average scores using the same survey data. Since the mid 1980s, the Government has sought to devise measures with which to assess the performance of NHS providers. To this end, it has published a variety of statistics including yearly finished consultant episodes for each provider in England. This is a measure of the number of instances of in-patient or out-patient treatment from commencement to completion. This was used as a measure of the workload sustained by each provider for the purpose of

selecting a 'typical-case' sample. The statistics in Figure Eighteen are taken from the financial year 1992-3.

Figure Eighteen Finished Consultant Episodes in a Sample of Five Acute Trust Hospitals



Department of Health, Ordinary and Day Case Admissions for England Financial Year 1992-3 (1993), London, UK, Department of Health

For a hospital to be classed as typical, its annual finished consultant episodes had ideally to fall within one standard deviation of the mean. As illustrated in Figure Eighteen, this is true of each of the five selected for this research except Hospital C, which, with 24800 is marginally below minus one. Overall, however, this sample consists of hospitals with neither an especially large or small yearly intake of patients. These hospitals are, therefore, close enough to the mean average to be thought of as reasonably typical of the wider population of NHS acute Trust hospitals.

The second unit of analysis was the individual hospital from which a sample of managers was selected. Pinnsoneault and Kraemer (1993) examined 141 articles devoted to IS published between 1980 and 1990 in which a survey method had been used in data collection. In forty-one of those articles, researchers had attempted to compare organisations. In thirty-five of the forty-one, respondents from each organisation were sampled either from a single job function only or from a single level in the management hierarchy. The latter is true of Galliers and Sutherland (1991) in the development of their IS and IT maturity model, who sampled exclusively from members of boards of directors. Furthermore, in three out of five empirical tests of models, samples consisted exclusively of representatives from IS and IT departments. To seek a more representative sample of each hospital taking part in this research, fifteen to twenty managers were selected from each: they consisted of executive directors. i.e. top management, finance managers, facilities managers (not IT), corporate planners, managers of clinical services such as surgery, radiography, pathology and pharmacy, IT and information managers. The sampling strategies employed in this research are summarised in Figure Nineteen.

Figure Nineteen Sampling Strategies

Unit of Analysis	Sampling Strategy	Sample
NHS providers operating as Trusts	'intensity' and 'typical case' (Patton, 1990)	Five acute Trust hospitals
Organisation		Trust directors, clinical and non-clinical, IT and information managers

3.4 IS and IT Maturity

A research instrument was constructed to fulfil two distinct functions. The first function was to detect and locate differences between hospitals in IS and IT characteristics taken from existing models. This established which, if any, characteristics differentiated IS and IT maturity in NHS acute Trust hospitals. Results were also used to rank hospitals in order of IS and IT maturity. The second function was to detect and locate differences in methods of contributing information to the IS planning process between the same sample of hospitals. This analysis was used to establish whether methods varied between hospitals of differing IS and IT maturity. The former of these functions is articulated more fully in paragraph 3.4, the latter in 3.5.

3.4.1 Operationalisation of Maturity Characteristics

In constructing a research instrument from which to measure IS and IT maturity, specific characteristics from existing models had to be

operationalised: questions had to be formulated with which to differentiate the maturity of each hospital (Oppenheim, 1992). These questions were designed to establish how intensely each maturity characteristic was exhibited by each hospital and to detect differences in intensity between hospitals. Figure Twenty is a summary of the content of questions from the structured interview reproduced in Appendix B.

Figure Twenty Operationalisation of Maturity Characteristics

Questions	Maturity Characteristics
Regularity with which IT-driven systems were used to carry out certain activities	Operational activity, (day-to-day tasks), monitoring financial performance, sharing information, making management decisions, business planning,
Regularity with which managers involved themselves in IS-related activities	IS planning for department-based and systems used by the entire Trust, assessing the ability of current systems to satisfy information needs, seeking competitive advantage from IT, experimenting with new IT
Regularity with which IS was used to access data from other departments	Systems integration
Regularity with which IS were used to support the achievement of business objectives	The alignment of IS with business strategy
Priority placed by managers on strategic, factory, turnaround and support systems	The assignment of specific roles for systems in support of business objectives
Regularity with which staff were trained when new systems were introduced	Staff training in the use of IT
Regularity with which new systems were introduced using pilot schemes	Implementation of systems using pilot schemes
Frequency with which managers were encouraged to undertake specific tasks	Acquisition of business management skills by IS managers, communication of information needs, (business managers to IS and visa versa), participation of heads of IS departments in business planning
Regularity with which policies were developed to increase the credibility of IT-driven IS	End-user confidence in IT

Of the questions in Figure Twenty, those concerning the assignment of specific systems to the achievement of business objectives, systems integration and the alignment of IS with business strategy require further clarification. Ward *et al.* (1990) mapped Earl's model of

maturity in IS planning onto McFarlan's 'Strategic Grid' and hypothesised that emphasis on planning and implementation changes from 'factory' and 'support' systems in earlier stages of maturity to 'turnaround' and 'strategic' as they became more mature.[2] Four questions were formulated in order to establish what priority was placed by respondents on the development of systems when categorised according to the 'Strategic Grid'.

Examination of the model by Galliers and Sutherland[3] led to the conclusion that the extent to which IS were used to access data concerning departments other than ones own could be taken as an indication of the level of systems integration. This was based on the following assumptions. If a hospital consisted mainly of unconnected standalone systems, staff were less likely to use such systems to obtain data from departments other than their own, and more likely to use other resources such as written reports. Where the majority of IS were linked together, thus showing a high level of integration, staff were more likely to use IS for this purpose.

The alignment of IS with business strategy is a characteristic for which no precise definition was offered in existing maturity models for the purposes of data collection. Consultation of other IS literature revealed a consensus that the alignment of IS with business strategy is

[2]see Chapter Two, paragraph 2.4.6
[3]see Chapter Two, paragraph 2.2.3

reflected in the extent to which IS strategy, when implemented, supports the achievement of business objectives (Galliers, 1993; Willcocks, 1992; Saunders and Jones, 1992). The extent to which IS supported the achievement of business objectives was, therefore, used to establish the extent to which IS was aligned with business strategy.

3.4.1.1 Differentiating the IS and IT Maturity of One Hospital from Another

Differences in IS and IT maturity were sought by comparing sets of responses from each hospital to questions concerning each maturity characteristic. A hospital was deemed to be more mature than another if there was evidence that IT-driven IS were used more regularly in carrying out certain activities. It was similarly deemed to be more mature if business managers involved themselves more regularly in specific IS-related activities, including the development of department-based IS. Hospitals were also considered to be more mature if IS were implemented more regularly using pilot schemes, staff were trained more regularly when new systems were introduced and IS were more regularly used to support the achievement of business objectives.

3.4.3 Measurement Scales

The researcher has a choice between nominal, ordinal, interval and ratio measurement scales. It is desirable to employ at least an interval scale of measurement because of the greater accuracy afforded by knowing the precise distance between a point on a scale (Sekaran, 1992; Siegel and Castellan, 1992). However, such precise measurement of IS and IT maturity characteristics was considered too difficult to achieve with the available data. A five point ordinal scale was, therefore, used from which, it was anticipated, respondents could make realistic approximations when questioned about each maturity characteristic.

3.4.4 Data Collection and Analysis

In data collection using survey method, the researcher has a choice between a mailed questionnaire, a face-to-face interview and a face-to-face questionnaire. To ensure that data collected were as representative as possible of each participating hospital, the sample of managers key to the provision of such data, had to be maximised. Pinnsonneault and Kraemer's investigation of use of the survey method revealed that in seventy-five per cent of surveys in which mailed questionnaires had been used, response rates of less than fifty per cent had been obtained. In the light of the findings from this investigation, the risk of obtaining too few responses from mailed

questionnaires to obtain sufficient data for analysis was considered too great. Data were, therefore, collected using a structured face-to-face interview. Responses were recorded by the interviewer on a pre-prepared pro forma.

Data collected from the structured interview were analysed to compare the maturity of each hospital in the sample. This comparison was achieved by the following step-by-step process. Firstly, the responses made by each manager to questions in the structured interview were coded. Each response was allotted a number from one to five. A code of one denoted the lowest possible level of IS or IT maturity with respect to the characteristic the response was designed to measure. For example, in coding responses to a question concerning the regularity with which managers involve themselves in IS planning, a five was allocated to those who responded, 'always', whereas a one was allocated to those who responded 'never'.[4] Secondly, to seek differences in maturity levels between hospitals in the sample, the distributions of scores were compared. However, to calculate the probability that observed differences in distributions of responses across the five possible scores had occurred by chance, statistical tests were performed. Before carrying out these tests, hypotheses were stated formally and a level of significance was chosen. In analysis such as this, research questions are always expressed in the form of the

[4] see Appendix B

null hypothesis. In this research, the initial question being asked is, are there any differences in maturity among this sample of hospitals? It is only if the researcher can be sufficiently certain that any differences have not occurred by chance that the question is then asked which hospitals differ from which with respect to each maturity characteristic. The null hypothesis is that of no difference between samples. It is rejected only when there is insufficient probability of making what is known as a Type One error, of rejecting the null hypothesis when it is in fact true, i.e. of concluding that there are differences between samples when such differences have been observed merely by chance. The probability of making such an error is called the level of significance and is expressed as a percentage. Researchers select a significance level according to the level of risk they wish to run of making a Type One error. Consultation of management research literature has revealed that some researchers have taken ten per cent as an acceptable level of risk of making a Type One error. Other researchers feel unable to reject the null hypothesis until the level of risk has been reduced to one per cent. Given this wide range of significance levels, a five per cent level has been used in this research by way of occupying a middle ground between these two extremes. To seek differences in IS and IT maturity, two null hypotheses were tested and are referred to in subsequent chapters as

Hypothesis One and Hypothesis Two. Hypothesis One was stated formally as,

H_0 There are no differences between hospitals in the distribution of scores with respect to characteristic$_x$.

Where the null hypothesis was rejected with respect to a particular characteristic, Hypothesis Two was tested and formally stated as,

H_0 There is no difference between the distribution of scores in hospital$_x$ and the distribution of scores in hospital$_y$.

In this and subsequent chapters, an 'H' has been used in place of the word 'hypothesis', where a formal statement of a hypothesis has been made. In such statements, the letters $_s$ to $_z$ have been used to represent a variable, in order that such letters are not, in error, assumed by the reader to refer to actual hospitals which took part in the study. These hospitals are termed Hospital P, A, B, C and D.

The next step was to select an appropriate test. As the scale of measurement used was ordinal, non-parametric tests were used. As tests of Hypothesis One involved the comparison of four independent samples, the Kruskal-Wallis One-Way Analysis-of-Variance by Ranks was used. In this test, a chi-squared (χ^2)statistic is calculated, the

value of which determines whether or not the researcher is able to reject the null hypothesis for a given level of significance. The computed value of χ^2 is compared with what is known as the 'critical value'. The critical value of χ^2 is dependent on the number of degrees of freedom in the sample and the significance level chosen. In testing Hypothesis One, the number of degrees of freedom is equal to the number of independent samples being compared, minus one. In the Kruskal-Wallis Test, the null hypothesis may be rejected if the computed value of χ^2 is greater than the critical value of χ^2 for a given level of significance. In testing Hypothesis One, the null hypothesis was rejected when the computed value of χ^2 was greater than the critical value at the five per cent level of significance for three degrees of freedom. *i.e.* the four hospitals in the main study minus one.

When the null hypothesis was rejected, there was a five per cent probability of differences in maturity between hospitals with respect to a particular characteristic occurring by chance. Tests of Hypothesis Two involved pairs of hospitals for which the Mann-Whitney U Test was required. In this test, a U statistic is calculated with which to accept or reject the null hypothesis. If the computed value of U is less than the critical value of U for a given level of significance and a given number of degrees of freedom, the null hypothesis is rejected. In this case, the number of degrees of freedom is the total number of responses in the two samples being compared minus one. When the

null hypothesis was rejected, there was a five per cent probability of differences in maturity between pairs of hospitals occurring by chance. These tests were conducted to find out which hospitals differed from which in IS and IT maturity and with respect to which characteristics they differed. Where the null hypothesis was rejected in tests of Hypothesis Two, raw data scores were examined to see which hospital possessed the greater proportion of higher scores, and therefore, was the more mature of the two. Having completed this process, hospitals were then ranked in order of maturity concerning each individual characteristic measured. This ranking was presented in a Positioning Framework.

3.5 Methods of Contributing information to the IS Planning Process

Existing investigations by Ward *et al.* (1990), Pyburn (1983), Zmud (1984) and Earl (1993) could have been used to construct a structured instrument to seek differences in methods of contributing information to the IS planning process. Use of such an instrument would have involved asking managers to consider pre-defined methods out of context of the IS planning process in which they are used. It was felt for this reason that this approach would hinder collection of analysable data. A semi-structured interview format was preferred to an unstructured format so that, by keeping questions to the topic of the IS planning process rather than

content of the IS plans themselves, the minimum amount of valuable interview time was wasted on tangential subject matter. Responses were again recorded by the interviewer using a pre-set pro forma.

A step-by-step process was also undergone in seeking differences between hospitals in methods of contributing information to the IS planning process. Semi-structured interview transcripts were examined to identify methods of contributing information which retained an independent significance, either by the specific function they fulfilled in the planning process or by identifiable differences in characteristics. In order to be in a position to perform statistical analysis, numerical data were needed. These data were generated using 'content' analysis (Easterby-Smith *et al.,* 1991). The number of managers in each hospital which reported the use of a particular method in the planning processes in which they been involved was counted, in addition to the number of managers which did not.

The next step was to formulate a series of null hypotheses with which to seek two sets of differences. The first set consisted of differences in emphasis between hospitals on one method over another. For example, does a greater proportion of managers in $hospital_x$ report the use of $method_y$ than $method_z$ whereas in $hospital_w$, the opposite is the case? The second set consisted of differences in emphasis between hospitals on the same method. For example, does a greater proportion of managers report the use of $method_y$ in $hospital_x$ than in hospital $_w$? The following null hypotheses were tested in the process of seeking these differences. They

are referred to in subsequent chapters as Hypothesis Three, Four, Five, Six and Seven. Hypothesis Three was stated as,

H_0 There are no differences between hospitals in emphasis on methods of contributing information to the IS planning process.

On the rejection of H_0 pairs of hospitals were compared to establish which methods were preferred to which. This was achieved by testing Hypothesis Four stated as,

H_0 There are no differences between hospitals in emphasis between $method_t$ and $method_u$ of contributing information to the IS planning process.

Pairs of methods for which the null hypothesis was accepted were omitted from further analysis. Where H_0 was rejected however, further pairwise comparisons were made to establish which hospitals were different from which. To achieve this, Hypothesis Five was tested stated as,

H_0 There are no differences in emphasis on $method_t$ and $method_u$ of contributing information to the IS planning process between $hospital_v$ and $hospital_w$.

The second set of differences was sought by testing Hypotheses Six and Seven. Hypothesis Six was tested to seek differences among the four hospitals in emphasis on each method taken individually. It was stated as,

H_0 There are no differences between hospitals in emphasis on $method_x$ of contributing information to the IS planning process.

Methods with respect to which the null hypothesis was accepted were omitted from subsequent analysis. Where the null hypothesis was rejected, pairs of hospitals were compared to establish which hospital was different from which. To achieve this, Hypothesis Seven was tested and stated as,

H_0 There are no differences in emphasis on $method_x$ of contributing information to the IS planning process between $hospital_y$ and $hospital_z$.

As when seeking differences in IS and IT maturity, the next step was to select appropriate tests. As the numerical data generated from 'content' analysis was nominal, category data, the Chi-squared test was required. As in the Kruskal-Wallis Test, a value of χ^2 was calculated, which, if greater than the critical value of χ^2 for the five per cent level of significance and the degrees of freedom in the sample, permitted the rejection of the null hypothesis. However, when testing Hypotheses Six and Seven, it was not

always possible to use the χ^2 test. Research into the application of this test by Cochran (1950) showed that, for a valid interpretation of the χ^2 statistic to be made, it is a requirement that a maximum of twenty to twenty-five per cent of managers in each nominal category total five or less. Where this requirement was not met by the data set, the Fisher Exact test was used, which performs the same function, but whose interpretation is not restricted by sample size (Siegel and Castellan, 1992). In cases where χ^2 proved inapplicable, this precluded tests of Hypothesis Six before Hypothesis Seven. This had the disadvantage of increasing the chance of making a Type One error, that of rejecting the null hypothesis when it was in fact true. To minimise this chance, the one per cent level of significance was chosen in preference to the five per cent level of significance.

Tests of Hypothesis Three to Seven established which hospitals if any, differed from which in the methods used to contribute information to the IS planning process and with respect to which specific methods they differed. By 'mapping' these results onto the Positioning Framework of IS and IT maturity, it was anticipated that evidence could be found to support the hypothesis that such methods are an additional characteristic in the IS maturing process.

3.6 Pilot Study

Before undertaking the data collection and analysis described in paragraphs 3.4 and 3.5 the research instrument was piloted in a selected general hospital. This precluded collection of data from which several hospitals could be compared. However, two aims were achieved by seeking instead, differences in maturity between IS and IT characteristics and differences in emphasis on methods of contributing information across departments. The first aim was to establish whether the scales of measurement used allowed differences in maturity and in methods of contributing information to be detected using statistical analysis. The second aim was to establish that questions were constructed in a manner which permitted managers to give responses which were both as accurate as possible, and in sufficient detail to from which to test the research hypotheses.

3.6.1 Data Collection and Analysis

The results of data and collection and analysis from the pilot study are presented below.[5] They show that the measurement scales proposed for the main study would enable the location of differences between hospitals. Fifteen managers were selected from one of a sample of five Trust hospitals (Hospital P) and interviewed for approximately forty-five minutes each. The sample included managers of clinical

[5] see Appendices A and B for an example of the research instrument used and a data summary.

and non-clinical departments, IS managers and executive Trust directors who were responsible for both departmental and Trust-wide IS planning. Managers answered questions about IS and IT maturity characteristics choosing one response from a five point scale. Each response was then given a code from one to five. To establish whether there were any differences in maturity between characteristics within Hospital P, the null hypothesis of no difference in maturity between IS and IT characteristics within Hospital P was tested. As the samples were matched, *i.e.* the same group of managers were questioned about each characteristic, the Friedmann Two-Way Analysis-of-Variance by Ranks was used which resulted in a χ^2 of 110.223. This was greater than the critical value of χ^2 for a five per cent level of significance and so the null hypothesis was, therefore, rejected. This result showed that differences in maturity could be detected using this research instrument.

Analysis of data collected from the same managers, using a semi-structured interview, revealed a number of methods of contributing information. 'Content' analysis was performed on these data to generate numerical data. The number of managers who reported the use of a method was counted in addition to those that did not. The results of this analysis are presented in Table Two. The number of managers which reported the use of a particular method is recorded by a tick, and those that did not, by a cross.

Table Two Methods of Contributing Information in Hospital P

Method	√	×
Ad-hoc Committees	4	11
Standing Committees	6	9
Meetings for IS and other Issues	7	8
Meetings for IS Issues Only	11	4
One-to-One Meetings	7	8
Group Meetings	10	5
Oral Presentations	2	13
Group Discussion	11	4
Business Case	5	10
IS Plan	5	10
Business Plan	2	13
Memo	4	11

The null hypothesis of no difference in emphasis on one method over another was tested using the χ^2 test. The computed value of χ^2 was greater than the critical value of χ^2 for the five per cent significance level and the degrees of freedom, which was equal to the number of different methods being compared minus one, *i.e.* eleven. The null hypothesis was rejected; therefore there were differences in emphasis between methods in Hospital P.

3.6.2 Revision of the Instrument to Measure IS and IT Maturity

It became apparent from the pilot study that with respect to some maturity characteristics, the instrument had not permitted respondents to provide data in enough detail for measurement purposes. In addition, questions were not always constructed in a manner which assisted respondents to respond as accurately as they would have liked.

With respect to some characteristics, respondents commented during interviews that use of a single item measure did not permit them to provide sufficient data for meaningful conclusions to be drawn. This applied to the use of IT-driven IS to support operational activity, the use of IT-driven IS to support management decision-making and systems integration. Respondents felt that to measure the use of IT-driven IS to support operational activity for example, a more detailed breakdown of types of activities was necessary. The research instrument was revised accordingly to include the following breakdowns which were constructed from further consultation of existing models and other IS literature.

Five examples of the use of IT-driven IS to support operational activity were taken from Ward *et al.*'s (1990) systems portfolio model. These were scheduling, purchasing, invoicing, inventory control and the maintenance of employee records.

Examples of the use of IT-driven IS to support decision-making were taken from the same model but adapted to the Trust hospital environment. These were the forecasting of revenue from services, the forecasting of demand for services, the costing of services, manpower and materials planning and budgeting.

A detailed definition of systems integration is lacking from the models presented in Chapter Two. Oesterle, Brenner and Hilbers have, however, concluded that the following characteristics are present in an integrated systems portfolio (Oesterle, Brenner and Hilbers, 1993). Data are passed between systems electronically in preference to re-entering data from hard copy or other storage media such as tape streamers or floppy discs. Departments use common data sets rather than developing their own, and systems are shared with as many departments or divisions as possible. This definition was used to form further questions concerning the integration of hospital-based IS and IT.

Respondents also commented that questions were sometimes constructed in a manner which did not assist them to respond as accurately as they would have liked. They expressed some difficulty in providing accurate answers to questions which asked for an estimation of the regularity with which IS were used by staff to perform certain tasks, or the regularity with which managers involved themselves in certain activities. This was mainly due to extreme

variation amongst staff for whom respondents were responsible. While some staff members, for instance, always used IT-driven IS to provide data for business planning, others never used IT-driven IS for this purpose. For this reason respondents experienced some difficulty in estimating the regularity with which staff in their departments as a whole used IT-driven IS to support them in performing certain tasks.

This problem was addressed in the revised research instrument by substituting questions concerning regularity with questions about the proportions of managers or tasks. This made the task of estimation rather easier. For example, respondents were required to decide only which managers or staff involved themselves in an activity, which did not, and then estimate the proportion of one to the other. It was similarly thought easier for respondents to estimate what proportion, minority or majority for example, of an activity such as budgeting was undertaken using IT-driven IS. This was thought to be a more straightforward task than the provision of an aggregate figure from a potentially large group of staff, the regularity of whose participation might vary tremendously.

Respondents also commented that to provide accurate estimations concerning IS planning and implementation, questions needed to cover changes to existing IS as well as totally new IS. This was because it was comparatively rare for entire systems to be replaced, due to high costs and the unsustainable disruption which would be caused by the

installation of a replacement system. It was, for this reason, far more common for changes to be made to existing systems in a hospital environment. Questions concerning changes to existing systems were, therefore, added to the revised instrument.

It was also felt that characteristics measured by the regularity with which managers were encouraged to undertake specific tasks merely measured the importance which was attached to them. It was decided that questions which established the proportion of managers who actually took part in these tasks would provide a more effective measure of the acquisition of business management skills by IS managers, the communication of information between IS and business managers and the participation of heads of IS departments in business planning. The revised research instrument used in the main study is summarised in Figure Twenty-One.

Figure Twenty-One Revised Operationalisation of Maturity Characteristics

Questions	Maturity Characteristics
Extent to which tasks performed using IT-driven IS	Operational activity, (scheduling, purchasing, invoicing, inventory control, maintenance of employee records) information sharing, management decision-making, (forecasting revenue from services, costing of services, manpower planning, materials planning budgeting) monitoring financial performance, business planning,
Proportion of business managers/staff undertaking IS-related activities	IS planning and implementation, (changes to existing and new systems) experimenting with IT, assessing ability of existing portfolio to satisfy information needs, searching for competitive advantage from IT, communicating information needs to IS staff
Proportion of IS managers involved in specific activities	Communicating IS needs to business staff, IS managers using business management skills
Proportion of systems on which staff receive adequate training	Staff training in the use of IT
Proportion of staff confident in the ability of existing IT-driven IS to satisfy information needs	End-user confidence in IT
Proportion of changes to existing and totally new IS	Implementation of pilot schemes

Using the revised instrument, the IS and IT maturity of hospitals was differentiated as follows. A hospital was deemed to be more mature than another if there was evidence that a greater proportion of certain tasks was undertaken using IT-driven IS. It was also deemed to be

more mature if a greater proportion of business managers and staff involved themselves in specific IS or IT-related and a greater proportion of IS staff involved themselves in business-related activities. Hospitals were also considered to be more mature if a greater proportion of staff were confident in the ability of existing IT-driven IS to satisfy information needs, and a greater proportion of IT-driven IS were implemented using pilot schemes. A more mature hospital was also distinguished by a greater proportion of IT-driven IS on which staff received adequate training.

3.7 Reliability

Where possible, the reliability, or accuracy with which each maturity was measured in the main study was assessed using Cronbach's Coefficient Alpha (Cronbach, 1955). This is a standard statistical test performed on multi-item scales to assess the degree to which several items *i.e.* questions are in fact measures of the same overall concept. Cronbach's Alpha is a number between minus one and plus one. The nearer the coefficient to plus one, the more reliable the scale (Sekaran, 1992). In using this technique, however, researchers' opinions vary in the level of accuracy needed for a research instrument to be considered a reliable measure of the construct in question. At one extreme is Bryman (1989), who considers a multi-item scale to be unreliable unless it has a coefficient of at least 0.8.

At the other, Lederer and Sethi (1992) have taken a coefficient of 0.6 or above as an indication of a reliable scale, when used for the first time in their study of success factors in IS planning. In the structured interview used in the main study, multi-item scales were used to measure the following maturity characteristics. These are presented with their alpha coefficients in Table Three.

Table Three Reliability of Multi-Item Scales

IS Maturity Characteristics	Coefficient Alpha
IT-driven IS to Support Operational Activity	0.62
IT-driven IS to Support Decision-making	0.75
Systems Integration	0.06
Communication of IS needs between IS and Business staff	0.33
Involvement of Business Managers in IS Implementation	0.96
Involvement of Business Managers in IS Planning	0.68
Involvement of Top Managers in IS Planning	0.80
Implementation of Pilot Schemes	0.86

Given the variation concerning the level accuracy which is accepted in the generation of research results, previous research is of little assistance in deciding which of the characteristics in Table Two have been measured with sufficient accuracy for valid conclusions to be drawn. Six of characteristics in Table Three have alpha coefficients of between 0.6 and 0.9.

However, the other two, systems integration and the communication of IS needs between business and IS staff fall considerably short of the lower of these two values. It was decided, therefore, that the scales used to measure these concepts were insufficiently accurate for valid conclusions to be drawn. For this reason, these maturity characteristics were omitted from the analysis presented in Chapter Four.

Chapter Four IS and IT Maturity in NHS Acute Trust Hospitals

4.1 Chapter Overview

Chapter Four is devoted to the results and conclusions drawn from analysis of data collected concerning IS and IT maturity. Results show variation in IS and IT maturity concerning six characteristics from existing models. It is explained how and why it is that managers, by addressing these particular characteristics can improve the response made by their hospitals to the demands placed on their IS and IT portfolios by Government reforms. The implications of these results for the formulation of national IM and T strategy are then discussed. Results also showed that while a majority of characteristics were contained in all-embracing models which examined a wider range of IS and IT-related issues, other characteristics were added by models which concentrated on a single aspect of IS or IT management.

4.2 IS and IT Maturity Characteristics in NHS Acute Trust Hospitals

The first aim of this research was to establish which characteristics managers of NHS providers operating as Trusts could address in order to

improve their response in comparison with other providers to the demands placed on IS and IT portfolios by Government reforms. This aim was achieved by establishing which characteristics from existing models differentiate the IS and IT maturity of a sample of NHS acute Trust hospitals. The second aim was to establish whether further insight is gained into the maturity concept by combining two distinct modelling approaches. The first approach consists of the development of an all-embracing model which examines a wider range of IS and IT-related issues. The second approach consists of more detailed concentration on one aspect of IS or IT management. Paragraph 4.2. is focused on the first aim and paragraph 4.3 on the second of these aims.

4.2.1 Differentiation of IS and IT Maturity

For the main study, data were collected from between sixteen and twenty-one managers from each of four hospitals and were used to test Hypothesis One for each IS or IT characteristic, the results of which are presented in Figure Twenty-Two. Those characteristics for which the null hypothesis was rejected at the five per cent level of significance are headed by a cross, those for which it was accepted, by a tick.[6]

[6]see Appendix D, Table Eight

Figure Twenty-Two Differences in IS and IT Maturity

×	√
Alignment of IS with business strategy	Use of IT-driven systems to share information
Top management involvement in IS planning	Use of IT-driven systems to monitor financial performance
Involvement of heads of IS departments in business planning	Use of IT-driven systems to support business planning
Use of IT-driven IS to support decision-making	Business management involvement in IS planning and implementation
Use of IT-driven IS to support operational activity	The search for competitive advantage from IT
Staff training in the use of IT	Use of pilot schemes
	Control of IS and IT expenditure
	Assignment of specific roles for systems in support of business objectives
	Management experimentation with IT
	Managerial assessment of the current applications portfolio
	The business management skills of IS staff

Among those characteristics headed by a cross, IT-driven IS to support operational activity, IT-driven IS to support decision-making and top management involvement in IS planning were measured by more than one item. The results of testing Hypothesis One for each item are presented in Figure Twenty-Three. Those in which the null hypothesis was rejected are shaded.

Figure Twenty-Three Multi-item Measures

IS and IT Maturity Characteristic	Item
Use of IT-driven IS to support operational activity	Scheduling
	Stock control
	Purchasing
	Invoicing
	Maintenance of employee records
IT-driven IS to support decision-making	Forecasting revenue from services
	Forecasting demand for services
	Budgeting
	Costing of services
	Manpower planning
	Materials planning
Top management involvement in IS planning	Planning for totally new systems
	Planning for changes to existing systems

A limitation of existing models discussed in Chapter One was the impossibility of knowing whether all IS and IT maturity characteristics identified in existing models differentiated the maturity of organisations in most, if not all industry sectors, or whether they differed from one sector to another. This was because Hirschheim *et al.* are the only researchers to report the use of representatives from a cross-section of industry sectors in the development of their model. In Chapter One, it was inferred that a contribution to knowledge could be gained from further work which would seek to establish which characteristics differentiated the IS and IT maturity of specific environments. Tests of Hypothesis One have provided support for a

hypothesis of differences among four acute Trust hospitals in maturity with respect to six characteristics, or just over a quarter of the total identified in existing models.

4.2.2 Implications for Hospital Management

For hospital managers to understand the fuller implications of these results, managers can be greatly assisted by knowing why and how it is that addressing these characteristics can improve the response of their Trusts to the demands placed on their IS and IT portfolios by Government reforms. In this research, the alignment of IS with business strategy was measured by the extent to which current IS contributes to the achievement of business objectives. Addressing the other five characteristics will assist managers in maximising that contribution.

Top managers *i.e.* Trust directors, have the greatest potential influence over the contribution of IS because they decide how much money to invest in IS development and when to invest it. By increasing their overall involvement in IS planning they afford themselves an increased chance of ensuring that IS investment is prioritised in favour of those IS which make the greatest contribution to a Trust, both in increased cost effectiveness and the quality of care provided.

Similarly, by increasing the involvement of IS managers in business planning, IS managers have a greater opportunity of contributing a

more detailed body of knowledge of how IS can be most fully exploited in the achievement of business objectives, than by the involvement of business managers alone.

An essential requirement for the preservation of Trust status is to break even at the end of the financial year. This research has revealed differences in the extent to which IT-driven IS were used in forecasting revenue from services. Increasing the use of IT-driven IS to support this kind of decision increases the likelihood of breaking even at the end of the fiscal year. Trust hospitals risk making an annual loss if the revenue generated from purchasers such as DHAs and GPFHs is less than the cost to the hospital of providing the services which purchasers have bought. By making fuller use of IT-driven IS to forecast revenue, managers have a better chance of identifying those services whose future cost is likely to outweigh the maximum amount of money that can be charged for them. By increasing the use of IT-driven IS to forecast revenue, Trust management has the opportunity to be better informed in making decisions such as reducing the cost of such services or discontinuing their provision.

A key objective, therefore, in ensuring that Trusts break even at the end of each year is to minimise the cost of service provision. Increasing the use of IT-driven IS in scheduling assists in the achievement of this objective by keeping the turnaround time for a

consultant episode, *i.e.* the period of time a patient remains in hospital, to a minimum.

Clearly the benefits of such systems to a Trust can be maximised by ensuring that staff receive adequate training on the IT they currently use and are likely to use in the future. Adequate training allows staff to make the maximum use of IT to assist them in tasks such as scheduling and forecasting revenue from services.

4.3 Implications for the Formulation of National IM and T Strategy

The results of testing Hypothesis One also have implications for the IMG which formulates national IM and T strategy. From scrutiny of both the objectives and achievements of specific projects as publicised by the IMG, it was inferred that the IMG had already addressed some of the maturity characteristics identified in existing models in an attempt to raise the level of exploitation of IT in the NHS as a whole. These characteristics are listed in the left hand column of Figure Twenty-Four.

Figure Twenty-Four Maturity Characteristics in the Four Hospitals and Characteristics addressed by the IMG

IMG	Four Hospitals
Alignment of IS with business strategy	Alignment of IS with business strategy
Training of staff in the use of IT	Training of staff in the use of IT
Involvement of business managers in IS planning and implementation	Top management involvement in IS planning
Managerial assessment of the ability of IS to satisfy information needs	
Systems integration	
Use of IT-driven IS to share information	
	Involvement of heads of IS departments in business planning
Use of IT-driven IS to forecast revenue from services	Use of IT-driven IS to forecast revenue from services
	Use of IT-driven IS in scheduling

By setting these against maturity characteristics in the four hospitals in this study, it can be seen that four characteristics are already being addressed nationally: the alignment of IS with business strategy, the training of staff in the use of IT, top management involvement in IS planning, and the use of IT-driven IS to support the forecasting of revenue from services. It is anticipated that those responsible for the formulation of national IM and T strategy may perceive a benefit from assisting less mature hospitals to achieve parity with their more mature counterparts. The results of this research indicate that such a benefit might be realised more easily by extending the focus of national IM and T strategy beyond those

characteristics already considered to the use of IT-driven IS for scheduling and the involvement of heads of IS departments in business planning.

4.4 A Combination of Approaches to Modelling IS and IT Maturity

Existing models have been developed using two contrasting approaches. The first approach consisted of developing an all-embracing maturity model. The second approach consisted of concentrating in more detail on a specific aspect of IS or IT management. The second aim of the research was to establish whether further insight is gained into IS and IT maturity by combining these approaches than by exclusive use of the first approach. To address this question, each maturity model was scrutinised to establish how many maturity characteristics identified within it were shared with NHS acute Trust hospitals. The results of this analysis are presented in Figure Twenty-Five. Where a characteristic from NHS acute Trust hospitals is shared with a particular model, this is recorded by a tick, and where it is not, it is recorded by a cross.

Figure Twenty-Five Maturity Models and NHS Acute Trust Hospitals

Maturity Characteristics in NHS Acute Trust Hospitals	Galliers *et al.* Six Stage	Galliers and Somogyi Three 'Era'	Ward *et al.* Three 'Era'	Nolan Six Stage	Earl Five Stage IS Planning	Bhabuta Four Phase IT in Business Planning	McFarlan *et al.* Four Phase IT Assimilation	Hirschheim *et al.* Three Stage Role of the IS Department	Ward *et al.* Three Stage Development of the Systems Portfolio
IT-driven IS to Support Operational Activity	✓	✓	✓	✓	×	✓	✓	✓	✓
IT-driven IS to support Decision-making	✓	✓	✓	✓	×	×	×	✓	✓
Alignment of IS with Business Strategy	✓	✓	×	×	✓	✓	×	✓	×
Involvement of Heads of IS Departments in Business Planning	✓	×	×	×	×	×	×	×	×
Staff Training in the Use of IT	×	×	×	×	×	×	✓	×	×
Top Management Involvement in IS Planning	×	×	✓	×	✓	✓	×	×	×

These results constitute evidence that combining development of all-embracing models with more detailed concentration on a single aspect of IS or IT management can provide greater insight into IS and IT maturity than by use of the former approach alone. This has implications for the choice of approaches taken by researchers who seek to model IS or IT maturity in NHS acute Trust hospitals and other environments in the future. Rather than concentrating such efforts exclusively on less detailed examinations of a wider range of issues, it remains worthwhile combining this approach with a more detailed examination of a specific aspect of IS or IT management.

Of the models used in this research, Galliers and Sutherland's shares more characteristics with acute Trust hospitals than any other model with four out of the six characteristics. Those characteristics not shared with Galliers and Sutherland's model are top management involvement in IS planning and staff training in the use of IT. The former characteristic is shared by Ward *et al.*, whose model also covers a wide spectrum of IS and IT issues. The latter characteristic however is identified only in the model of McFarlan *et al.* which concentrates specifically on IT assimilation.

Chapter Five Methods of Contributing Information to the IS Planning Process as an IS Maturity Characteristic

5.1 Chapter Overview

Chapter Five is focused on a hypothesised relationship between methods of contributing information to the IS planning process and IS and IT maturity. Statistical analysis of data revealed evidence to support the hypothesis that methods of contributing information to the IS planning process are an additional characteristic in the maturing process of NHS Acute Trust hospitals. This evidence was revealed by firstly ranking hospitals with respect to each individual characteristic. Secondly, hospitals were ranked in order of overall IS and IT maturity based on all six maturity characteristics. Of ten oral and written methods of contributing information which retained an independent significance, six varied in the emphasis managers placed upon them between hospitals of differing IS and IT maturity. Further insight was then gained into the maturity concept by comparing these results with existing hypotheses or inferences concerning differences in the IS and IT maturity of organisations who place greater emphasis on some methods of contributing information to the IS planning process than other methods. The chapter concludes with implications of

these results for hospital managers and for the formulation of national IM and T strategy.

5.2 Methods of Contributing Information and IS Maturity

The third aim of this research was to seek empirical evidence that methods of contributing information to the IS planning process are also a characteristic with which to differentiate IS maturity. In order to seek such evidence, the data used in Chapter Four were further analysed to establish which hospitals were more mature than which with respect to each maturity characteristic. The results of this analysis were presented in a framework which showed the maturity of each hospital in relation to the others in the sample. This framework was then used to rank hospitals in order of overall IS and IT maturity. Data collected concerning methods of contributing information to the IS planning process were then analysed to seek differences in emphasis between each hospital. The results of this analysis were then 'mapped' onto the Positioning Framework.

5.2.1 Positioning Framework of IS and IT Maturity

In Chapter Four it was established through hypothesis testing which characteristics differentiated IS and IT maturity in NHS acute Trust hospitals. In order to construct a positioning framework, Hypothesis Two was tested to establish which hospitals differed from which with

respect to each characteristic. The pairs of hospitals for which the null hypothesis was rejected at the five per cent level of significance are presented in Figure Twenty-Six.

Figure Twenty-Six Differences between Hospitals in IS and IT Maturity

IS Maturity Characteristic	Pairs of Hospitals
Use of IT-driven IS for scheduling	D,A
	D,B
Use of IT-driven IS in forecasting revenue from services	D,A
	C,B
	D,B
Top management involvement in planning for totally new IS	C,B
	C,A
Staff training in the use of IT	B,A
	B,D
Alignment of IS with business strategy	D,C
	D,B
	D,A
Involvement of heads of IS departments in business planning	D,A

Raw data were then examined in order to establish which of each pair of hospitals exhibited the greater maturity with respect to each characteristic. The relevant raw scores for each hospital and for each characteristic in Figure Twenty-Six, are presented in Table Four. Each of the four hospitals which took part in the study are termed A, B, C

and D. Scores are presented in frequency tables. Using these tables, distributions of scores were compared in order to establish which hospitals were more mature than which. The results of this comparison were cast in a framework in which to position hospitals in terms of their comparative IS and IT maturity. This Framework is presented in Figure Twenty-Seven.

Table Four Comparison of Distributions of Scores

Maturity Characteristics	Hospital	Scores					Median Average	Sample Size (N)
		1	2	3	4	5		
IT-driven IS for Scheduling	D	1	4	4	3	1	3	13
	A	9	5	1	1	2	1.5	18
	B	7	3	1	0	1	1	12
IT-driven IS for forecasting revenue from services	D	0	0	1	10	0	4	11
	C	2	1	0	7	4	4	14
	A	2	4	3	8	1	3.5	18
	B	4	5	1	2	2	2	14
Top management involvement in planning for totally new IS	C	0	4	0	6	7	4	17
	A	3	5	6	4	0	3	18
	B	0	8	3	2	1	2	14
Staff training in the use of IT	B	0	0	0	8	6	4	14
	A	1	3	4	9	3	4	20
	D	0	2	3	7	2	4	14
Use of IS to support the achievement of business objectives	D	0	1	0	4	10	5	15
	C	0	1	4	8	4	4	15
	B	1	1	5	6	4	3	21
	A	1	5	5	6	4	3	21
Involvement of heads of IS departments in business planning	D	1	2	3	4	3	4	13
	A	8	9	1	2	0	2	20

Figure Twenty-Seven Positioning Framework of IS and IT Maturity

IS and IT Maturity Characteristics	Less Mature Hospitals	More Mature Hospitals
IT-driven IS to support operational activity	AB	D
IT-driven IS for decision-making	AB	D
Alignment of IS with business strategy	ABC	D
Involvement of heads of IS departments in business planning	A	D
Staff training in the use IT	AD	B
Top management involvement in IS planning	AB	C

5.2.2 Ranking Hospitals in Order of IS and IT Maturity

This Framework was used to rank each hospital in order of overall IS and IT maturity. However, one of the inherent limitations of existing maturity models impacts on attempts to rank hospitals in this way. This limitation is the lack of weighting given to the contribution made by specific characteristics to the maturing process in comparison with other characteristics. Had such a comparison been made by researchers, this would have added an extra dimension to the differentiation of overall IS and IT maturity. In the light of this limitation, equal weighting for each of the six characteristics in the Positioning Framework has been assumed. From the Framework, it can be seen that Hospital D is more mature than Hospitals A, B and C in at least one of the characteristics measured. While Hospital B shows greater maturity than Hospital D in staff training in the use of

IT, D is the more mature in IT-driven IS to support operational activity, IT-driven IS for decision-making and the alignment of IS with business strategy. Hospitals A and C do not exhibit greater maturity than Hospital D in any of the characteristics in the Framework. From this it can be concluded that Hospital D exhibits greater overall IS and IT maturity than Hospitals A, B or C. Hospital B shows greater maturity than Hospital A in staff training in the use of IT. Hospital C is more mature than Hospitals A and B with respect to top management involvement in IS planning. Therefore, while Hospital C shows greater maturity than B in one characteristic, Hospital B is not more mature than C in any of the characteristics measured. Hospitals B and C are more mature than A in at least one. From this it was concluded that Hospital C is more mature than B and that both are more mature than A. Overall, therefore, hospitals were ranked in ascending order A, B, C and D.

5.2.3 Differences in Emphasis on Methods of Contributing Information to the IS Planning Process

Data were collected from the same sample of managers concerning methods of contributing information.[7] These data consisted of accounts of the IS planning processes in which managers had recently been

[7] see Appendix C for an example interview pro forma

involved.[8] These accounts were scrutinised to establish a profile of methods which maintained an independent significance. A comparison of oral and written is presented in Figures Twenty-Eight and Twenty-Nine.

[8] see Appendix D, paragraph 2 for sample interview transcripts

Figure Twenty-Eight Oral Methods

	Permanent IS Steering Committee for Trust-wide IS Strategy	Ad-hoc IS Steering Committee for Trust-wide IS Strategy	Presentation (OHP)	Ad-hoc Planning Groups for Departmental IS Planning	Routine Group Management Forum	One-to-One Meeting
Participants	• multidisciplinary • service manager(s)[9] • Head of IS department • minimum of one Trust Director (executive) • external IS consultants	• multidisciplinary • service manager(s) • Head of IS department • Trust director • someone with experience of the systems under review • external IS consultants	• Head of the IS department • a service manager	• multidisciplinary • service manager(s) • Head of IS department/member of the IS department • Trust director-only if high capital outlay is involved • someone with experience of the systems under review	The following separate combinations of managers • Trust directors and service managers • service managers alone • service managers and departmental staff	The following separate combinations of managers • service managers and the Head of the IS department • service managers and Trust directors
Size	• six to fifteen	• six to twelve	• presentations made singly or jointly	• three to twelve	• unspecified	

[9]a term commonly used in the four hospitals to describe managers of clinical services

Figure Twenty-Eight Oral Methods

	Permanent IS Steering Committee for Trust-wide IS Strategy	**Ad-hoc IS Steering Committee for Trust-wide IS Strategy**	**Presentation (OHP)**	**Ad-hoc Planning Groups for Departmental IS Planning**	**Routine Group Management Forum**	**One-to-One Meeting**
Content of Discussion	• selection of which objectives from departmental IS plans are of sufficient importance to constitute a component of Trust-wide strategy • external IS developments • monitoring of IS expenditure in the Trust	• selection of which objectives from departmental IS plans are of sufficient importance to constitute a component of Trust-wide strategy • external IS developments	• departmental IS plan • Trust-wide strategic plan	• present and future IS needs related to a system(s) • the inadequacies of a system(s) about which there is consensus • aims and objectives of an IS plan and implementation programme	• business planning including IS where considered relevant • which IS-related projects to allocate funds to and in what chronological order to implement them • exchange of IS planning intentions of service managers whose information requirements involve the use of related systems • daily interdepartmental IS and other needs	• the performance over a monthly period of the service under review • systems changes proposed by a service manager • business plan which may or may not contain IS requirements
Frequency of Meetings	• quarterly	• quarterly and increasingly frequent as the written Trust-wide strategy nears completion	• when the presenter considers this to be an effective means of convincing key stakeholders to approve the plan	• frequency varies from group to group but increases as the plan nears completion	• frequency varies from weekly to every six weeks	• when the service manager considers the immediate approval and implementation of a system change is required

Figure Twenty-Nine Written Methods

	Minutes	IS Plan within a Business Plan	Standalone IS Plan	Interim Documentation
Cost and Complexity of the Proposed Change to the IS Portfolio	• used to record contents of planning meetings pertaining to major and minor systems changes and the introduction of new systems	• used for IS plans involving expenditure of 5000 pounds or over	used for IS plans involving expenditure of 5000 pounds or over	• a range from one page pro formas for minor inexpensive changes to thirty to forty pages for totally new systems
Perceived Urgency of the Proposed Change to the IS Portfolio	• used where immediate implementation of a plan is considered necessary • used where a plan may not be implemented for up to another five years or more	• departmental IS plans are incorporated into business plans annually • implementation can commence once a year only	• used by departmental/service managers when a need for immediate implementation is perceived	• used where immediate implementation of a plan is considered necessary • used where a plan may not be implemented for up to another five years or more
Level of Detail of Material Set Out Using Each Method	• as detailed as the discussion they record • brief if possible to minimise the time required for Trust directors and other senior staff to understand what was discussed	• varies with the complexity of the proposed change	• varies with the complexity of the proposed change	• more detailed if the perceived IS need to be addressed is greater
Function of Each Method	• record discussion and decisions made as a result of group meetings	• to set out information needs for a specific period in the future and the systems changes needed to fulfil them	• to set out information needs for a specific period in the future and the systems changes needed to fulfil them	• to record IS needs of an individual member of staff, departments or groups of services in preparation for a discussion by groups of managers or incorporation into an IS plan

The inherent differences between some methods are immediately apparent from examination of Figures Twenty-Eight and Twenty-Nine. Differences between other methods are, however, less obvious and are highlighted below. With reference to oral methods, permanent and ad-hoc steering committees for Trust-wide IS strategy are broadly similar in terms of the managers who participate in such committees, their size and content of the discussion. However, other than the fact that one committee is permanent and the other ad-hoc, the frequency of meetings of ad-hoc committees increases as a plan nears completion whereas meetings of the permanent group remain quarterly. This is because the former group is engaged in a periodic exercise and will disband when implementation of a strategy is largely complete. The latter group, however, upgrades Trust-wide strategy on an on-going basis. The two groups also differ slightly in the content of discussion. Permanent groups are also continuously responsible for monitoring IS expenditure within a Trust.

Ad-hoc steering committees for Trust-wide IS strategy are also broadly similar to ad-hoc groups used for departmental IS planning. They differ, however, in the participation of executive Trust directors. While one or more executive Trust directors always participates in the former group, a manager of such seniority participates in the latter group only if potentially high capital outlay is required in the implementation of a plan.

With reference to written methods, minutes and interim documents are broadly similar concerning three of the criteria in Figure Twenty-Nine. In terms of function, however, minutes are confined to the output from meetings whereas interim documentation can be the thoughts of individual managers working alone. Similarly, IS plans incorporated into a business plan are broadly similar to standalone IS plans. They differ in one respect, however, which is that standalone IS plans are used when implementation is considered to be sufficiently urgent not to be left until the plan can be considered as part of the annual business planning process.

To seek differences between hospitals in the emphasis placed on these methods, Hypotheses Three to Seven were tested using statistical techniques. Before this could be undertaken, numerical data needed to be generated from interview transcripts from which the methods in Figures Twenty-Eight and Twenty-Nine were identified. This was achieved by counting the number of managers which reported the use of each method and the number which did not. The number of managers which reported the use of each method is presented in Table Five.

Table Five Methods of Contributing Information to the IS Planning Process

Methods	Hospital A	Hospital B	Hospital C	Hospital D	Total
Total Number of Managers Interviewed	21	18	17	16	72
One-to-One Meeting	21	13	9	14	57
Routine Group Management Forum	21	18	16	15	70
Presentation (OHP)	3	7	6	1	17
Ad-hoc Group for Departmental IS Planning	7	9	10	3	29
Standalone IS Plan	13	16	16	8	53
IS Plan within a Business Plan	21	10	4	3	38
Minutes	20	18	17	16	71
Interim Documents	9	5	15	12	41

These numerical data were used to test Hypothesis Three. A calculated value of χ^2 of 54.94 was obtained which was higher than the critical value of χ^2 and so the null hypothesis was rejected at the five per cent level of significance.

This constituted support for a hypothesis of differences in emphasis between methods. Hypothesis Four was then tested to locate differences both between methods and between hospitals.[10] χ^2 statistics were generated for differences in emphasis between methods, the results of which are presented in Figure Thirty. In Figures Thirty

[10]see Appendix E, Table Ten

and Thirty-One, methods for which the calculated value of χ^2 was large enough to reject the null hypothesis at the five per cent level are recorded by a cross, those for which it was not, by a tick.

Figure Thirty Differences in Emphasis between One Method and Another

Methods	Null Hypothesis Accepted
Standalone IS plan and IS plan within a business plan	×
Routine group management forums and ad-hoc planning groups	√
Minutes and interim documentation	√
One-to-One meetings and routine group management forums	√

To locate differences in emphasis between hospitals on use of standalone IS plans and the incorporation of IS plans within a business plan, Hypothesis Five was tested for every possible pair of hospitals.[11] Results of these tests are presented in Figure Thirty-One.

Figure Thirty-One Location of Differences between One Method and Another

Pairs of Hospitals	Null Hypothesis Accepted
A,B	√
A,C	×
A,D	×
B,C	√
B,D	√
C,D	√

[11]see Appendix E, Table Eleven

The second set of differences sought were those in emphasis on a particular method between Hospitals A, B, C, and D. This was achieved by testing Hypotheses Six and Seven.[12] To test these hypotheses, the number of managers who reported the use of a particular method was compared with those that did not. This breakdown is presented in Table Six below. The number of managers which reported the use of a particular method is recorded by a tick, the number that did not, by a cross.

[12]see Appendix E, Table Twelve

Table Six Differences in Emphasis on a Particular Method

Hospital	A		B		C		D	
Method	✓	×	✓	×	✓	×	✓	×
One-to-One Meeting	21	0	13	5	9	8	14	2
Routine Group Management Forum	21	0	18	0	16	1	15	1
Presentation (OHP)	3	18	7	11	6	11	1	15
Ad-hoc Group for Departmental IS Planning	7	14	9	9	10	7	3	13
Standalone IS Plan	13	8	16	2	16	1	8	2
IS Plan within a Business Plan	21	0	10	8	4	13	3	7
Minutes	20	1	18	0	17	0	16	0
Interim Documents	9	12	5	13	15	2	12	4

Hypothesis Six was tested in respect of ad-hoc groups and OHP presentations only. In both cases the null hypothesis was accepted. Tests of Hypothesis Six were precluded in respect of other methods in Table Six because cell frequencies were too small to permit a valid interpretation of a calculated value of χ^2 to be made. Therefore, in deciding to reject or accept the null hypothesis in tests of Hypothesis Seven, the one per cent level of significance was selected. Pairs of hospitals for which the null hypothesis was rejected are presented in Figure Thirty-Two.

Figure Thirty-Two Differences in Emphasis on a Particular Method between Hospitals A, B, C and D

Method	Pairs of Hospitals
One-to-One Meeting	A,C
	A,B
IS Plan within a Business Plan	A,B
	A,C
	A,D
Interim Documents	A,C
	B,C

Tests of Hypotheses Three to Seven provided support for the following conclusions. Less emphasis was placed in Hospital A on using a standalone IS plan than incorporating IS plans into a business plan than in either of Hospitals C or D. IS plans were more likely to be subsumed within business plans in Hospital A than in any of the other hospitals. Greater emphasis was placed on use of interim documents during the planning process in Hospital C than in Hospitals A or B. Managers were also more likely to use one-to-one meetings in IS planning in Hospital A than in Hospitals B or C. It was also apparent that while Hospitals A and B used permanent IS steering groups to formulate Trust-wide IS strategy, Hospitals C and D used ad-hoc groups for this purpose. The relationship between the four hospitals in the main study in terms of methods of contributing information to the IS planning process is presented in Figure Thirty-Three.

Figure Thirty-Three Differences in Methods of Contributing Information to the IS planning process

Methods of Contributing Information to the IS Planning Process				
Ad-hoc planning groups used in formulating Trust-wide IS strategy	Yes	A,B	C,D	No
Standing IS steering group used in formulating Trust-wide IS strategy	No	C,D	A,B	Yes
IS plan within a business plan	Less emphasis	B,C,D	A	Greater emphasis
	Less emphasis than on a standalone IS plan	C,D	A	Greater emphasis than on a standalone IS plan
Interim documentation	Less emphasis	A,B	C	Greater emphasis
One-to-One meetings	Less emphasis	B,C	A	Greater emphasis

5.2.4 Differences in Methods between Hospitals of Varying IS and IT Maturity

To establish whether methods of contributing information to the IS planning process differed between hospitals of varying IS and IT maturity, the ranking established earlier in the Chapter was 'mapped' onto Figure Thirty-Three. The result of this mapping is presented in Figure Thirty-Four.

Figure Thirty-Four IS and IT Maturity and Methods of Contributing Information to the IS Planning Process

Less Mature	A	B	C	D	More Mature
	Standing IS steering group used in formulating trust-wide IS strategy		Ad-hoc planning groups used in formulating trust-wide IS strategy		
	Greater emphasis on IS plans within a business plan	Less emphasis on IS plans within a business plan			
	A	B	C		
	Less emphasis on Interim documentation		Greater emphasis on interim documentation		
	Greater emphasis on one-to-one meetings	Less emphasis on one-to-one meetings			
	A		C	D	
	Greater emphasis on IS plans within a business plan than on standalone IS plans		Less emphasis on IS plans within a business plan than on standalone IS plans		

The 'mapping' in Figure Thirty-Four revealed differences in methods of contributing information to the IS planning process between hospitals of differing IS and IT maturity. These differences are detailed as follows.

Managers in comparatively more mature hospitals used ad-hoc planning in preference to permanent IS steering groups in the formulation of Trust-wide IS strategy. IS plans were less likely to be incorporated into business plans in comparatively more mature hospitals. Furthermore, less mature hospitals placed greater emphasis on incorporating IS plans within a business plan than presenting them

as standalone documents. In more mature hospitals, however, the opposite was the case. Managers in more mature hospitals were also less likely to use one-to-one meetings in IS planning. There was greater likelihood, however, that interim documentation would be used in such hospitals as a means of recording information needs, before drawing up a final IS plan.

5.3 Implications for IS Planning in NHS Acute Trust Hospitals

The principal conclusion to be drawn from this research is that greater emphasis on written methods of contributing information is a characteristic of hospitals whose overall IS and IT maturity is greater. This conclusion has been drawn from two pieces of evidence. First and foremost is the support this research provides for the hypothesis that managers in more mature hospitals are more likely to use interim written documentation in the planning process before putting together the final IS plan. Furthermore, the use of such documentation is not confined to large, potentially expensive systems implementation, but extends to minor systems changes funded by individual departments. The second piece of evidence is centred around the priority which managers perceived should be placed on the implementation of an IS plan in relation to other non-IS related projects. From Figures Twenty-Eight and Twenty-Nine, it can be seen that a shared characteristic of one-to-one meetings and of standalone IS plans is the use of both methods when managers consider the

implementation of a system to be of especially high priority. This research provides support for the hypothesis that, whereas more mature hospitals are more likely to use standalone plans for this purpose in preference to incorporating a plan into the annual business plan, less mature hospitals are more likely to use one-to-one meetings with Trust directors or the heads of IS departments. Notwithstanding managers who undoubtedly combine both methods when planning IS whose implementation is considered urgent, this research leads to the conclusion that in more mature hospitals, managers are more likely to make greater use of a written method, such as a standalone IS plan, in such circumstances.

The implications of this conclusion for NHS acute Trust hospitals is that, for their IS planning processes to become more mature, greater emphasis needs to be placed on the use of written documentation to record information and IS needs, in addition to minutes of planning meetings and the IS plans themselves. Also, when the highest priority is placed in the implementation of an IS plan, greater use needs to be made of standalone IS plans, over and above one-to-one meetings with Trust directors or heads of IS departments and IS plans which have been incorporated into annual business planning cycles.

5.4 Implications for National IM and T Strategy

Recommendations concerning IT planning have come from the NHSME in the form of PRINCE and POISE. Both of these approaches place considerable stress on the need for the documentation of IS and IT needs in the planning process. A characteristic of IMG guidelines concerning the planning and implementation of systems is the production of 'business cases'. Within the business cases, cost-benefit analyses detail how changes to existing systems or the implementation of new systems will support the achievement of business objectives. The inclusion of such written documentation is considered a critical factor in the successful implementation of IS and IT. The results of this research mirror this view. An emphasis on such documentation is shared by hospitals who are demonstrably more IS and IT mature. This shared emphasis indicates that to increase the level of IS planning maturity of less mature hospitals, effort might be made to ensure that a greater proportion of managers record, in writing, their IS needs in accordance with existing IMG recommendations.

5.5 Methods of Contributing Information as a Maturity Characteristic in Relation to Existing Research

This research has contributed further insight into IS maturity by finding support for the hypothesis that methods of contributing information to the IS planning process are an additional IS maturity characteristic. Further insight was gained by comparing the results of this research with existing hypotheses or inferences concerning differences in the IS maturity of organisations who place greater emphasis on some methods of contributing information than other methods. As a result of this comparison, it was established that the majority of methods which researchers hypothesised or which, it was inferred, were more likely to be emphasised by hospitals which exhibited greater IS maturity, were in fact emphasised by hospitals of lesser IS maturity and visa versa.

The literature search in Chapter Two revealed that Nolan and Ward *et al.* are the only researchers to have identified a relationship between methods and IS maturity. Nolan hypothesised that organisations would make greater use of IS steering committees as they matured. Results from this research show, however, that steering committees are used by hospitals at both ends of a maturity continuum. The presence or absence, therefore, of steering committees is no longer a maturity characteristic in itself. It is whether they are permanent or ad-hoc that currently differentiates maturity. Ward *et al.* considered the relationship between the categories of methods identified by Pyburn and IS maturity. They hypothesised that

organisations at early stages of maturity place more emphasis on 'written-formal' methods than any of Pyburn's other categories. By later stages, emphasis has shifted to the 'personal-formal' category. Evidence from this research indicates to the contrary, however, that the 'written-formal' category is emphasised by hospitals which exhibit greater overall IS maturity. This conclusion has been drawn from the fact that interim documents emphasised in more mature hospitals are used, not only to communicate planning decisions to more senior members of staff, but also to document information needs and consequent IS requirements. The function fulfilled by such documentation in acute Trust hospitals is, therefore, closer to the 'written-formal' category than the 'personal-formal' category, in which written documentation is used only to inform key stakeholders of decisions.

Ward *et al.* (1990) and Zmud (1984) recommend the methods whose use they considered would facilitate the IS planning process. It has, therefore, been inferred, that methods recommended by these researchers, are likely to receive greater emphasis in hospitals whose overall IS maturity is greater.

This research shows, however, that methods which Ward *et al.* recommend as most likely to facilitate the IS planning process receive greater emphasis in hospitals of lesser IS maturity. The Management Steering Group recommended by Ward *et al.* shares characteristics with both permanent and ad-hoc groups used to formulate Trust-wide strategy in the four

hospitals which took part in the study. These characteristics include the use of representatives from all areas of the business, such as senior end-users and managers of groups of services, who are in a position to allocate substantial amounts of money to IS investment from their own annual budgets. However, the group recommended by Ward *et al.* is closer in character to less mature hospitals because it is permanent and not ad-hoc.

While some of the methods which Zmud found in organisations who had undertaken successful IS planning efforts are emphasised in more mature hospitals, other methods received greater emphasis at the other end of the maturity continuum. Zmud recommends use of both standing and ad-hoc planning committees, the former of which was used by the more mature hospitals C and D, the latter by the less mature hospitals A and B, to formulate Trust-wide IS strategy.

The comparison of results from NHS acute Trust hospitals and existing literature is summarised in Figure Thirty-Five. Inferred or hypothesised relationships between methods of contributing information to the IS planning process and IS maturity found in existing literature are printed in italics.

Figure Thirty-Five Methods of Contributing Information from Existing Research and IS and IT Maturity

Lesser IS Maturity	Greater IS Maturity
Ward et al. 1990 Permanent Steering Group for Trust-wide IS Strategy Zmud 1984 Permanent Steering for Trust-wide	Pyburn 1983 'Written-Formal' Interim Documents and Ad-Hoc Planning Groups IS Strategy
Pyburn 1983 'Written-Formal' Interim Documents	*Ward et al. 1990 Permanent IS Steering Group for Trust-wide IS Strategy* *Zmud 1984 Permanent Steering and Ad-hoc Planning Groups for Trust-wide IS Strategy*

Chapter Six Research Outcomes and Evaluation

6.1 Chapter Overview

In Chapters Four and Five, the results of research conducted through data collection and analysis from a sample of four NHS acute Trust hospitals have been presented and discussed. Chapter Six concludes with the outcomes generated by the achievement of the research aims first elucidated in Chapter One. It is then explained how each of these outcomes firstly adds to the existing body of knowledge relating to IS and IT maturity, and secondly, provides evidence that potentially changes current understanding as documented in existing research literature. The value of these outcomes both to managers of acute Trust hospitals, to those responsible for the formulation of national IM and T strategy and to IS researchers is then discussed taking into account any limiting factors on the overall research contribution.

6.2 Research Outcomes

This research had three aims. The first of these aims was to establish which IS and IT characteristics NHS providers, operating as Trusts, could address in order to improve their response in comparison with other

providers to the demands placed on IS and IT portfolios by Government NHS reforms. These characteristics were established by identifying those which differentiated the IS and IT maturity of a sample of NHS acute Trust hospitals. A total of twenty-one characteristics were identified from nine existing models. Of these characteristics, six were found to differentiate IS and IT maturity. These six are shaded in Figure Thirty-Six.

Figure Thirty-Six IS and IT Maturity Characteristics in NHS Acute Trust Hospitals

Use of IT-driven IS to support operational activity
Use of IT-driven systems to support decision-making
The search for competitive advantage from IT
Business management involvement in IS planning
The alignment of IS with business strategy
End-user confidence in IT
Top management involvement in IS planning
Systems integration
Business management involvement in IS implementation
Communication of IS needs between IS business management
Control of IS expenditure
Assignment of specific roles for systems in support of business objectives
Business management skills of IS staff
Involvement of heads of IS departments in business planning
Use of IT-driven IS to support business planning
Use of IT-driven IS to monitor financial performance
Use of pilot schemes
Management experimentation with IT
Use of IT-driven IS to share information
Managerial assessment of the current systems portfolio
Staff training in the use of IT

Researchers have taken two distinct approaches to modelling IS and IT maturity. In four of the nine existing models, a plethora of IS and IT-related issues have been examined in the development of an all-embracing model. In the other five, researchers have concentrated in more detail a single aspect of IS or IT management. The second aim of the

research was to establish whether or not further insight could be gained into organisational maturity by combining these approaches than by exclusive use of the first approach. Of the six maturity characteristics in Trust hospitals, five had already been identified in other environments using all-embracing models developed by Ward *et al.* and Galliers and Sutherland. The sixth, training of staff in the use of IT, was added by the model developed by McFarlan *et al.*, which had concentrated in more detail on a single aspect of IT management, that is, the assimilation of IT into the organisation. This was evidence that by combining the two approaches to modelling IS and IT maturity outlined above, further insight can be gained into organisational maturity than by exclusive use of the first approach. This is illustrated in Figure Thirty-Seven. Characteristics which are shared with a particular model are recorded by a tick, those which are not, by a cross.

Figure Thirty-Seven A Combination of Approaches to Modelling IS and IT Maturity

Maturity Characteristics in NHS Acute Trust Hospitals	Galliers and Sutherland Six Stage	Ward *et al.* Three 'Era'	McFarlan *et al.* Four Phase IT Assimilation
IT-driven IS to Support Operational Activity	✓	✓	✓
IT-driven IS to Support Decision-making	✓	✓	×
Alignment of IS with Business Strategy	✓	×	×
Involvement of Heads of IS Departments in Business Planning	✓	×	×
Staff Training in the Use of IT	×	×	✓
Top Management Involvement in IS Planning	×	✓	×

A key maturity characteristic identified in existing models is the contribution of business managers to the formulation of IS plans. The third aim of the research was to seek evidence to support the hypothesis that methods of making such a contribution during the IS planning process were also a maturity characteristic. Evidence was found to support the hypothesis that varying emphasis was placed on methods by hospitals of differing IS and IT maturity. This variation is illustrated in Figure Thirty-Eight.

Figure Thirty-Eight Methods of Contributing Information to the IS Planning Process and IS and IT Maturity

<table>
<tr><td>Less Mature</td><td colspan="4">A B C D</td><td>More Mature</td></tr>
<tr><td rowspan="5"></td><td colspan="2">Standing IS steering group used in formulating trust-wide IS strategy</td><td colspan="2">Ad-hoc planning groups used in formulating trust-wide IS strategy</td><td rowspan="5"></td></tr>
<tr><td>Greater emphasis on IS plans within a business plan</td><td colspan="3">Less emphasis on IS plans within a business plan</td></tr>
<tr><td colspan="4">A B C</td></tr>
<tr><td colspan="2">Less emphasis on Interim documentation</td><td colspan="2">Greater emphasis on interim documentation</td></tr>
<tr><td colspan="2">Greater emphasis on one-to-one meetings</td><td colspan="2">Less emphasis on one-to-one meetings</td></tr>
<tr><td rowspan="2"></td><td colspan="4">A C D</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Greater emphasis on IS plans within a business plan than on standalone IS plans</td><td colspan="2">Less emphasis on IS plans within a business plan than on standalone IS plans</td></tr>
</table>

6.3 Contribution to Current Knowledge of IS and IT Maturity

The contribution to the IS and IT fields made by this research is twofold. Firstly, the research has added to the existing body of knowledge concerning organisational IS and IT maturity. Secondly, it has provided evidence which changes current understanding of IS and IT maturity and its relationship with methods of contributing information to the IS planning process.

It was noted in Chapter Two that published empirical tests exist of the characteristics identified in only two of nine published maturity models,

namely Nolan's six stage model and McFarlan *et al.*'s four stage model of IT Assimilation. Empirical evidence to support the existence of any additional characteristics identified by the other seven models was to date lacking, independent of the models themselves. This research has, therefore, contributed to knowledge of IS and IT maturity by seeking to establish which, if any, characteristics from all nine models differentiate the maturity of NHS acute Trust hospitals, the results of which are presented in Figure Thirty-Six. This research also has the advantage of an increased level of representativeness over existing empirical tests which have sampled exclusively from IS and IT managers. This advantage has been realised by sampling from clinical managers, non-clinical managers, executive Trust directors in addition to IS and IT managers from each hospital.

This research has also revealed evidence that additional insight can still be gained into the maturity concept using a combination of one approach which consists of consideration of a range of IS and IT issues in an all-embracing model, with another approach which concentrates in more detail on a single aspect of IS or IT management. The latter is, therefore, an approach which continues to be worthwhile both as an accompaniment, and an alternative, to the development of an all-embracing model. This research has also found support for the hypothesis that methods of contributing information are an intregal part of organisational maturity in the IS planning process. Two methods were emphasised in more mature

hospitals: a greater emphasis on written records of information and IS needs before drawing up a final IS plan and a greater tendency towards the formulation of a standalone IS plan, when accelerated implementation was considered necessary, in preference to either the inclusion of an IS plan with the annual business plan, or one-to-one meetings with a Trust director or Head of an IS department.

Evidence from this research potentially changes understanding of IS and IT maturity in two respects. Firstly, it changes current understanding of existing maturity characteristics and secondly, understanding of the relationship between IS maturity and methods of contributing information to the IS planning process.

Nolan found that organisations began to use steering committees of managers when planning for IS during later stages of maturity. Results from this research show, however, that such groups are used by hospitals of varying IS maturity. The presence or absence, therefore, of steering committees is no longer a characteristic in itself. It is whether they are permanent or ad-hoc that currently differentiates IS maturity. Ward *et al.* hypothesised that organisations at early stages of maturity place more emphasis on what Pyburn describes as 'written-formal' methods than other methods, but by later stages, greater emphasis is placed on 'personal-formal' methods. Evidence from this research indicates to the contrary, however, that the methods emphasised by hospitals which exhibit greater overall IS maturity are closer in character to the 'written-formal'

category. Ward *et al.* recommend the use of a permanent steering group to formulate organisation-wide IS strategy. It was inferred, therefore, that such a group would be featured in hospitals of greater IS maturity. Results from this research showed, however, that less mature hospitals used a permanent steering group whereas more mature hospitals used an ad-hoc group to formulate organisation-wide IS strategy. Zmud recommends use of both standing and ad-hoc planning committees. While it was inferred, that both of these methods would be emphasised by more mature hospitals, standing committees were used exclusively by less mature hospitals for the formulation of Trust-wide IS strategy.

6.3.1 Factors Limiting the Research Contribution

There are three factors which limit, to an extent, the impact of the research contribution and are centred on the research method used in this study. The first of these factors is the accuracy with which two maturity characteristics were measured. Systems integration and the communication of IS needs between business and IS managers were characteristics which were not measured sufficiently accurately for valid conclusions to be drawn. It was, therefore, impossible using this research to determine whether these were maturity characteristics or not. The second of these factors is inherent in the use of statistical techniques to test hypotheses. It has already been noted that the level of significance chosen in rejecting the null hypothesis is a measure of

the level of risk of making a Type One error, that of rejecting the null hypothesis when it is fact true. In this research, the five per cent level of significance was used in seeking evidence of differences in IS and IT maturity. This was combined with the one per cent level when seeking differences in methods of contributing information to the IS planning process. These choices of significance level have left a small but nonetheless real possibility that differences identified using statistical techniques have, in fact occurred by chance and, therefore, might not be replicated were the same sample of managers to be questioned again. The third factor is routed in the sampling strategy. The choice of 'purposeful' sampling in preference to random sampling prevents the researcher from generalising to the wider population of NHS acute Trust hospitals. This lack of generalisability gives rise to the possibility that findings may not be replicated in an alternative random sample. A further limitation imposed by the sampling strategy is the selection of acute Trust hospitals from the population of NHS providers operating as Trusts. This clearly restricts the usefulness of the results of this research to this type of provider. Further work is, therefore, required to establish the extent to which these results are replicated in other providers such as ambulance and paramedic services, community healthcare and mental health Trusts.

6.4 The Value of this Research

It is anticipated that this research will be of value to managers of NHS acute Trust hospitals, to those involved in the formulation of national IM and T strategy and for IS researchers. This research has found evidence that six characteristics differentiate the IS and IT maturity of NHS acute Trust hospitals. By addressing these six, managers have the opportunity to improve their response in relation to other such providers to the demands placed on hospital-based IS and IT portfolios by Government reforms. This improvement can be achieved by becoming more IS and IT mature. This research is potentially valuable to those involved in the formulation of national IM and T strategy. It has provided evidence that current IM and T strategy has, and continues to address issues that will improve the level of exploitation of IT in the NHS as a whole. Four of the six maturity characteristics identified for acute Trust hospitals and a fifth, written methods of contributing information to the IS planning process have been addressed by a number of projects undertaken by the IMG. However, national examination of two further maturity characteristics, the use of IT-driven IS in scheduling and the involvement of heads of IS departments in business planning presents a further opportunity to increase the level of IS and IT maturity in NHS acute Trust Hospitals.

The value to IS researchers lies both in the basis this research provides for further work and its implications for the research approach with which it is undertaken. In using survey method in preference to other methods such

as action research, an instrument has been constructed which is, as far as possible, independent of the individual researcher carrying out the study. Other researchers have the opportunity to use this to address some of the limitations of this initial research, noted earlier in the chapter. A first step could be to establish the extent to which results were reflected in a random sample of acute Trust hospitals. A second step could be to do the same in other NHS providers operating as Trusts. These steps could also involve adding or subtracting maturity characteristics as a result of this testing process. A third step could be to establish the extent to which these results are reflected in other operating environments. This would be established, via a cross-sectoral study, by determining which organisations have the most characteristics in common with NHS providers operating as Trusts. If considerable commonality were found between such providers and other industry sectors, this would constitute evidence for the feasibility of developing a more generic set of maturity characteristics.

This research also has implications for researchers who, in preference to the above line of enquiry, wish to develop one or more of their own alternative maturity models. It has revealed evidence that further insight can be gained into IS and IT maturity in the future by combining an approach which examines a range of IS and IT-related issues with an approach which concentrates in more detail on a single aspect of IS or IT management. The latter of these approaches might prove particularly

enlightening in the case of areas, such as end-user computing, which have not been examined in detail by existing models.

Appendix A Pilot Study Research Instrument

The research instrument used in the pilot study consisted of separate structured and semi-structured interviews. The pro formas used for the collection of data are reproduced below. In the structured interview, the interviewer drew a ring around the response selected by the interviewee. In the semi-structured interview, the interviewer wrote down responses in the space provided.

COMPUTERISED INFORMATION SYSTEMS

Previous research has identified characteristics in the use and management of computerised information systems which affect organisational performance. I would like to ask you some questions about the use and management of computerised information systems in your hospital.

The following questions concern the use of computerised information systems.

To what extent are computerised information systems used in your department to do the following:

perform day-to-day tasks?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

monitor financial performance?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

obtain data for decision-making?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

access hospital-wide data?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

share information between departments?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

support the achievement of business objectives?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

obtain data on which to base departmental business objectives?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

To what extent do managers involve themselves in the following activities:

searching for a competitive advantage over other hospitals using computerised information systems?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

assessing the ability of current computerised information systems to satisfy information needs?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

planning for computerised information systems to be used in their own department?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

developing computerised information systems to be used in their own department for their own use?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

planning computerised information systems to be used by the hospital as a whole?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

Please place the development of the following computerised information systems in order of priority from 1 to 4 scoring 1 for the highest priority and 4 for the lowest.

those which are critical to the hospital in the future.....
those which may be critical to the hospital in the future.....
those which are critical to the hospital at present.....
those which improve management and performance
but are not critical to the hospital.....

The following questions concern the introduction of new computerised information systems.

To what extent are new computerised information systems:

introduced on an experimental basis?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

experimented with by staff in order to establish how they might best be used?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

To what extent are staff trained when new computerised information systems are introduced?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

The following questions concern information systems managers and their departments.
To what extent are the following actively encouraged in the hospital as a whole:

acquisition of business management skills by information systems managers?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

communication of information needs by departmental managers to information systems managers and their departments?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

communication of information needs by information systems managers and their departments to departmental managers and their departments?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

involvement of the information systems departmental head in business planning?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

the development of policies to increase the credibility of computerised information systems within the hospital?

ALWAYS
MOST OF THE TIME
SOMETIMES
SELDOM
NEVER

The next question is concerned with expenditure on computerised information systems.

Is expenditure on computerised information systems in your hospital

VERY TIGHTLY CONTROLLED
TIGHTLY CONTROLLED
NEITHER TIGHTLY NOR LOOSELY CONTROLLED
LOOSELY CONTROLLED
VERY LOOSELY CONTROLLED

Methods of Contributing Information to the IS Planning Process

Hospital: P

Staff Member: *Mrs. A.N. Other*

Post: *Service Manager, Therapies*

Please tell me as much as you can about planning for computerised information systems undertaken in your hospital as a whole.

Please tell me as much as you can about planning for computerised information systems undertaken in your hospital as a whole. (cont'd)

Please tell me as much as you can about the contribution your department makes to planning computerised information systems.

Please tell me as much as you can about the contribution your department makes to planning computerised information systems.

(cont'd)

Appendix B Pilot Study Data

Appendix B is divided into summaries of data collected from the structured interview concerning IS and IT maturity and from the semi-structured interview concerning methods of contributing information to the IS planning process. The summary is presented in Table Seven in the form of a frequency table for each characteristic, a median average and sample size.

Table Seven IS and IT Maturity Data

Maturity Characteristic	Scores					Median	Sample (n)
	1	2	3	4	5		
IT-driven is to support operational activity	0	1	3	2	9	5	15
IT-driven is to support decision-making	0	1	7	5	2	3	15
IT-driven IS to monitor financial performance	1	2	1	6	5	4	15
Systems integration	4	1	3	3	4	3	15
IT-driven IS to share information	1	5	5	4	0	3	15
IT-driven IS to support the achievement of business objectives	0	1	6	5	3	4	15
IT-driven IS to provide data for business planning	0	2	7	4	2	3	15
Managerial involvement in IS planning for ones own department	2	1	5	3	4	3	15
Managerial involvement in IS implementation for ones own department	3	1	5	3	3	3	15
Managerial involvement in IS planning for the Trust as a whole	4	2	5	4	0	3	15
Involvement in searching for competitive advantage from IT	5	8	2	0	0	2	15

Maturity Characteristic	Scores					Median	Sample (n)
	1	2	3	4	5		
Assessment of the ability of existing IS to satisfy information needs	2	3	6	3	1	3	15
Priority placed on development of strategic systems	1	3	6	5		3	15
Priority placed on development of turnaround systems	8	5	2	0		1	15
Priority placed on development of factory systems	0	2	4	9		4	15
Priority placed on development of support systems	6	5	3	1		2	15
Implementation of IS and IT using pilot schemes	1	6	4	3	1	3	15
Managerial involvement in experimenting with IT	0	2	3	5	5	4	15
Staff training in the use of IS	0	0	1	6	8	5	15
Acquisition of business management skills by IS managers	0	2	4	5	3	4	14
Communication of information needs from business to IS staff	0	1	4	5	5	4	15
Communication of information needs from IS staff to business managers	0	2	4	6	3	4	15
Involvement of heads of IS departments in business planning	0	0	3	4	8	4	15
Staff confidence in IT	1	0	7	4	3	3	15
Control of IS and IT expenditure	0	0	1	10	4	4	15

When differences between characteristics were sought using the Friedmann Two-Way Analysis-of-Variance, a χ^2 statistic of 110.223 was calculated which was greater than the critical value of χ^2 for the five per cent level of significance. The null hypothesis was, therefore, rejected.

Fifteen managers were interviewed about the IS planning processes within their hospital. They included Trust directors, IS managers and managers of both clinical and non-clinical departments. While a full set of transcripts is recorded elsewhere a typical example is presented below.

Interview Transcript

Manager A

Planning is undertaken by the Information Systems Steering Group who make strategic and purchasing decisions. It meets every two months on average and sometimes once a month. This group will make decisions on capital expenditure. It reviews proposals for new systems or systems changes. These proposals consist of a case and option appraisal prepared by the managers to whom the new system or change is relevant. The proposal would also need to be supported by the IT and Information Managers. Questions to be answered in the proposals include the following:

Why is the change needed?

What are the costs and benefits?

How does the proposed change or new system fit into overall business strategy?

It the proposed new system involves a great deal of money, options are also considered by the Trust Board. If the system is relevant to one department only,

the Trust Board consults the IT Manager to see if the idea is suitable for the Trust as a whole. The IS Steering Group discusses how to use IT to increase business success, information that is needed and the hard and software required to provide that information. Decisions on the IS Steering Group are reached by consensus. If no agreement can be reached, the decision is made by the Director of Finance. All major decisions to implement new systems are put to the Trust Executive for approval. If there is a clear split between supporters of two different options within the IS Steering Group, each party presents a case to either the Trust Directors and or/non-executive directors. The IS Steering Group formulates an Information Systems and IT strategy. This is then evaluated by the Trust Board using the following criteria:

Does it fit in with the business plan?

Does it meet the needs of users?

Does it meet purchaser and GP needs?

Does it take the Trust forward?

When a strategy has been formulated, it is discussed with Trust directors in a meeting with the IS Steering Group. It is made every three years and reviewed annually by directors. The Trust Board makes the final decision on any amendments to the strategy.

If the Information Systems Steering Group decides to proceed with a project, a dedicated project group is set up to manage the implementation of a new system. This group may be appointed by the IS Steering Group. The chair of the project group will then convene a meeting with all other participants to discuss planning, implementation, and post-implementation evaluation of the project. There is always an IS Steering Group member on a project group who reports back to the IS Steering Group. If a decision has been made by the project group, the report is formal and written, if a progress report only, it is oral.

Regular meetings with senior managers are held to discuss all departmental requirements including information needs. A one-to-one meeting is held between each manager and myself. Meetings are held every two weeks with other staff members to discuss future information needs and other issues are also discussed within a formal agenda. Ideas about information needs are brought to the attention of senior managers by other staff orally. Changes to departmental systems are discussed with IT and Information Departments. If the change is minor, a phone call may suffice. If the change is more major, a meeting is arranged. The decision to make changes whose costs fall within departmental budgets is made by myself. Advice would be sought from the IT department on hardware compatibility.

Appendix C Main Study Research Instrument

The research instrument used in the main study consisted of separate structured and semi-structured interviews. The pro formas used for the collection of data are reproduced below. In the structured interview, the interviewer drew a ring around the response selected by the interviewee. In the semi-structured interview, the interviewer wrote down responses in the space provided.

COMPUTERISED INFORMATION SYSTEMS

Previous research has identified characteristics in the use and management of computerised information systems which affect organisational performance. I would like to ask you some questions about the use and management of computerised information systems in your hospital.

Some terms used in the questions may be interpreted in a number of different ways. To help you to answer as accurately as possible, the following definitions have been adopted for the purposes of this study.

Computerised Information System

A system for the storage, retrieval and manipulation of data supported by the use of information technology. Such systems may be developed by users for their own use from manufactured software such as Microsoft Excel or Lotus 123. Alternatively they may be developed by an IT department from scratch.

Planning

The process of identifying a set of objectives to be implemented at some time in the future.

Implementation

The process of fulfilling the objectives articulated in the plan.

Business planning

The process of identifying a set of objectives which will improve the current position of the Trust.

In answering the following questions, you will be asked to choose one response from a possible five. Please offer that which best describes the current position of the department or directorate of which you are a member. If, for whatever reason you consider the question cannot be meaningfully applied to your department or directorate, please answer, non-applicable (N/A)

How much of the **maintenance of employee records** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **purchasing** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **invoicing** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **stock control** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **scheduling** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **sharing of information with other departments** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much **forecasting demand for services** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much **forecasting of revenue from services** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **materials planning** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **manpower planning** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **costing of services** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **budgeting** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **business planning** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How much of the **monitoring of financial performance** which takes place involves the use of computerised information systems?

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How many managers involve themselves in **planning for changes to existing computerised information systems** ?

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers involve themselves in **planning for totally new computerised information systems?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers involve themselves **implementation of changes to existing computerised information systems?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers involve themselves in **implementation of totally new computerised information systems**?

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers involve themselves in **assessing the ability of current computerised information systems to satisfy information needs?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers involve themselves in **searching for a competitive advantage over other hospitals using computerised information systems?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many staff are **confident in the ability of computerised information systems to satisfy their information needs?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many staff **make their information needs known to Information Systems and/or Information Technology departments?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many managers **experiment with information technology in order to establish it might best be used?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

Which of the following statements best describes the training in the use of computerised information systems which staff receive?

Staff receive the **training they feel they need on none** of the computerised information systems they use.

Staff receive the **training they feel they need on less than half** the computerised information systems they use.

Staff receive the **training they feel they need on approx. half** the computerised information systems they use.

Staff receive the **training they feel they need on the majority** of the computerised information systems they use.

Staff receive the **training they feel they need on all** the computerised information systems they use.

How much of the data used is **replicated on more than one independent computerised information system?**

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE

How much of the **data used can be transferred to another independent computerised information system without re-keying it using printed hard copy?**

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE

How many computerised information systems are **developed independently when the development of one system used by 2 or more departments would have been feasible?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many computerised information systems **are used to support the achievement of business objectives?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How much **implementation of changes to existing computerised information systems is undertaken using pilot schemes?**

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE

How much **implementation of totally new computerised information systems is undertaken using pilot schemes?**

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE

The next questions are about information technology/information systems staff.

To how much of the **business planning** which takes place do the following staff members make a contribution? If such a person does not exist in your hospital, please answer N/A.

The Head of the Information Department

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

The Head of the Information Systems Department

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

The Head of the Information Technology Department

ALL	MOST	APPROX. HALF	LESS THAN HALF	NONE	N/A

How many **Information Systems and/or Information Technology staff use business management skills?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many **Information Systems and/or Information Technology staff make their information needs known to staff in other departments?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

The following two questions are about the involvement of Trust directors in planning for systems used both at directorate or departmental level and by the Trust as a whole.

How many Trust directors involve themselves in **planning for changes to existing computerised information systems** ?

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

How many Trust directors involve themselves in **planning for totally new computerised information systems?**

ALL	THE MAJORITY	APPROX. HALF	A MINORITY	NONE

In the following questions, please apply your responses to yourself only.

Researchers have classified computerised information systems into 4 categories according to the contribution each category makes to the organisation. Please indicate the priority you would place on the development of computerised information systems which fall into each category from 1, the lowest priority to 4, the highest priority. 2 or more categories may be ranked of equal priority.

Computerised information systems which are **definitely critical to the future success of the Trust.**

lowest priority	1	2	3	4	**highest priority**

Computerised information systems which are **likely to be critical to the future success of the Trust.**

lowest priority	1	2	3	4	**highest priority**

Computerised information systems which **are critical to the maintenance of existing services.**

lowest priority	1	2	3	4	**highest priority**

Computerised information systems which **support but are not critical to the maintenance of existing services.**

lowest priority	1	2	3	4	**highest priority**

Please indicate on a scale of one to five how tightly expenditure on computerised information systems is controlled in your Trust. The response one indicates that no control is exercised over expenditure. The response five indicates that expenditure is tightly controlled.

no control is exercised over expenditure	1	2	3	4	5	**expenditure is tightly controlled**

Methods of Contributing Information to the IS Planning Process

Hospital: A B√ C D

Staff Member: *Mr. A.N. Other*

Post: *Service Manager, Pharmacy*

Please tell me as much as you can about planning for computerised information systems undertaken in your hospital as a whole

Please tell me as much as you can about planning for computerised information systems undertaken in your hospital as a whole. (cont'd)

Please tell me as much as you can about the contribution your department makes to planning computerised information systems.

Please tell me as much as you can about the contribution your department makes to planning computerised information systems. (cont'd)

Appendix D Main Study Data concerning IS and IT Maturity

Appendix D consists of summaries and analyses of data concerning IS and IT maturity. Data are summarised in frequency tables for each maturity characteristic, median averages and sample size for each hospital. To test Hypothesis One, the Kruskal-Wallis One-Way Analysis-of-Variance by Ranks was used, the results of which are presented in Table Eight. The shaded value of χ^2 was greater than the critical value of χ^2 at the five per cent level of significance. The value of a test statistic such as χ^2 is commonly calculated using computer software especially written for statistical analysis. When a test statistic is calculated by hand using the necessary formula, the researcher then has to consult a statistical table to find out whether the calculated value is great or small enough to reject the null hypothesis, i.e. greater or smaller than the critical value of that statistic for a given level of significance. However, when statistical software is used, there is no need to consult a statistical table in order to make the decision whether to accept or reject the null hypothesis. This is because such software assumes that the null hypothesis is being tested and calculates a precise level of significance at which the null hypothesis may be rejected for the number of degrees of freedom in the test.

The statistics package Statistical Package for the Social Sciences (SPSS) was used

in all the statistical data analysis in this research. The values of test statistics such as χ^2 and U and the levels of significance at which the null hypothesis can be rejected were generated using this package. Significance levels are reported as p (probability) values, i.e. the probability of making a Type One Error.

Table Eight Data Summary and Significance Levels for Tests of Hypothesis One

Maturity Characteristic	Hospital	Scores 1	2	3	4	5	Median	Sample Size	χ^2	pValue
Use of IT-driven IS in the maintenance of employee records	A	3	9	2	3	2	2	19	0.518	0.9150
	B	4	3	2	2	2	2	13		
	C	2	5	0	4	2	2	13		
	D	2	3	2	1	2	2.5	10		
Use of IT-driven IS in purchasing	A	3	6	2	2	4	2	17	3.058	0.3827
	B	3	1	3	3	3	3	13		
	C	3	3	2	2	5	3	15		
	D	0	2	1	4	4	4	11		
Use of IT-driven IS for invoicing	A	2	4	2	6	3	4	17	6.914	0.0747
	B	4	0	1	3	4	4	12		
	C	0	4	0	0	8	5	12		
	D	0	0	0	6	5	4	11		
Use of IT-driven IS for stock control	A	8	3	2	2	2	2	17	4.819	0.1856
	B	4	5	1	2	2	2	14		
	C	3	2	2	5	1	3	13		
	D	0	2	2	5	0	3	9		

Maturity Characteristic	Hospital	1	Sc 2	or 3	es 4	5	Median	Sample Size	χ^2	pValue
Use of IT-driven IS for scheduling	A	9	5	1	1	2	1	18	9.024	0.0290
	B	7	3	1	0	1	1	12		
	C	4	8	1	0	4	2	17		
	D	1	4	4	3	1	3	13		
Use of IT-driven IS for forecasting demand for services	A	4	6	4	4	1	2	19	3.067	0.3814
	B	4	3	2	4	1	2	14		
	C	3	6	1	5	3	2.5	18		
	D	0	3	5	5	1	3	14		
Use of IT-driven IS for forecasting revenue from services	A	2	4	3	8	1	3	18	8.930	0.0302
	B	4	5	1	2	2	2	14		
	C	2	1	0	7	4	4	14		
	D	0	0	1	10	0	4	11		
Use of IT-driven IS for materials planning	A	4	7	5	0	0	2	16	0.348	0.9507
	B	3	4	3	0	1	2	11		
	C	6	4	1	3	0	2	14		
	D	2	4	1	1	0	2	8		

Maturity characteristic	Hospital	Scores 1	2	3	4	5	Median	Sample Size	χ^2	pvalue
Use of IT-driven IS for costing of services	A	1	4	2	7	6	4	20	1.858	0.6024
	B	2	3	0	5	5	4	15		
	C	2	2	1	8	3	4	17		
	D	0	5	0	7	0	4	12		
Use of IT-driven IS for budgeting	A	1	3	4	7	6	4	21	3.104	0.3759
	B	1	1	2	6	5	4	15		
	C	0	2	2	7	4	4	15		
	D	0	1	0	4	7	5	12		
Use of IT-driven IS in manpower planning	A	4	9	2	0	1	2	16	3.0397	0.3855
	B	6	4	1	2	0	2	13		
	C	2	9	1	3	0	2	15		
	D	1	7	1	1	1	2	11		
Use of IT-driven IS share information	A	3	11	2	4	1	2	21	5.509	0.1381
	B	3	6	3	1	1	2	14		
	C	0	8	2	8	1	3	19		
	D	0	8	4	3	0	2	15		

Maturity characteristic	Hospital	Sc 1	or 2	es 3	4	5	Median	Sample Size	χ^2	pvalue
Use of IT-driven IS to provide data for business planning	A	1	9	2	7	1	2	20	2.083	0.554
	B	0	6	3	4	1	3	14		
	C	2	1	4	9	1	4	17		
	D	0	5	3	4	1	3	13		
Use of IT-driven IS to monitor financial performance	A	2	1	3	8	7	4	21	4.238	0.2368
	B	1	2	0	7	5	4	15		
	C	2	2	1	3	8	4.5	16		
	D	0	0	0	5	8	5	13		
Managerial involvement in planning changes to existing IS	A	1	4	2	2	11	5	20	3.901	0.2723
	B	0	3	1	7	4	4	15		
	C	0	1	1	6	9	5	17		
	D	0	2	0	2	9	5	13		
Managerial involvement in planning totally new IS	A	0	1	4	5	10	4.5	20	1.876	0.5986
	B	0	5	1	4	5	4	15		
	C	0	4	1	4	8	4	17		
	D	0	3	1	3	6	4	13		

Maturity characteristic	Hospital	Scores 1	2	3	4	5	Median	Sample Size	χ^2	pvalue
Top management involvement in planning changes to existing IS	A	1	9	2	4	1	2	17	2.531	0.4698
	B	1	8	1	1	2	2	13		
	C	1	6	2	4	4	3	17		
	D	0	6	1	4	1	2.5	12		
Top management involvement in planning totally new IS	A	3	5	6	4	0	3	18	12.036	0.0073
	B	0	8	3	2	1	2	14		
	C	0	4	0	6	7	4	17		
	D	1	3	2	5	1	3.5	12		
Managerial involvement in implementing changes to existing IS	A	1	2	4	3	10	2	20	2.375	0.4983
	B	0	3	1	4	7	4	15		
	C	1	3	0	5	8	5	17		
	D	1	3	2	3	4	4	13		
Managerial involvement in implementing totally new IS	A	0	2	3	4	11	3	20	2.315	0.5096
	B	0	4	0	3	8	5	15		
	C	0	3	0	5	9	5	17		
	D	1	2	2	4	4	4	13		

Maturity characteristic	Hospital	1	Sc 2	or 3	es 4	5	Median	Sample Size	χ^2	pvalue
Staff involvement in assessing the ability of current systems to satisfy information needs	A	0	3	4	6	7	4	20	2.193	0.5332
	B	0	4	3	6	2	4	15		
	C	0	5	1	3	8	4	17		
	D	0	2	3	4	4	4	13		
Staff involvement in seeking competitive advantage from IT	A	4	8	0	3	5	2	20	1.221	0.7480
	B	1	6	2	2	4	3	15		
	C	3	8	2	1	3	2	17		
	D	3	5	1	2	2	2	13		
Staff confidence in IT	A	0	8	5	5	3	2	21	2.880	0.4104
	B	2	3	5	4	0	3	14		
	C	0	3	7	8	1	3	19		
	D	0	2	6	5	1	3	14		
Staff experimentation with IT	A	4	9	2	2	3	2	20	2.763	0.4297
	B	1	7	4	2	1	2	15		
	C	2	12	1	0	2	2	17		
	D	1	6	1	2	3	2	13		

Maturity characteristic	Hospital	1	Sc 2	or 3	es 4	5	Median	Sample Size	χ^2	pvalue
Staff training in the use of IT	A	1	3	4	9	3	4	20	8.2135	0.0418
	B	0	0	0	8	6	4	14		
	C	0	3	3	8	5	4	19		
	D	0	2	3	7	2	4	14		
Use of IT-driven IS to support business objectives	A	1	5	5	6	4	3	21	11.062	0.0089
	B	1	1	3	6	4	4	15		
	C	0	1	4	8	4	4	17		
	D	0	1	0	4	10	5	15		
Implementation of changes to existing IS and IT using pilot schemes	A	4	9	1	6	1	2	21	1.196	0.7540
	B	3	3	2	6	1	3	15		
	C	3	4	2	6	2	3	17		
	D	2	3	2	4	1	3	12		
Implementation of totally new IS and IT using pilot schemes	A	6	5	2	3	4	2	20	2.544	0.4674
	B	4	1	3	6	1	3	15		
	C	1	7	0	6	3	4	17		
	D	2	1	1	5	3	4	12		

Maturity characteristic	Hospital	1	Sc 2	or 3	es 4	5	Median	Sample Size	χ^2	pvalue
Involvement of heads of IS in business planning	A	8	9	1	2	0	2	20	9.425	0.0241
	B	4	4	0	5	2	2	15		
	C	9	3	0	3	4	2	19		
	D	1	2	3	4	3	4	13		
Acquisition of business management skills by IS managers	A	3	9	6	0	0	4	18	7.344	0.0617
	B	1	6	3	2	0	2	12		
	C	0	7	3	6	0	3	16		
	D	1	2	3	4	0	3	10		
Priority placed on the development of strategic systems	A	0	0	1	20		3	21	0.4073	0.4058
	B	0	1	2	12		4	15		
	C	0	0	2	17		4	19		
	D	1	2	1	12		4	15		
Priority placed on the development of turnaround systems	A	0	3	11	7		4	21	0.5099	0.9167
	B	2	1	6	6		3	15		
	C	3	1	7	8		3	19		
	D	0	2	6	7		3	15		

Maturity characteristic	Hospital	Scores 1	2	3	4	5	Median	Sample Size	χ^2	pvalue
Priority placed on the development of factory systems	A	0	2	6	13		4	21	1.396	0.7064
	B	0	0	5	10		4	15		
	C	0	1	3	15		4	19		
	D	1	0	4	10		4	15		
Priority placed on the development of support systems	A	4	10	5	2		2	21	1.696	0.6379
	B	1	8	5	1		2	15		
	C	1	10	7	1		2	19		
	D	2	5	5	3		3	15		
Control of IS and ITexpenditure	A	0	1	3	6	11	5	21	1.265	0.7374
	B	1	0	3	6	5	4	15		
	C	0	1	2	9	7	4	19		
	D	0	1	2	5	7	4	15		

To test Hypothesis Two, the Mann Whitney U Test was performed on each possible pair of hospitals for each maturity characteristic for which the null hypothesis was rejected in tests of Hypothesis One. The results of testing Hypothesis Two are presented in Table Nine. The shaded values of U are those for which the null hypothesis was rejected because the calculated value of U was less than the critical value of U at the five per cent level of significance.

Table Nine Data Summary and Significance Levels for Tests of Hypothesis Two

Maturity Characteristic	Hospital	Scores					Median	Sample Size	U	p Value
		1	2	3	4	5				
Use of IT-driven IS for scheduling	A	9	5	1	1	2	1	18	97.5	0.6254
	B	7	3	1	0	1	1	12		
	A	9	5	1	1	2	1	18	113.5	0.1677
	C	4	8	1	0	4	2	17		
	A	9	5	1	1	2	1	18	62	0.0228
	D	1	4	4	3	1	3	13		
	B	7	3	1	0	1	1	12	65.5	0.0860
	C	4	8	1	0	4	2	17		
	B	7	3	1	0	1	1	12	32	0.0097
	D	1	4	4	3	1	3	13		
	C	4	8	1	0	4	2	17	83	0.2307
	D	1	4	4	3	1	3	13		

Maturity characteristic	Hospital	Scores					Median	Sample Size	U	p value
		1	2	3	4	5				
Use of IT-driven IS in forecasting revenue from services	A	2	4	3	8	1	3	18	92.5	0.1890
	B	4	5	1	2	2	2	14		
	A	2	4	3	8	1	3	18	85	0.0983
	C	2	1	0	7	4	4	14		
	A	2	4	3	8	1	3	18	60.5	0.0466
	D	0	0	1	10	0	4	11		
	B	4	5	1	2	2	2	14	56.5	0.0490
	C	2	1	0	7	4	4	14		
	B	4	5	1	2	2	2	14	34.5	0.0130
	D	0	0	1	10	0	4	11		
	C	2	1	0	7	4	4	14	68	0.5507
	D	0	0	1	10	0	4	11		

Maturity characteristic	Hospital	Scores					Median	Sample Size	U	p value
		1	2	3	4	5				
Top management involvement in planning for totally new IS	A	3	5	6	4	0	3	18	125	0.9681
	B	0	8	3	2	1	2	14		
	A	3	5	6	4	0	3	18	62	0.0020
	C	0	4	0	6	7	4	17		
	A	3	5	6	4	0	3	18	78	0.1887
	D	1	3	2	5	1	3.5	12		
	B	0	8	3	2	1	2	14	55.5	0.0082
	C	0	4	0	6	7	4	17		
	B	0	8	3	2	1	2	14	63.5	0.2660
	D	1	3	2	5	1	3.5	12		
	C	0	4	0	6	7	4	17	62.5	0.0669
	D	1	3	2	5	1	3.5	12		

Maturity characteristic	Hospital	Scores					Median	Sample Size	U	p value
		1	2	3	4	5				
Staff training in the use of IT	A	1	3	4	9	3	4	20	69	0.0072
	B	0	0	0	8	6	4	14		
	A	1	3	4	9	3	4	20	162	0.4069
	C	0	3	3	8	5	4	19		
	A	1	3	4	9	3	4	20	132.5	0.7798
	D	0	2	3	7	2	4	14		
	B	0	0	0	8	6	4	14	87	0.0689
	C	0	3	3	8	5	4	19		
	B	0	0	0	8	6	4	14	50	0.0150
	D	0	2	3	7	2	4	14		
	C	0	3	3	8	5	4	19	119.5	0.6018
	D	0	2	3	7	2	4	14		

Maturity characteristic	Hospital	Scores					Median	Sample Size	U	p value
		1	2	3	4	5				
Use of IT-driven IS to support the achievement of business objectives	A	1	5	5	6	4	3	21	125.5	0.2888
	B	1	1	3	6	4	4	15		
	A	1	5	5	6	4	3	21	131.5	0.1512
	C	0	1	4	8	4	4	17		
	A	1	5	5	6	4	3	21	65.5	0.0020
	D	0	1	0	4	10	5	15		
	B	1	1	3	6	4	4	15	123.5	0.8728
	C	0	1	4	8	4	4	17		
	B	1	1	3	6	4	4	15	61.5	0.0226
	D	0	1	0	4	10	5	15		
	C	0	1	4	8	4	4	17	68.5	0.0164
	D	0	1	0	4	10	5	15		

Maturity characteristic	Hospital	Scores					Median	Sample Size	U	p value
		1	2	3	4	5				
Involvement of heads of IS departments in business planning	A	8	9	1	2	0	2	20	88.5	0.3695
	B	4	4	0	5	2	2	15		
	A	8	9	1	2	0	2	20	82.5	0.0230
	C	9	3	0	3	4	2	19		
	A	8	9	1	2	0	2	20	46.5	0.0280
	D	1	2	3	4	3	4	13		
	B	4	4	0	5	2	2	15	72.5	0.2416
	C	9	3	0	3	4	2	19		
	B	4	4	0	5	2	2	15	42	0.2141
	D	1	2	3	4	3	4	13		
	C	9	3	0	3	4	2	19	75.5	0.8016
	D	1	2	3	4	3	4	13		

Appendix E Main Study Data concerning Methods of Contributing Information to the IS Planning Process

1.1 Data Analysis

Appendix E consists of summaries of data and data analysis undertaken to locate differences in methods of contributing information to the IS planning process which are discussed more fully in Chapter Five. The results of testing Hypothesis Four are presented in Table Ten.

Table Ten Significant Levels for Tests of Hypothesis Four

$Method_T$	$Method_U$	χ^2	p Value
Standalone IS Plan	IS Plan Within A Business Plan	10.553	0.014
Ad-Hoc Planning Group	Routine Group Management Forum	2.610	0.455
One-To-One Meeting	Routine Group Management Forum	1.486	0.690
Minutes	Interim Documentation	4.504	0.211

Results of testing H_5 are presented in Table Eleven overleaf.

Table Eleven Significance Levels for Tests of Hypothesis Ten

Pairs of Hospitals	χ^2	p Value
A,B	3.203	0.073
A,C	8.834	0.0029
A,D	3.972	0.0462
B,C	1.819	0.1773
B,D	0.424	0.546
C,D	0.2147	0.6572

The shaded values of χ^2 are those which were greater than the critical value of χ^2 for the five per cent level of significance.

Due to restrictions placed on use of the χ^2 statistic by sample size, Hypothesis Six could only be tested with reference to two of the eight methods in Table Five. Ad-hoc planning groups resulted in a χ^2 of 6.641 with a p value of 0.0842 and OHP presentations a χ^2 of 7.302 with a p value of 0.0628. Neither calculated value of χ^2 was large enough to reject the null hypothesis at the five per cent level of significance.

Where samples were too small to permit the interpretation of the χ^2 statistic, Hypothesis Seven was tested using the Fisher Exact Test. The significance levels for each possible pair of hospitals and each method are presented in Table Twelve overleaf. Where the Fisher Exact Test was used, results are printed in bold.

Table Twelve Significance Levels for Tests of H_7

Hospitals	One-to-One Meetings	Routine Group Management Forums	Standalone IS Plan	IS Plan Within A Business Plan	Written Minutes	Interim Documentation
A,B	0.015	0.9999	0.074	0.0007	0.9999	0.527
A,C	0.0005	0.4474	0.0263	0.0001	0.9999	0.0109
A,D	0.1801	0.4324	0.4285	0.00005	0.9999	0.1058
B,C	0.4066	0.4857	0.9999	0.1123	0.9999	0.001
B,D	0.4054	0.4710	0.6015	0.2543	0.9999	0.0162
C,D	0.0570	0.9999	0.5350	0.9999	0.9999	0.3983

2.1 Sample Interview Transcripts

In order to obtain the numerical data from which to perform statistical analysis, 'content analysis' was performed on interview transcripts generated from over seventy managers' accounts of the IS planning processes to which they had recently made a contribution. These managers can be categorised according to their particular roles in the management of their respective hospitals. These categories are IS managers, managers of non-clinical departments such as finance or facilities, managers of clinical departments such as accident and emergency or general medicine and Trust directors. While a complete set of transcripts is documented elsewhere, two sample transcripts are reproduced in the following paragraphs for each category of manager.

2.1.1 IS Manager A

The Computing and Information department is headed by one manager who holds the title of Head of Computing and Information and reports to the Trust Board. A business manager discusses an IS need with the Head of Computing and Information either with or without the aid of written notes. The latter then meets the Computer Projects Manager to find out if the proposed development is suitable in respect to the current systems portfolio. Based on the results of this discussion, the Head of Computing and Information meets the business manager again with a letter accepting or rejecting his IS plan. For developments requiring high capital investment, the Head of Computing and Information discusses the proposal with the Director of Finance. Alternatively, a business manager may frame an IS plan as a bid for capital that he submits to the 'Capital Sub-Committee'. This group either accepts it, rejects it, or refers it to the Head of Computing and Information for further information that will allow it to make a decision.

Trust-wide IS plans are made at monthly meetings of the 'IT Strategy Group' consisting of one non-executive director, the Director of Finance, the Head of Computing and Information, some clinicians and a business manager. Where specific IS requirements are to be discussed, managers who might gain from a specific development are co-opted onto the Group by the Chief Executive. If such a request is

made, participation in the Group is compulsory. It gathers information from which to form Trust-wide IS plans by sending memos to business managers requesting their opinions concerning their present and future IS needs.

2.1.2 IS Manager B

Directorate managers discuss IS needs with members of the IT department by telephone, the output from which they incorporate into a business case of length two sides of A4. If the proposed change can be financed from a directorate budget, the Director of IT scrutinises the case and approves it himself. If external finance is needed, the Directorate Manager incorporates the approved case into the annual directorate business plan. IS needs are also discussed in meetings of the Business Information Group. This brings IS needs to the attention of the Trust Board. If the Trust Board approves a directorate-based or Trust-wide system change, the Chief Executive instructs the Director of IT or Deputy Director of Resources to set up a Project Board consisting of senior users, a directorate and information manager to co-ordinate planning and implementation. This Board nominates a project team to draw up a written IS plan in a series of minuted meetings which the Project Board approves. The Team implements the plan, the progress of which is monitored by the Project Board through monthly and quarterly written reports.

2.1.3 Non-Clinical Manager A

IS needs are discussed at fortnightly minuted managers meetings to which members of the IT department are invited and in fortnightly minuted one-to-one meetings between the Director of Facilities and each manager. The former discusses the output from these forums with members of the IT department in a specially arranged minuted meeting. The Director of Facilities incorporates the output from this discussion directly into an IS plan. Alternatively he sets up a planning team consisting of key end users and members of the IT department to formulate a plan. If implementation is to be financed from the directorate budget, the plan is submitted to the Director of Facilities for approval. For more costly changes, the latter presents a pre-circulated IS plan to the Trust Board and answers questions on it. He is assisted by a representative from the IT department if the entire hospital is affected by the change.

2.1.4 Non-Clinical Manager B

A manager in the Contracts Department sends a memo to a member of the IS department documenting an IS need which they discuss in a specially arranged meeting or most commonly by telephone. The finance manager concerned discusses the outcome of this meeting in a monthly unrecorded staff meeting and weekly minuted managers meeting chaired by the Director of Finance. If the Director of Finance

is satisfied that there is a need to be addressed, a business case is compiled by the manager concerned. The Director of Finance then scrutinises the business case. If he is convinced that a change is necessary, he convenes either a project group or, if he considers the need for an IS change to be immediate, a task force. A project group is selected from managers and doctors to whom the change is relevant, usually one manager from each function. A 'task force' is selected using the same criteria with the addition of a management consultant and is limited to five members only. Due to the increased cost incurred by use of a management consultant however, the Director of Finance refers the need to the Chief Executive for prior approval. Either the Project Group or Task Force discuss the implications of the existing business case and compile a further written case which they present to the Director of Information Systems.

2.1.5 Clinical Manager A

Staff discuss IS and other needs at a monthly minuted meeting and nurses in one-to-one meetings with the Service Manager. The Service Manager attends the former forum only when management and not exclusively clinical issues are discussed. Three distinct IS planning processes are used in these departments. Unminuted meetings are convened especially to make an IS plan termed an 'Operational Requirement.' This is then forwarded to the Information Management

and Technology Manager. He examines this and forwards a copy of his revised 'Operational Requirement' to the Service Manager. Alternatively, an IS plan is made in a series of monthly minuted meetings, the last of which is attended by the Clinical Audit Manager. He writes the IS plan and, after consultation with the Information Management and Technology Manager, presents it to the General Manager. The Service Manager also discusses IS needs with the Information Management and Technology Manager. Based on the output from these, the former writes an IS plan and incorporates it into a business plan for the service concerned. She then discusses this with the General Manager during a Performance Review meeting.

2.1.6 Clinical Manager B

IS needs are discussed at unrecorded monthly staff meetings. Before making an IS plan, the Service Manager discusses IS needs in unrecorded meetings with the Information Management and Technology Manager. Based on the output from these forums, the Service Manager selects a 'Theatre Team' consisting of the Service Manager, a financial advisor, clinicians and a Business Development Manager to co-ordinate more detailed IS planning. This is carried out by a 'Project Group' that reports to the 'Theatre Team' through monthly minuted meetings. The Service Manager selects this group to compile an IS plan in unrecorded fortnightly meetings. The 'Project Group'

forwards the plan to the Service Manager who discusses it in a 'Performance Review' meeting with the General Manager. The latter presents the approved plan firstly to the Information Steering Group and presents an approved plan to a bimonthly meeting of the Trust Board. She answers pre-prepared questions posed by the Board members. If they reject the plan, she meets the Service Manager on a one-to-one basis to explain why the Trust Board is unwilling to approve it.

2.1.7 Trust Director A

The current Trust-wide IS plan is to introduce a hospital-wide HISS. It is made by the Project Board of twelve consisting of executive Trust directors and clinicians chaired by the Director of Information Systems. This Board meets in monthly minuted meetings and reports directly to the Trust Board. The Project Team brings together directorate information needs which it inputs in the form of minutes to the Project Board. The latter uses this to prepare a written business case, (IS plan) which it submits to the Trust Board. Individual managers make their IS needs known to Trust directors via three alternative mechanisms. A clinical director discusses needs with the Chief Executive who ensures that it is placed on the agenda of the monthly minuted Trust Board meeting. Alternatively, a clinical director discusses an IS need with individual members of the HISS Project Board. If a system change

affects one directorate only, a directorate manager submits a standard form of length two sides of A4 paper as an IS plan to the Capital Group. The latter discusses it in one or more minuted meetings before it is approved. If the cost of the proposed change is less than 100 000 pounds however, the Chief Executive may approve implementation without consulting other staff.

2.1.8 Trust Director B

The Chief Executive writes a Trust-wide business plan based on discussions in the Operations Board attended by three Trust directors and doctors. The Trust Board then approves this before publication. If IS development is considered, the IS component of the plan is made by a 'task force' consisting of three consultants, the Directors of Finance and Computing and Information and some non-executive directors. They write a 'specification' -a statement of future IS requirements. A set of recommendations is then circulated a week before the next Trust Board meeting that are also presented orally to the Trust Board.

Business managers also present bids for IS funding to the Operations Board that asks the 'Capital Sub-Committee' to evaluate them at a monthly meeting. The business manager is notified in writing of the decision. The Trust Chairman has an interest in IT. Senior consultants therefore 'lobby' him and discuss IS plans on a one-to-one basis. The Chairman then asks the Head of Computing and Information to evaluate

those from which he considers the Trust may benefit. Less senior clinicians also 'lobby' the Directors of Finance and Performance Management and the Chief Executive in the same manner.

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