DEVELOPMENT OF PERFORMANCE MODELS FOR CO-OPERATIVE INFORMATION SYSTEMS IN AN ORGANISATIONAL CONTEXT

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SUMMARY

The thesis reports the results of a study into the *effect upon organisations of co-operative* information systems (CIS) incorporating flexible communications, group support and group working technologies. A review of the literature leads to the development of a model of effect based upon *co-operative business tasks*. CIS have the potential to change how co-operative business tasks are carried out and their principal effect (or performance) may therefore be evaluated by determining to what extent they are being employed to perform these tasks. A significant feature of CIS use identified is the extent to which they may be *designed* to fulfil particular tasks, or by contrast, may be applied creatively by users in an *emergent* fashion to perform tasks. A research instrument is developed using a survey questionnaire to elicit users judgements of the extent to which a CIS is employed to fulfil a range of co-operative tasks. This research instrument is applied to a longitudinal study of Novell GroupWise introduction at Northamptonshire County Council during which qualitative as well as quantitative data were gathered. A method of analysis of questionnaire results using principles from fuzzy mathematics and artificial intelligence is developed and demonstrated. Conclusions from the longitudinal study include the importance of *early experiences* in setting patterns of use for CIS, the persistence of *patterns of use* over time and the dominance of *designed* usage of the technology over *emergent* use.

KEYWORDS

"CSCW", "CO-OPERATIVE WORK", "INFORMATION SYSTEMS", "FUZZY ANALYSIS", "ORGANISATIONAL IMPACT".

DEDICATION

To Iona and Michael

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1. INTRODUCTION

"What we call the beginning is often the end
And to make and end is to make a beginning."

T.S. Eliot, from "Little Gidding".

1.1. BACKGROUND

Management concern about the performance and effectiveness of information systems and technology (IST) has varied over a period during which they have become one of the dominant factors of organisational and business life. In early computer applications the justification for investing in IST, both hardware and software, was clearly based upon the production economics which automated data processing was able to offer. However, in recent years, over a period spanning approximately the early 1980's to the present, greater attention has been given to other ways in which IST investments can increase organisational performance and deliver benefits. In particular, the potential of IST both to improve organisational effectiveness and to create competitive advantage increasingly exercises the energies of practising managers, consultants and researchers in the field of information systems (IS). In *Information Technology The Management Challenge*, Caroline Daniels states *"IT is far more than a technology to be mastered. Properly implemented IT can fundamentally change the nature of a business and the way it is managed."* (Daniels, 1994, p1).

In part at least, this shift in emphasis from pure production economics towards a focus upon less tangible, transformational and longer term benefits of IST, reflects dramatic developments in the variety and capability of the technology on offer. Hardware prices have been driven down to the level where, for perhaps a majority of organisations in the developed world, a computer per office desk is a viable proposition. During the period 1980 to 1995 sales of personal computers (PCs) is estimated to have risen from $2 billion to $160 billion (Willcocks and Lester, 1999, p16). Software developments, especially network based, seem limited only by the imagination of their programmers, and a wide variety of useful and usable programs and systems have resulted. For example, the explosion in the use of the global Internet and World Wide Web (WWW) has been largely driven by developments in software capabilities growing from the Mosaic browser first introduced as recently as 1993. In this environment, increasingly characterised by both inter-organisational and intra-organisational networking, there is a need for new ways of understanding IST effects and the benefits which may be delivered. Researchers and other commentators are aware of this, for example Willcocks and

Lester in *Beyond the IT Productivity Paradox* consider that *"It becomes increasingly important to grasp the economics of the fast developing network-based era because it embodies a fundamental shift out of systems and PC-centric thinking about IT investments...."* (Willcocks and Lester, 1999. p20). Further, evaluation which can deal with dynamic goals and shifting goalposts become important (Remenyi, Sherwood-Smith and White, 1997).

1.2. FOCUS AND AIMS OF THE RESEARCH

The rapidity of developments in IST presents a significant potential problem for any research upon organisational impact of IS. Such research aimed at evaluating particular types and applications of IST must inevitably become quickly out of date as successive generations of technology result in improvements to functionality and the introduction of new functionality. Initially therefore, it seems important to step back from particular ramifications of technology and to identify the main generic capabilities of what will be referred to in this thesis as **Co-operative Information Systems (CIS)**. This term has been coined in order to be able to make generic reference to those technologies and applications which are intended to add value to people working together in both formally and informally defined teams and groups. Various labels are been employed elsewhere, including *computer supported co-operative work (CSCW), work-group computing* and *groupware*.

What then is meant by a co-operative information system?

Firstly, the networked communications environment is leading to the increasing ubiquity of electronic mail (Email) (Finnegan and O'Mahoney, 1996), (Rudy, 1996); and following on from this are a number of group oriented scheduling, diary, resource and calendar management applications. The leading software vendors, Microsoft, Novell and IBM (Lotus) all offer tightly integrated suites of programs which provide Email correspondence between all staff members within a single organisation and, with suitable security controls, also allow such links to other organisations via the global Internet. The *capabilities* of Email in business terms reach far beyond the simple ability to exchange textual messages. This basic facility, plus mailing lists, the ability to send attachments in various formats and to generate messages automatically when various events occur, can provide powerful capabilities to support remote working, geographically separated teams and (so called) *virtual* communities of users. So, any information system or application based upon Email technology and facilities can be considered under the co-operative information system label.

Secondly, various technologies are aimed at directly supporting particular types of group tasks such as decision making, problem solving, idea generation and planning. Examples are electronic meeting room and group decision support systems (Finlay, 1994, pp142-152), shared workspace systems and video-conferencing systems (Wilson, 1991). Applications of the technology vary widely, the common thread being to provide a co-operative information system to support and enhance the capabilities of a defined group towards a defined task. Market available technologies for these applications tend to be specialised, although there are an increasing number of more generally available building blocks based around Internet/WWW and multi-media technologies.

The third generic area in which co-operative information systems are increasingly being introduced is that of *knowledge* management. Rather than using the technologies available to support shared workspaces towards specifically defined tasks, these types of systems instead provide for the pooling of both factual and process knowledge so that it can be accessed by people to provide support to diverse and changing tasks at different times and in different places. A example might be that of storing technical remedies in relation to product support so that they can become available to others (e.g. Orlikowski, 1996). Again, technologies are available to support these information systems applications from the software market leaders. Lately, co-operative information systems of these sorts have been increasingly based upon Internet/WWW technologies in the form of company and organisational *Intranets*.

Finally, because co-operative information systems are closely associated with office-based work, there has evolved the idea of work-flow and forms-flow which allow co-operative processing of bureaucratic tasks and management of casework in a variety of environments (e.g. *Form Flow*, Butler Group Technology Audit, May 1996). It is clear that these sorts of co-operative systems have something in common with transaction based systems in that user interaction possibilities are, to some extent, fixed. However, such systems employ many of the same technologies that other co-operative information systems do and provide much more flexibility than traditional data processing applications.

Co-operative information systems then will be assumed to include systems which;

- Provide communication, co-ordination and task management support to team members within an organisation who may be working in widely varying locations and at different times.
- Provide the capability to support groups and teams working upon tasks with defined outcomes.
- Provide the capability to contribute towards knowledge management in the sense of capturing both factual and process knowledge which may be disseminated widely within an organisation.
- Provide support for specific bureaucratic and pre-defined documentary processes within the context of a flexible co-operative IT architecture.

Following from the above, the research reported in this thesis is concerned with the possibility of developing a generic understanding of how co-operative information systems affect organisations which may be of use in evaluating the performance of such systems, of various kinds, in meeting management expectations.

The research aims and their relationship to the thesis content are as follows.

1. **To articulate generic ways in which co-operative information systems may be said to affect organisations.** In the light of the large amount of research already in existence on CIS technologies and applications, this aim forms a focus for the review of literature and prior research reported in Chapter 2.

2. **To devise a method of evaluating performance of a typical co-operative information system.** Chapter 3 considers various research approaches and methods for information systems evaluation following which a method is developed and described for evaluation of co-operative information systems in an organisational context.

3. **To trial the evaluation method.** Some aspects of the evaluation method are addressed in Chapter 3 and a pilot evaluation exercise, carried out at Northamptonshire County Council, is reported in Chapter 4.

4. **To conduct a study within an organisation using the developed evaluation method with the aim of understanding organisational effect of CIS in a live situation.** The results of a longitudinal study of the Novell GroupWise implementation within Northamptonshire County Council carried out between 1996 and 1998 are reported in Chapter 4.

5. **To draw conclusions relating to both the organisational effect of CIS and the usefulness of the evaluation method.** Detailed conclusions are developed and discussed in Chapter 5. Main findings and conclusions from the research are summarised in section 1.3. below.

A feature of the research reported is the emphasis upon development of a useful tool during the process of which various insights are generated. Central to the philosophy of the research is that practice and action research within a domain can lead to insights about it and to the possibility of useful knowledge. In summary, the aim has been to learn something about the generic nature of co-operative information systems, to develop a tool to measure their organisational effect and, finally, to develop practical knowledge which may be applied to their implementation within organisations.

1.3. SUMMARY OF FINDINGS AND CONCLUSIONS

The main findings and conclusions are presented in a tabular form below, while the substantive detail will be presented in chapter 4. These are related to the aims of the research described in the previous section.

Table 1.1. Main Findings and Conclusions.

Research Aim	Main Findings and Conclusions
To articulate generic ways in which CIS may be said to affect organisations.	CIS primarily affect the way in which different co-operative work tasks are carried out. In particular they have the ability to change the characteristics of such work tasks in terms of four main dimensions which are; 1. Whether contributors to tasks are co-located or not. 2. Whether interactions between contributors are required to take place synchronously or asynchronously. 3. Whether the power relationship between contributors is equal or un-equal. 4. Whether the division of labour within the task is pre-determined or locally determined at the time the task is carried out. A typology of co-operative work tasks is developed based upon these 4 dimensions.
To devise a method of evaluating performance of a CIS.	A method is developed based upon users completing a survey covering a range of pre-defined co-operative tasks. Such tasks may represent an **emergent application** theme, requiring users to determine their own use of the CIS to achieve them or a **design application** theme, where users simply make use of existing features of the technology as provided. Users are asked to judge the extent to which they use the CIS for performing each task. The method allows inter and intra departmental analyses to be carried out, Also, it is possible for managers expectation of the use of the CIS to be compared to staff judgements. A feature of the method is the employment of a fuzzy arithmetical method for analysing the results of the user surveys.

Research Aim	Main Findings and Conclusions
To conduct a study within an organisation using the developed evaluation method with the aim of understanding organisational effect of CIS in a live situation.	The results of 3 survey exercises totalling 322 respondents have been collated. Additionally a series of short semi-structured interviews was carried out with a total of 22 respondents. Co-operative tasks having been characterised as predominantly **emergent** or **design** theme and a significant finding was the relative lack of emergent theme application judged by users to be taking place.
To draw conclusions relating to both the organisational effect of CIS and the usefulness of the evaluation method.	Emergent theme application of the CIS is significantly lower than design theme application. Patterns of use of the CIS are established early and exhibit persistence over time. Patterns of use do not differ significantly between departments within the County Council. Managers tend to underestimate staffs use of the CIS to fulfil co-operative tasks. The fuzzy arithmetically based method of analysis has been demonstrated in use to provide meaningful outputs.

2. CO-OPERATIVE INFORMATION SYSTEMS WITHIN AN ORGANISATIONAL CONTEXT

"There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."

William Shakespeare, "Hamlet, Prince of Denmark", Act I, Scene V.

The domain of information systems and technology (IST) is assumed to include both automated and non automated systems used by people within organisations to process and manipulate information. Using this definition, information systems can be compared to the methods of physical production whereby manufactured goods and delivered services are produced.

In present day organisations information systems are ubiquitous and take many forms so that when using the term information system (IS) within the context of management research it is important to stress that it is not synonymous with a computer program or computer/computerised system. Rather it is the total embodiment of the means by which a definable process for information manipulation is accomplished. Clearly this can include computer hardware, programs and operating software; but, crucially, it also includes low technology elements such as paper documents, manual recording systems and human actors.

Because the extent of an organisational information system reaches well beyond any physical technology it may be clear that the boundary of such a system can be a subjective construct to a large extent. To use a simple example, whether a business sees its billing information system as a discrete entity or as some part of its overall sales and customer support operation may depend upon who is considering it, when they are considering it and the context in which any discussion is taking place. It is in part the ill defined yet multiply interrelated nature of organisational information systems which causes major difficulties in their design and implementation.

2.1. INFORMATION AND INFORMATION SYSTEMS

Information in the context of this study is concerned with meanings which are ascribed to data by persons who may be using an information system.

There has been much discussion about the nature of "information systems" as a discipline. The literature of information systems (IS) seems to have grown out of a concern for application of the technological possibilities inherent in IST. This has led to something of a crisis of identity amongst those seeking to develop a clear definition of the IS discipline. Is IS simply the application of IST to definable organisational problems? Is there something more to IS which sets it apart from typical science/social science? The field of research in information systems is, similarly, broad and admits of a wide variety of approaches (Galliers, 1992).

The initial position adopted in the current research is close to that advanced by such commentators as Mingers who compares the development of IST with the emergence of human language (Mingers, 1995). The technologies now being employed provide capabilities for new methods of interaction between human beings which have not been possible before. This is an evolutionary step and it is therefore not surprising that IST presents so many difficulties for researchers seeking to understand the interplay of users with technologically mediated information systems. Taking this approach it is possible to view information systems on a continuum, from the mundane transaction processors which essentially automate previously purely manual tasks, to the sophisticated communications and group support systems which are beginning to emerge in some applications. The distinctions within this continuum are elaborated upon within the following section.

2.1.1. Classification of Information Systems

Organisational information systems are called by a variety of names; typical examples being Management Information System (MIS), Executive Information System (EIS), Decision Support System (DSS), Expert System, Data Processing System. Over a long period of time there have been commentators who have proposed a hierarchy of organisational information systems; for example distinguishing a number of categories associated with different management levels (Sprague, 1980):

Electronic Data Processing (EDP) systems, being *data* focused

Management Information Systems (MIS), being *information* focused

Decision Support Systems (DSS), being *decision* focused

It is clear that Sprague considers there to be an historical dimension to this classification scheme; EDP systems being the earliest forms of computer based information system mainly concerned with automating routine business transactions. MIS and DSS have evolved over time, with the focus for MIS being control information for management and that for DSS decision making and planning.

A somewhat different perspective is offered by Henderson, Rockart and Sifonis who describe strategic information systems in relation to an integrated corporate data model (Henderson, Rockart and Sifonis, 1984). In this definition MIS and DSS are seen essentially as the same as in Spragues view. However the concept of an Executive Support System (ESS) is also introduced where the focus is upon the assumptions and constraints within which the other systems must operate. The ESS is externally focused and concerned with strategy and policy formulation. Other more recent writers employ similar terminology which can be related to the basic EDP/MIS/DSS/ESS view. A good example demonstrating the wide dissemination of these basic approaches within the academic and research community is Walford who offers the following application function classification (Walford, 1990).

Classification	Meaning
Management Information System (MIS)	A system providing automation of a basic business function, such as order entry, billing, inventory, etc.
Management Support System (MSS)	A system providing business data and analysis tools to enable a manager to make informed and effective decisions.
Strategic Information System (SIS)	A system enabling customers and/or suppliers of a business to interact directly with its data processing facilities to make business transactions and inquiries easier and more efficient for both organisations.
Network Support System (NSS)	A system to support network operation and management. This type of system does not interact with the user directly but is vital in maintaining a viable network.

Figure 2.1. Classification of IS, (Walford, 1990, p30).

Thus, Walfords classification of MIS is in line with an EDP system and his MSS with a DSS in the earlier definitions. Importantly, Walford refers to systems which are capable of providing communications with external organisations (SIS) and the need for a network infrastructure. These are important areas in relation to IST and, particularly the co-operative systems within this study.

2.1.2. A Systems View

It is not possible to discuss information systems for long without encountering ideas which have grown out of the systems movement. Taking this perspective the three level hierarchy with EDP/MIS as operation systems, DSS/MSS as middle management systems and, ESS/SIS as senior management and strategic systems can be shown to be consistent with various generic models of organisational and management systems. Thus, the work of Beer shows how an organisation can be described in a recursive model consisting of an operational unit, managed by a management unit, the goals for which are established a higher level of management (Beer, 1979, 1985). The higher level system (sometimes referred to as a meta-system) provides the normative environment in which the goal seeking part of the assemblage functions. Beer models this meta-system in greater detail and makes explicit the need for intelligence about the external environment. It is easy to see the relationship between the information thus required by the guiding meta-system and an ESS.

More explicitly, Harry has described three levels of management system as follows (Harry, 1997, p75):

process (operational unit)

goal seeking (management unit)

goal setting (meta-system)

This mature definition is viewed as useful when discussing business information systems whose primary objective is to support explicit business processes. However, in recent years there has been a proliferation of information technologies intended to support the performance of groups of people on an inter and intra-organisational basis which has made it easy to lose focus upon precise definitions and categories of information system.

2.1.3. Groupware and Group Support Systems

Groupware ranges from extended electronic mail, diary and calendar management to shared workspace, teleconferencing and group decision support. A good source of summary information is included in *Computer Supported Cooperative Work* (Wilson ,1991) which offers an introduction to the main applications and technologies classified and referred to as **CSCW**.

The categories of enabling technologies included for the purpose of CSCW are;

Communication systems

Shared work space systems

Shared information systems

Group activity support systems.

A further perspective on this can be gained when we look at what such information systems are aiming to achieve. Mentzas considered that

"Organisational productivity can be maximised by creating, using and maintaining structural and dynamic configurations of multi-participant interaction." (Mentzas, 1993).

Essentially, Mentzas maintains that the most important aim of CSCW technologies is to support group mediated processes within organisations. Developing from this is that the use of such systems will be dependent upon how people choose to act and react within the groups of which they are part. As in all group activity, the degree of involvement and level of individual activity may be expected to be different for different people at different times and in different circumstances, so that a premise of the current research is that CSCW/CIS applications differ significantly from other forms of business information system in the degree of voluntarism users have in interacting with them. Indeed the voluntary nature of such participation is often signalled early in the implementation of such systems. For example, one University manager in the author's experience introduced a new system to staff with the words *"Nobody who does not wish to will have to use the system"*.

Whether participation is voluntary (depends upon peoples more or less freely given commitment) or not may be judged by cultural context and rhetorical language used by managers when introducing it. Kendall and Kendall have analysed the metaphors present within organisations and their relationship to the likely success of differing types of information system (Kendall and Kendall, 1994). Specifically they associate successful CSCW systems with the metaphors of *Journey*, *Game* and *Organism*. The first two of these imply a strong goal orientation shared by members of the organisation. In other words success will depend on people co-operating (voluntarily) to the common good, being members of a successful team rather than being coerced to perform.

Kendall and Kendall in fact present a classification of information systems types, which includes;

Co-operative systems

Competitive systems

traditional MIS

Expert system/AI

Decision support systems (DSS)

Executive information systems (EIS)

In as much as Kendall and Kendall reflect the view that contingent and organisational cultural factors affect the success of information systems implementation this classification has appeal to the present work.

The table below presents a summary view of the authors presented thus far.

Level & management focus (Harry,1997)	**Classification**					
	Sprague (1980)	Henderson et Al (1984)	Walford (1990)	Mentzas (1993)	Kendall & Kendall (1994)	
Process	EDP		MIS/SIS	CSCW	MIS	Co-opera-tive
Goal seeking	MIS	DSS/MIS	MSS			
Goal setting	DSS	ESS			DSS/EIS	

Figure 2.2. IS Classification.

As can be seen, this classification shows CSCW/CIS affecting all levels within the organisation.

Other ways of classifying organisational information systems may look more closely at business functions as well as levels. This approach, with cross referencing of business functions and levels, is common in general business and teaching texts, for example (Daniels, 1994, p40), (Curtis, 1995, p27), and, reproduced below, (Laudon and Laudon, 1995).

Figure 2.3. Anthony Triangle, (Laudon and Laudon, 1995, p43).

The Laudon and Laudon classification is presented in an educational context intended for practising managers. It is not surprising therefore that the functional business elements are emphasised rather than the shared characteristics of the IST involved or the diffusion of information systems throughout the business. In a sense the Laudon and Laudon model lies rather near the instrumental end of a continuum which ranges from IST (instrumentally) as a technical support to organisationally embedded functions, roles and structures and (at the idealistic end) IST as a transforming potential which can alter the very shape and function of the organisation as in for example (Jones, 1991) and (Kawalek, 1994) discussed later in the present chapter.

It seems clear from the above that, whilst classifications schemes differ, co-operative information systems cross most boundaries, whether functional, hierarchical or defined by job role. A definition of a co-operative information system may therefore relate to the nature of co-operative work output by people acting together within an organisation, regardless of role, function or level within it. The focus of the present research is partly upon the specific technology and partly upon what it is that people acting co-operatively can achieve using it. With this in mind I shall, firstly, discuss alternative ways of conceptualising and interpreting the effects of information systems within organisations and then proceed to examine specific research in the area of co-operative information systems in some depth.

2.1.4. Conceptualising Co-operative Information Systems

In order to define what is meant by **Co-operative Information Systems (CIS) in an Organisational Context** it is useful to discuss firstly some of the common conceptual perspectives which are associated with IST both in the research literature and in general usage. This will help to provide a framework for any rationale of evaluation and performance measurement.

We are concerned with ways of interpreting information systems, of explaining their use and effect within organisations as both technological and social phenomena. A variety of interpretative stances are available and these mirror more generally adopted schemes in other areas of management research. A useful introduction to these schemes is provided in an article entitled *Refining Common Sense: Types of Knowledge in Management Studies* (Tsoukas, 1994) in which the author discusses four types of world hypothesis which can lead to different ways of modelling, based upon ideas first advanced by Pepper. The basic hypotheses are *Formism*, *Contextualism*, *Mechanism* and *Organicism*.

Models based upon the formist perspective are concerned with structure. Formist ontology is concerned with identifying the categories and arrangements of components of an area of study and understanding the relationships between them and how they relate one with another. Tsoukas identifies the basic world hypothesis approach, separating types of hypothesis into four main types as being itself formist. In general, all schemes of classification and the explication of relationships are formist.

Models which are contextualist are concerned to stress the contingent nature of events and actions. The contextualist view of the world leads largely to interpretative schemes of explanation. In research terms, the emphasis is upon qualitative modes of enquiry and in practice concern with social and political action.

Mechanism adopts the common *machine* metaphor for organisations. This approach seeks direct causal links between actions and events, which are predictable, measurable and, by extension, manageable through an *engineering* rationale. Mechanist models are formal, logical and verifiable according to intrinsic and extrinsic rules. It is clear that most of engineering and the physical sciences adopts this perspective with respect to modelling.

Finally, organicism stresses the process of development of an organisation in a way that is analogous to an organism. The emphasis is upon the processes of growth, differentiation and decay and the possibilities for interaction with the environment and other organisms. The organism metaphor can clearly be carried some distance in the world of management studies, since organisations do seem to have a living existence, including a lifecycle, growth through stages and a rich interaction with their environment.

In the article, Tsoukas' main concern is to show how different management commentators can fail to meet minds because they adopt different fundamental world hypotheses. In the context of the present research, it is of interest to examine the possible relevance in the interpretation of information systems within organisations.

Formist Interpretation of Information Systems

Formist interpretations of information systems may best be seen as any attempt to classify such information systems, rather along the lines of the discussion leading to Figure 2.2. In as much as classification and description are necessary in order to enable communication and debate about issues of concern, formist models may be seen as more fundamental than others.

In respect of CIS; some evidence has been presented above to suggest that these do not sit easily into earlier classifications for information systems and technologies. The difficulties encountered whilst attempting to construct a single coherent model covering IS may signal that things are not as they once were. This leads us towards a particular type of formist model which stresses how forms and conformation vary at different periods of time. Thus for example we could initially classify the electronic computation age as the *era of electronic computation*, then the *era of miniaturisation* then the *era of networking*; at each stage of which certain groups of technologies and applications would be present in various relationships one with another. This has been attempted on many occasions and by many authors but, by means of further example, the model proposed by Moschella and quoted by Willcocks and Lester is as follows.

> **Stage/era**
>
> *System Centric* (@1964 - 2005), characterised by data centres, timesharing and mini-computers.
>
> *PC Centric* (@1979 - 2025+), characterised by micro-computers and the client server architecture.
>
> *Network centric* (@1990 - 2030+), characterised by the internet, local intranets and global hardware/software solutions.
>
> *Content centric* (@2005 - ...?.), characterised by virtualisation, software and embedded systems.
>
> Adapted from Willcocks and Lester, 1999, P15.

In terms of technologies, CIS fits into the network centric era.

Formist models then are mainly of relevance to information systems research and CIS in terms of a *road map*. A useful conclusion that emerges from the classification quoted above is that we might group CIS together with current technologies based upon the internet and world-wide web. The importance of CIS is not the very specific technology being adopted but what people and organisations are seeking to do with it.

Information Systems as Machines

The machine metaphor represents the basic position of much practice. Indeed, information systems can be seen as automating systems which provide a way of addressing design requirements typical of machines in all parts of organisational life. The machine metaphor implies a number of fundamental assumptions about the purpose, constitution and role of information systems within organisations and in, for example, *Interpreting Information Systems in Organisations* (Walsham, 1993) the author offers the following characterisation:

"With reference to information systems, a useful contribution to the discussion of mechanistic metaphors has been made by Kling (1987). He describes one way in which computer-based technologies and systems are conceptualized as 'discrete-entity models'. These focus on explicit economic, physical or information processing features of the technology, and the social context in which the technology is developed and used is limited to a few formal relationships or is ignored. Organizational behaviour is best described by the formal goals, procedures, and administrative arrangements of the acting units." (Walsham, 1993 p29).

It is certainly possible to consider CIS from the perspective of the machine metaphor. Provided a co-operative task can be defined in sufficient and concrete detail, it is possible to develop a automating solution for it using an appropriate technology. This is the **design** rationale which will be returned to later in the more detailed discussion of CIS research.

Information Systems as Organisms

The organismic metaphor is what lies behind certain perspectives of the systems viewpoint already briefly discussed. Walsham again identifies two main lines of theory developing out of the organismic perspective (Walsham, 1993, pp30-31). These are related to the socio-technical movement, which sees means of automation being intimately related to the human actors involved in bringing the automation into effect alongside the technology, and contingency theory, which is concerned with the process of achieving a balance and fit between tasks to be performed, organisational forms and environmental circumstances.

The socio-technical agenda has proved very popular with both researchers and practitioners in information systems over a number of years. Essentially, the socio-technical movement attempts to translate the design rationale of traditional engineering into a more people-sensitive form whereby explicit methods of incorporating human actors into overall *system design* are developed. An example of the developed approach is included in *Multiview An Exploration in Information Systems Development* (Avison and Wood-Harper, 1990). A whole chapter (Chapter 11.) of this book is spent on the subject of *"Socio-Technical Design"*. Socio-technical design is described as being adaptive to user concerns and needs through the generation of alternative technical approaches to meeting business requirements. Much the same approach is adopted in the ETHICS approach to information systems design (Mumford, 1991). It is fair to say that, in the information systems sphere, the socio-technical approach is broadly accepted by practitioners and many researchers as an implicit paradigm in its own right. Moreover, in developing the discussion of organisations as organisms Walsham considers that *"..the image of organisations as organisms has arguably been the most influential metaphor for management practice over the last few decades."* (Walsham 1993, p30). However, Walsham concludes that there are considerable limitations to this point of view. Notably, whilst models arising from the organism metaphor, including socio-technical approaches and contingency (internal and external adaption) theories are useful for thinking about organisations, they can nevertheless fall down when applied to specific organisational situations. Thus, it is not unusual to find similar approaches leading to different outcomes in what are apparently similar organisations. Further, conflict and political struggles between individuals and interest groups mean that real organisations do not have anything like the unity of purpose and interest that individual organisms do; to quote Walsham in full:

"A second major weakness of the organismic metaphor is the stress on the unity of an organization on an analogous basis with the human organism itself. However, organizations are looser couplings than is implied by this metaphor, and conflict, politics and power struggles are potential forces of disunity. For example, the socio-technical design approach to information systems presumes it is possible to design systems which simultaneously satisfy technology needs and the human desires and aspirations of various interest groups. Little is said about circumstances where it is not possible to resolve these potentially divergent needs, and where political action is critical." (Walsham, 1993, p31).

In terms of CIS, it is clear that the socio-technical view which relates to an underlying organismic metaphor, is important in many cases. For example, the tremendous developments put into the evolution of the *windows* form of interface for most end-user computer workstations is testimony to a desire to provide an adaptive mechanism which is best in keeping with the human abilities to interact.

Information Systems in Context

Contextualism is largely concerned with interpretation, with the symbolic meanings of actions and events and, as such, is linked very strongly to the qualitative paradigm in research. Because of practical difficulties in both practice and research within Information systems, workers have been led towards development of views of information systems which are grounded in broader interpretative perspectives. For example, in *Deconstruction contexts in interpreting methodology* (Watson and Wood-Harper, 1996), the authors consider the effect on methodologies in shaping contexts for interpretation and propose that a deconstructive approach could be employed to help interpret these contexts critically. Briefly, Watson and Wood-Harper set out to demonstrate how a limited set of contexts; for example a taxonomy introduced by Lyytinen consisting of *technology*, *language* and *organization* may be deconstructed to undermine its own position.

Another example is Kawalek in *Interpreting business process re-engineering on organisation work flow* (Kawalek, 1994) where the author attempts to contrast the mechanistic paradigm of BPR with *"...wider frameworks for social and organisational analysis..."* In the early part of this paper Kawalek seeks to ground the discussion in present views of BPR (*"... towards a definition ..."* !), concluding that *"BPR concepts are likely to be most effectively utilized and applied in the key areas of business which are central to the operation of the organisation"*. He then proceeds to discuss BPR in the two contexts of sociology of organisations and management research followed by introduction of a case study of use of groupware technology (Lotus Notes) within a technical services organisation. The final interpretative framework produced reflects a rather technical concern, for example classifying applications into *centralised-stable*, *distributed-organic* etc. and then linking this classification to the technologies most likely to be employed, in particular level and location of computing power. The paper is representative of a particular genre of published work which attempts to link technical themes with more interpretative contexts so that it is not immediately clear whether the interpretative structure derives from technological capabilities or whether the technological capabilities serve particular interpretative rationales.

The work by Walsham already referred to is also largely interpretative. As well as discussion of the machine and organism mechanisms in relation to information systems, Walsham discusses societal and political metaphors. Most interestingly, he introduces a framework called *structuration theory*, developed by Giddens, which sees structure of organisations and actions and events linked via *modalities* (Giddens, 1984, p29). Thus, communications between individuals within a structure occur through a modality referred to as an *interpretative scheme*; power is exercised through a modality referred to as a *facility* (comprising processes and procedures) and sanctions are applied through a modality referred to as a *norm*. In this theory the structure incorporating signification, domination and legitimation is created through the actions of individuals and can be changed by them. In other words there is an action/structure duality to organisational (and societal) life.

Interpreting information systems using structuration theory involves examining how new technologies or systems affect the modalities and hence the relationship between individual action and organisational form. Because, as Walsham points out, IS embody interpretative schemes, provide co-ordination and control capabilities and encapsulate norms they have the ability to transform both individual action and organisational form (Walsham, 1993, p69).

Synthesis

When interpretative frameworks are employed by researchers within information systems they are moving away from the formist insistence on definition and relationships as well as the instrumental concerns of both mechanist and organicist perspectives. Interpretative perspectives can be useful in understanding actions and events as stories, systems of symbolic meaning, which may or may not have relevance to future actions and events. By contrast, both mechanist and organicist perspectives are concerned with designing, planning and enacting; whilst formist perspectives are concerned with describing.

Another possible way of viewing the four perspectives is as paired dualities; formism being linked closely to mechanism and organicism with contextualism. In this scheme we can view much of information systems development as related to the formist/mechanist duality, what might be described as **document and automate**. By contrast, recent technological changes together with the pervasiveness of technologies and their rich interaction with human beings working within organisations are leading researchers and practitioners towards the interpretative/organicist duality, what might be described as **understand and grow**.

2.2. CO-OPERATIVE INFORMATION SYSTEMS RESEARCH

Research into the area of co-operative systems has been developed over the last 10 years or so with three main aims. Firstly, with the recognition that emerging information technologies seem somehow qualitatively different in their effect from their predecessors, a body of research has been developed which has addressed *generic* issues relating to the application of such technologies. Secondly, possibly because of the difficulty of considering the whole area of CIS as a body, much effort has gone into what might be described most accurately a specific application or case study histories. In these cases, certain technologies are applied to particular applications and studies made as to how efficacious they are in meeting the specific application needs. Sometimes the studies limit themselves to describing the application and how it has been effected and spend little time upon evaluation. Thirdly, there is a body of more reflective work concerned with how emerging information technologies are changing the very nature of organisations. This work is of interest in that affects the context in which managerial judgements relating to co-operative information systems are made. Finally, there is a tightly focused literature on development of the underlying technologies. In the current study, this research into the technologies is touched upon but is not considered central to the issues under consideration.

Examples of material from each of the first three research areas introduced above are reviewed below. However, it is worth noting that this is a highly active area, especially towards the application and technology directions. It would have been possible to dedicate a large amount of time to reviewing individual cases and specific technologies without adding significantly to overall conclusions. Instead, the material is covered in such as way as to illuminate the important conclusions discernible from recent research which have a bearing upon the current work.

2.2.1. CIS - Generic Research and Perspectives

In considering research that has been developed from a generic management and organisational perspective it is useful to attempt to identify key themes, issues or concerns in relation to co-operative systems. In a paper presented at the conference *CSCW 92,* Bannon and Schmidt have addressed this requirement under the title *CSCW: Four Characters in Search of a Context* (Bannon and Schmidt, 1992). In this work the authors consider the different perspectives of workers and researchers in the field and identify a number of focuses of interest.

These focuses include firstly, those workers interested in the technical development of what is termed *groupware* and whose main concern is the development of the technical capability to support appropriate process interactions of people working together in groups. This work therefore tends to concentrate upon the requirements for the activities of the groups and then the technical means to bring these about. In the words of Bannon and Schmidt;

"People working on Groupware have a focused goal, namely to design new widgets that might support teams or groups." (Bannon and Schmidt, 1992, p7).

This group of workers represent a rather traditional approach to the development of new IT systems in the implicit assumption of a **design** model where requirements are addressed by specific technical capabilities within an enabling technology. In IST development terms this is "business as usual".

A second area of interest is represented by workers who reject the efficacy of the strict design model. For them the enabling technology allows users of the IT to co-operatively design systems to address their working needs. This leads paradoxically to an emphasis on the development of appropriate enabling technology and thus too great a focus on the design of this technology at the expense of understanding application requirements. It may be that this is indeed reflected in much of recent software development in the office and intranet/internet applications. In a number of cases it has been clear that rapid changes in technology including new revisions of essentially similar products is being accomplished with little real improvement in application effectiveness.

Finally, Bannon and Schmidt identify those social scientists who are concerned to use their analysis of group mediated processes to affect the design of CSCW systems. In this situation the focus is *"what social science can do for you"* in terms of improving technology design. So in these cases, the emphasis is shifted from one of design of applications or technical design of enabling technologies to a more socio-technical approach where theories of group interaction are used to guide technical development.

Developing this stream of analysis further the last position can be reflected by considering various theories of how best to enhance presumed beneficial group interactions. To paraphrase Bannon and Schmidt, "what can technology do for organisational (social scientifically guided) practice?". Beer has recently addressed some important issues relating to enhancing the abilities of groups of people to work in problem solving situations. In *Beyond Dispute , The Invention of Team Syntegrity* (Beer, 1994) the author describes a way of organising a group or groups of individuals to work on a problem situation based upon a process of interaction mediated by an icosahedral model defining the interactions and relationships between groups (or as Beer calls them *infosets*). In the evolution of this essentially non-centralised and anti-hierarchical structure Beer refers to earlier work by Bavelas in which he considered measures for quantifying organisational (implicitly information flow) structure. To quote from Beer.

"Bavelas devised three measures for quantifying the organisational pattern. The first is Group Dispersion. Take each member of a network, and count the minimal number of steps it takes (according to the protocol established) to reach every other member. Some will be one step away. To reach others, one might need to ascend and descend various hierarchical ladders. That count for one member is his/her minimal connectivity. Having made the count for every person, add up the results. This is now an unequivocal measure of the extent to which the group is dispersed. Each member now has a personal Relative Centrality. To calculate this, divide the Group Dispersion by the minimal connectivity of the individual. Third, the measure of Peripherality for member Fred Bloggs is the Relative Centrality of the most central member, minus Bloggs's own." (Beer, 1994, p4)

So, one possible way of considering co-operative information systems technologies would be to explore the extent to which they are capable, by providing alternative paths and protocols for individuals and groups which change *Group Dispersion, Relative Centrality* and *Peripherality*, of allowing organisations to optimise for particular applications.

Bannon and Schmidt also consider what they term core issues for CSCW. These are;

articulating co-operative work

sharing an information space

adapting the technology to the organisation and vice versa

Articulating co-operative work means understanding and being able to implement technology that is capable of supporting interactions of a complex nature of between people within organisations. The authors discuss the traditional bureaucratic model of the office environment where it is assumed that set procedures and processes will occur based upon the aim of achieving particular and defined outcomes. Clearly, there is a feeling that when all the procedures have been documented and tied down there is still something not articulated, the organisation has been reduced to its bare functional purpose but some *essence* is missing. This missing element, Bannon and Schmidt argue, is the way in which people interacting together within the organisation provide structure and articulation to the processes that occur. Any CSCW technology that is to deliver real benefits must in some way support this articulation process in a way that offers a potential for change. From an interpretative/contextualist viewpoint this fits well with the *action-structure* dualism which runs through Giddens work on structuration (Giddens, 1984, pp16-34). From an organicist viewpoint, the introduction of new technologies within an organisation is to adjust the internal (and potentially external) environment of the organisation, providing changed potentials for growth and development.

The second core issue is, perhaps, easier to comprehend. It becomes clear that co-operation requires sharing of information and this presents technical, logistical, cultural and political problems. Technical problems obviously revolve around version and concurrency control and timeliness of information so that, for example, in situations where access to information is not **synchronous** (in the sense of *necessarily* taking place at the same time) these technical issues can evolve away from the technology and into the business processes in effect within the organisation. These logistical and cultural problems present many areas of difficulty. If, for example, it is intended that a shared space be employed to support the group decision making capabilities, information is required which reflects individuals preferences and models. Also, any information must be stored in context so that appropriate judgements can be made by individuals about its value and relevance to their work. The point is also made by Bannon and Schmidt that information within organisations is not neutral, but, in many situations, provision of and possession of particular information has political implications. Finally, the fact that individuals are asked to place information within a shared area may affect their willingness to provide certain types of information; being open to scrutiny may not appeal to all.

The other core issue is adapting the technology to the organisation which Bannon and Schmidt paraphrase as *"Designing Socio-Technical Systems"*. This may involve the understanding of a range of factors including;

> The forms of interaction in the labour process itself as determined by the natural and technical resources available.
>
> The organisational setting of the interaction.
>
> The customary privileges and prejudices of task allocation.
>
> Institutional forms of expressing and regulating conflicts of interest, etc.
>
> The forms of social control in the work place.
>
> The forms of allocation of power and authority.
>
> The impact of the function of the enterprise in the socio-economic system at large.
>
> The impact of the structure and state of the labour market.

Source, Bannon and Schmidt, 1992, p13.

A further generic analysis of co-operative or CSCW systems is provided in *Co-ordination of joint tasks in organisational processes* (Menzas, 1993). This study is aimed at the two main application areas of group decision support (GDSS) and office information systems (OIS). In it, the author firstly identifies a taxonomy identified as *the groupware time space matrix*. This defines four types of interaction according to whether they are spatially and temporally coincident or separate.

	Same time	**Different times**
Same place	Face-to-face interaction	Asynchronous interaction
Different places	Synchronous distributed interaction	Asynchronous distributed interaction

Figure 2.4. Groupware Time-Space Matrix, (Mentzas, 1993, Table 1).

Since Mentzas' main concern is to investigate how co-operative systems can improve co-ordination, he first discusses the main issues for co-ordination which include protocols for co-ordination, control models of co-ordination, time spans for co-ordination, synchronous and asynchronous forms of co-ordination and information sharing. There follows an analysis of the capability of a number of CSCW products and platforms to support these aspects and issues, which are formalised as follows.

Specification and implementation of co-ordination.

Synchronous and asynchronous working phases.

Information exchange and information sharing.

Support of sequential and concurrent processing.

Support of negotiation and conflict resolution.

Support of analytical modelling.

Description of organisational environment.

A discussion is included within the paper for each of the above and sample systems are evaluated as to the extent of their support for each aspect.

It is useful at this stage to relate back to the Bannon and Schmidt work and try to match the evaluative issues identified by Mentzas to the core issues identified for CSCW by these authors.

Firstly there is the issue of articulating co-operative work. It seems that Mentzas, in choosing co-ordination as his starting point, is attempting to address how well particular systems can help in articulating co-operative work. In particular, the issues of specification and implementation of co-ordination, *synchronous/asynchronous* working and sequential and concurrent processing seem to relate to the hidden *essence* within co-operative work which useful CSCW technologies should address. Moreover, as will be discussed later in some of the case study descriptions, these issues recur in various forms at the boundary of discussions about co-operative information systems applications.

Secondly, the issue of sharing an information space is reflected as information exchange and information sharing. It is worth quoting Mentzas in full on this issue since his words chime very clearly with the discussion by Bannon and Schmidt.

"successful group co-ordination systems require aspects of both information (i.e. message) exchange and information sharing to be integrated. Shared spaces, however, need to capture the organisational context of the work and should take into account the coexistence of many different forms of co-ordination and co-operation.

Work conducted in the open distributed systems area provides a number of open research issues ranging from distribution transparency to the subject of continuous synchronisation for the control of event orderings and precise timing of multimedia interactions ....). The support of group processes could benefit greatly from advancements in such research." (Mentzas, 1993, pp146-147).

Thirdly, the core issue of adapting the technology to the organisation and vice versa is related to Mentzas' issues, support of negotiation and conflict resolution and description of organisational environment. On these however Mentzas takes a rather limited view. In relation to conflict resolution the issue is reduced to application for decision support where it is assumed that improved technical models can help groups reach consensus. In discussing description of organisational environment it is (rather hopefully it seems) suggested that holding organisation charts, job roles and other more or less formal organisational information within the system can help people adapt to its use.

The final issue identified by Mentzas is support of analytical modelling and relates to decision support generally and thus GDSS. It does not seem to reflect directly on any of the core aspects of CSCW discussed by Bannon and Schmidt but does perhaps most closely relate to decision models held within a shared information space.

Menzas paper is very useful in that it succeeds in presenting an essentially technical evaluation of some CSCW technologies whilst recognising that the presumed benefits delivered by these technologies are difficult to grasp in any quantitative way. In making the focus co-ordination of tasks it clarifies the importance of considering technologies in terms of how they contribute to organisational and business requirements rather than the fulfilment of technical capabilities.

Both the pieces of research reviewed thus far have made the implicit assumption that co-operative systems technologies are *qualitatively* different to other forms of information technology. Other workers have chosen to draw parallels with the successes and failures of information technologies applied to applications other than CSCW and to attempt to provide some insights into how co-operative systems should be developed and implemented. An example of such work is provided by Clegg, Waterson and Carey in

Computer supported collaborative working: lessons from elsewhere (Clegg, Waterson and Carey, 1994). In this paper the authors review lessons from implementations of advanced manufacturing technology incorporating CAD-CAM (AMT) and what is termed office automation (OA). In relation to the current study it should be clear that there is some overlap between technologies described as *office automation* and CIS.

The major thrust of the Clegg, Waterson and Carey paper is that developments in both AMT and OA have been typically aimed at technical development to the detriment of *"human and organisational aspects"*. Furthermore they emphasise that these systems were required to be embedded within an interacting set of wider social systems and that this is why the changes which were intended should be bought about by the technologies have proved so difficult to accomplish in practice. The argument in relation to co-operative systems is developed thus.

"If this characterisation and the social account of it, is correct, then one could reasonably predict that any other forms of new technology being developed within the same social milieu, would be subject to equivalent social forces, and thereby liable to the same processes and problems. Thus one emerging prediction is that the domain of CSCW would also be technically dominated and pay too little attention to the human and organisational aspects of its development and use. If this were not true then one would either have to argue that the underlying social analysis is misguided, or perhaps outdated, or alternatively that there is something quite different about this new field of enquiry. This last point has particular force. For example, one might argue that the community of researchers and developers who initiated work into CSCW recognised earlier techno-centrism and were keen to avoid it; indeed this perspective provided one of the key motivations for developing work in this area....................." (Clegg, Waterson and Carey, 1994, p91).

Evidence and argument is presented by Clegg, Waterson and Carey to suggest that workers in the CSCW field are indeed making the same mistakes exhibited in the earlier work on AMT and OA. These arguments relate to a number of points including;

Evidence of marketing push with an emphasis upon new technical features of products.

Applications which relate directly to a researcher centred agenda (shared writing and document editing are cited).

A challenge to the conceptual schema based upon the time/space dichotomy (documented above and in (Mentzas, 1993) already discussed).

Implicit or explicit adoption of a *rational actor* view of work organisation which is not well supported in the appropriate organisational literature.

User involvement framed at the level of getting users to contribute to design; perpetuating the separation between users and developers and systems.

A mindset which focuses on individual users differences rather than viewing the co-operative work environment as an organic whole.

The marketing push hardly needed emphasising in the environment when these words were written (1998). During a 15 month period up to this point the author had experienced the implementation of 3 versions of Email product implemented on a University Staff network. Each version has brought some changes in appearance and some new "widgets" but none has significantly enhanced application functionality *in actual day to day use*.

Clegg et al's point about applications is well made. Although there are similarities between research environments and other knowledge work environments, and the University model does at least present a very good research case where routine work and constraints on individual behaviour are small.

The critique of the time/space schema is interesting. The Clegg, Waterson and Carey version of this is as follows.

		Place: Same	Place: Different
Time	**Same**	e.g. meetings	e.g. video conferencing
Time	**Different**	e.g. collaborative writing	e.g. email

Figure 2.5. Time-Space Diagram, (Clegg et al, 1994, p93).

The authors argue that this represents an academic bias and lack of attention to organisational reality where division of labour is almost always organised both vertically (between super and sub-ordinate) and laterally (between specialisms and roles).

"Using a manufacturing example, a CAD-CAM system enables collaboration between people at different levels (e.g. senior designers and designers) and in different roles (e.g. stress engineers, designers, methods engineers, machine operators, etc.). Whilst these "collaborations" are distributed in time and place, they are just as crucially distributed by level, role and expertise. Yet, these issues are under-represented in the current debates about CSCW. The dominant conceptual schema needs changing." (Clegg, Waterson and Carey, 1994, p93).

With regard to the *rational actor* model for work organisation it is often clear that such organisation rarely follows the most obvious or logical process to achieve the task. The other identified arguments are to do with the way users of a system are treated during design and implementation, a complex area which it is not proposed to discuss in detail in the present work.

Issues relating to how co-operative information systems are designed and implemented are indeed another large research area. As has already been noted above (Bannon and Schmidt, 1992), in considering this it is possible to adopt a technical view of design (traditional engineering approach) or a socio-technical view of design (recognising that the technology is to be implemented within a human and organisational context). The research reviewed thus far has tended to emphasise the importance of the socio-technical approach and this is not an aberration. A large amount of recent research and publication into information systems development stresses approaches which have large socio-technical elements (Checkland, 1981), (Checkland and Scholes, 1990), (Avison and Wood-Harper, 1990), (Mumford, 1991), (Eason and Harker, 1991), (Eason, 1996), (Avison and Taylor, 1997), (Harry, 1997) and, an example of very recent work on socio-technical approaches to component based systems implementation, (Kunda and Brooks, 1999).

Before examining an example of formalised socio-technical design in a little more detail it is worth briefly making some remarks about the alternative, a thorough going traditional design approach. In part the importance of developing models of design other than technical design relates to the academic modernist/positivist position. The need to study design and how it can be made to more accurately reflect organisational realities, so that information systems can be implemented more effectively, reflects the desire to capture knowledge that may be codified, documented and transmitted in the form of written texts of various kinds. The practice of design of information systems is, like many other practices however, subject to the vagaries of human performance and, in specific circumstances, individual designers and teams vary in their ability to develop and implement effective systems almost regardless of the methods and approaches used. Some of the most effective systems to support co-operative activities may be developed by a method of trial and error (Hassall and Kingston, 1992) with no explicit socio-technical aspect to the method employed. Likewise, even the application of formalised methods which are increasingly aimed at taking into account socio-technical aspects of design or implementation has proved no guarantee of success. For example, in the context of considering the benefits of formal systems development approaches, Chaffey and Hickie report a consultancy study in the United States which shows only 26% of a sample of a survey of 23,000 projects completed in 1997 delivering the anticipated benefits (Chaffey and Hickie, 1999). It sometimes seems that a critique of technical design must inevitably lead to the desire for improved socio-technical design; whereas failure of socio-technical design leads only to the conclusion that better socio-technical design methods are needed. The alternative approach would be to educate everyone within an organisation in technical design leading to more precise definition of requirements, greater understanding of technical and technological developments and capabilities and (ultimately) more effective, if less ambitious, information systems.

Eason in *Division of labour and the design of systems for computer support for co-operative work* (Eason, 1996), addresses the issues of socio-technical design through use of a group of methods called ORDIT (Organisational Requirements Definition for Information Technology). In this paper Eason initially notes the same point as that made by Clegg , Waterson and Carey discussed above. This is that co-operative work may not only be classified in terms of coincidence or separation in space and time but also in terms of position within the organisation and specific job roles. Since job roles and tasks are a key part of the work, a classification is developed which relates the type of job to levels of power and influence (implicitly recognising that position in the hierarchy of an organisation is only one possible measure of realisable power). This is reproduced below.

Figure 2.6. Co-operative Work Classification, (Eason,1996, p40).

The matrix is used to define 4 broad classifications of collaborating groups (A, B, C, D as shown) depending upon whether the division of power within the group is more or less unequal and whether the division of labour is locally determined at the time it is undertaken or in some way predetermined. The discussion of these types of groups is quoted here in full.

"In (Figure 2.6.) *research teams and design groups are identified as collaborative groups of type A where power is relatively equally distributed amongst co-operating members and roles and responsibilities are to a large extent determined by group members during the course of undertaking the work. In this respect they are like the semi-autonomous work group favoured by many socio-technical systems theorists .... as a means of establishing local discretion and autonomy.*

In the case of type B co-operating groups there is a clear separation of power but little predetermined division of labour. An army unit may be an example, in which the officer assigns the duties to his troops as he sees fit. A builder who assembles a task force of labourers is in a similar position. In type C there may be a relatively equal distribution of power but a high degree of pre-established distribution of labour. A group of professionals in a case conference on, for example, child care, might be an example with medical, educational, legal and other specialists contributing their own perspectives and knowledge.

The majority of industrial and commercial co-operative groups are likely to be type D. There will be owners or managers accountable for group actions and an array of collaborators who are there because they have specific contributions to make. A crime investigation team is an example in which the collaborators come to the task with an *array of predetermined responsibilities and accountabilities. Under the general direction of the officers in charge there may be detectives, pathologists, fingerprint experts, lawyers and so on. This kind of co-operative work involves collaboration between people occupying highly differentiated work roles and quite different responsibilities and contributions from each work role."* (Eason, 1996, p40).

Eason continues to discuss how changes in job roles can result from the creation of new and specific tasks and sub-tasks, which arise from the introduction of new technology. In relation to co-operative working, this can be influenced by power relationships between individuals and groups. In particular there are a whole range of issues which relate to access to information, permissions to update and enter information and oversight of sub-ordinates' information space by managers. The point has been made in many studies that improving information access over an organisation can result in greater centralisation of power in the hands of fewer managers. In co-operative and CSCW systems, constraints tend to appear around issues relating to shared information space such as diary and calendar management as discussed in for example (Hassall and Macefield, 1995). There are difficulties in delegating responsibility for your diary to another person, whatever the technology employed, and this sort of difficulty arises in subtle forms because of differences in job roles and relationships within and between collaborating groups. Eason is led to conclude in summary that;

'the evaluation of twenty office automation systems sponsored by the Department of Trade And Industry .... showed that case applications, where professionals worked in collaborative teams, were difficult to support because of the subtle nature of responsibilities and accountabilities. It seems likely that CSCW systems will not be widely accepted in situations where there are important differences in contributions of participants until they are able to closely map the nature of these differences and support both the role of the individual and the performance of the overall group task." (Eason, 1996, p41).

From this point Eason proceeds to describe the application of ORDIT to service call handling in the electricity supply industry. This is not the place to enter into an extensive discussion and analysis of ORDIT or the specific application of it. However, it is worth noting the broad underlying method employed. The assumption is made that the technical means to support co-operative work will be related to the actual roles that individuals take responsibility for. These roles will, in turn, relate to the organisational position (power relationship), organisational task to be accomplished and technical capability to support particular roles and work tasks. Essentially, ORDIT is concerned with modelling the roles and tasks presented under various possible socio-technical alternatives; alternative designs for getting the work done. Presumably, the presentation of plural alternatives means that the eventual implementation selected will best reflect organisational realities. In effect, the organisation is being encouraged to develop alternative ways in which technology can support co-operative tasks with the hope that such pluralism will lead to more effective systems than if a single technically led initiative was attempted.

In as much as generation of a range of alternative approaches to implementing technology is likely to lead to greater possibility of selecting a "good" solution the ORDIT tools and structure seem sensible. It may be noted that, because of the wide variety of facilities and capabilities offered by many CIS technologies, there are always many alternatives as to how implementation should proceed. To this extent, ORDIT or something like it offers the possibility of developing a useful framework if nothing else.

Moving forward from consideration of design and implementation of co-operative information systems, what of the existing use of information technologies to support co-operative and group processes in organisations?

Finnegan and O'Mahony present a useful piece of research in *Group problem solving and decision making: an investigation of the process and the supporting technology*, (Finnegan and O'Mahony, 1996).

The research quoted is based upon surveying 100 Irish companies. The use of various types of group support technologies in decision making was surveyed and the following table presented.

Group supporting technology	Percentage of companies
Telephone	100
Fax	98
LAN	71
Electronic mail	58
Project management system	56
Conference calls	54
WAN	40
Voice mail	35
Electronic bulletin boards	25
Workflow management systems	20
Electronic group calendar	15
Video conferencing	14
Joint document editing	12
Filtering electronic mail	4
Electronic black boards	2
Anonymous voting systems	2

Figure 2.7. Group supporting technology, (Finnegan and O'Mahony, 1996, Table 2).

The extent to which the Finnegan and O'Mahony results accurately reflect the UK as opposed to Irish situation may be questioned. However, they do offer an instructive insight in terms of the position of particular technologies in the list. Attention is drawn particularly to the relative positions of electronic mail, workflow management systems, electronic group calendar, video conferencing and joint document editing. Electronic mail is perhaps the most pervasive of all group and co-operative system support technologies using IT software. Its wide availability and comparatively long history mean that it has the status of a "accepted" technology in a most organisations (whether employed by them or not). Exploration of the use of EMail in co-operative information systems is therefore particularly important since it is likely that its practical effects are being felt by many workers and groups.

Rudy in *A critical review of research on electronic mail* discusses some of the main issues arising in research into the use of electronic mail (Rudy, 1996). These include ;

> Media choice (including information richness, social influence models, critical mass, interactivity, symbolic meaning in messages and media and other ideas in relation to media choice).
>
> Media effects (including the concept of social presence, reduction of social cues, information overload and unforeseen effects).
>
> Email research methodologies (including epistemology, contextualism, network analysis and thread structures).

The Rudy article is very comprehensive with good summary discussions of the main research areas that have been covered in relation to Email. Of particular interest in the present context are various points relating firstly to epistemology and secondly to neglected research areas.

The discussion of epistemology initially notes that positivist models for research have provided the main tool for workers in this area and that relatively speaking interpretive and critical models have not been applied. Rudy goes on to argue that ethnographic approaches would be very useful in providing as the author puts it *"....an antidote to laboratory experiments."*. Email is situated within an organisational context and a positivist approach may miss the richness of events and processes which are thus situated. The perspective of contextualism is also cited. Essentially, choice of medium for communication may be context sensitive so that any theories we wish to test about how individuals and groups behave within an organisation may only be true to a certain extent and in relation to certain contexts. To quote from Rudy;

"In a very interesting paper, Perry (1988) takes the theory of contextualism developed by William McGuire and considers its implications for media research. McGuire's theory proposes that all theories and hypotheses are a priori both true and false, in different situations. Therefore it is foolish to search for hypotheses which are always true. Instead, one should look for a "main" hypothesis, which is true in some contexts, and then study which variables limit the validity of the main hypothesis to these contexts. If such a context variable is found, then one can imagine what might be called a second-level hypothesis, describing. when the main hypothesis is true, dependent on the context variable. The theory of contextualism would then of course note that this second-level hypothesis is true in only certain situations, and is limited by other variables. Obviously one can apply this argument infinitely many times. but after a few levels the exceptions

tend to become sufficiently uncommon to be of negligible importance. Although aimed primarily at mass media research rather than email, Perry's paper provides much food for thought for email researchers." (Rudy, 1996, p207).

The other epistemological perspectives discussed are *network analysis* and *thread structure*. Network analysis is essentially rooted in the same type of approach as that noted by Beer and referred to earlier. Thread structures are the identifiable discrete conversations involving Email users which Email is capable of supporting. (Further development of this idea is included in for example (Brothers et al, 1992) where an analysis of informal communication, within what the authors term *"ephemeral interest groups"*, is carried out.)

In respect of neglected research areas, Rudy identifies three main ones.

Organisational issues

Email from the receivers point of view

Face

Rudy considers that most Email research has concentrated upon individual users and groups and thus the effect upon the organisation as a whole has been ignored. It develops that there is a need to consider how Email can change the way in which organisations operate and how they are structured by providing different paths and modes of communication between people. These effects upon the organisation, it is noted, need not necessarily be positive and, in particular, may conflict with the norms of bureaucratic organisations. By contrast, some models of Email suggest that it can contribute to the *"weak ties"* which are necessary to ensure that groups within an organisation can communicate in other ways than provided for by formal structures.

From a user point of view it is argued that phenomenological perspectives may apply and would bear investigation. People receiving Email are likely to be strongly influenced in interpretation by their prior experience, knowledge of the sender and related factors.

Finally, ideas around *face* are to do with the positive social value claimed by someone as a result of and through their interaction with people. Thus, someone who wishes a colleague to do them a favour may present in a face to face meeting a very polite approach in the desire of positively influence that colleague. Via Email the methods of interacting would be different and the skills required to obtain an equivalent social value vary accordingly.

SUMMARY

Before proceeding to look at specific research case studies of co-operative information systems, it is worthwhile at this point to attempt to synthesise some of the main themes that have emerged throughout this section.

The first point to note is the feeling that co-operative information system technologies are qualitatively different from other and earlier information technologies. This qualitative difference seems to relate to the intimate relationship between forms of communication within organisations, the structures of these organisations and the behaviours, attitudes and work roles of individuals and groups within them.

Following from this is the desire to characterise and categorise different applications for CIS and CSCW systems using (initially) the time-space dichotomy; and then analyses based upon the nature of tasks, roles and power relationships within an organisation. Leading directly from this the following is a conflation of the time-space model reported by Bannon and Schmidt and the co-operative work types model of Eason.

	TIME			POWER AND INFLUENCE	
SPACE	Same (Synchronous)	Different (Asynchronous)	**Division of Labour**	Equal	Unequal
Same Location	**1**	**2**	Local	**A**	**B**
Different Location	**3**	**4**	Pre-determined	**C**	**D**

Figure 2.8. Time-space and power-work type classification.

Using the typology described in Figure 2.8. it is possible to codify co-operative work situations into a range of types and sub-types. If we take the division of labour and equal/unequal power relationship to be the most fundamental then co-operative work identified as "sub-type B3" may be expressed verbally as "co-operative work where there is local (in management terms) discretion as to task allocation, with co-operative workers being of unequal power and influence carrying out their tasks in distributed locations and at the same time". The reasoning behind making the division of labour and power model the primary type distinction is that it seems to relate most directly to a consideration of the organisational forms and processes which may be in existence prior to any attempt to introduce technological support for co-operative work. Technology may subsequently affect the sub-type as, for example, in providing communications capabilities that allow previously synchronous tasks to be carried out asynchronously, or, tasks requiring workers to be co-located to work in a distributed pattern. This reflects comments in Rudy's paper in relation to organisational effects of Email.

To follow this analysis a little further. The classification developed in Figure 2.8. offers a framework with which to evaluate the effect of a CIS on an organisation. It would be possible for example to produce a list of relevant tasks which are required to be completed by co-operative workers and groups. Each task could be codified in terms of the typology developed for situations "before" and "after" technological mediation was provided. A comparison would then be possible as to which tasks changed their classification and a number of possible evaluative conclusions drawn. The following are a number of ways in which such an exercise might provide useful information.

The numbers of tasks which have changed their classification would give a direct insight into the extent to which the co-operative information systems technology implemented had affected the organisation. Presumably, if no changes occurred it would be possible to argue that the organisation of work had not been affected to any great extent. (However, some technology might be expected to affect efficiencies of co-operative work directly without necessarily changing its classification in terms of the proposed scheme).

New co-operative tasks might emerge. In this case it would be necessary to evaluate how useful these were to the organisation concerned.

Efficiencies relating to the changing classification of co-operative tasks might be expected to emerge. For example, the possibility of de-synchronising and distributing some tasks might be expected to lead to their earlier completion. Thus, changes of a co-operative task from for example a type C1 to C2 or C3 would automatically imply an improvement in organisational performance.

It may be argued that some organisational tasks are only of the type they are because of the nature of the "technology" available. Thus, when new technology is implemented, an immediate benefit results from being **able to perform the task in a more "natural" manner** (see for example the discussion in (Hassall and Macefield, 1995) and below of diary and calendar scheduling).

The final general theme that emerges from the research thus far reviewed is that a socio-technical perspective to co-operative information systems is considered to be necessary in both practice and research. Since socio-technical design and implementation planning is a lot easier to talk and write about than it is to do, it can sometimes be difficult to see the way ahead. However, this theme will be returned to in relation to the epistemology of the current research in Chapter 3.

2.3. CIS - REPORTED CASE STUDY RESEARCH

Case Study Research - Introductory Remarks

There is such a large body of case study research in CIS that it is not easy to cover it all in any comprehensive manner. Case studies have tended to dominate research publications on CIS and "groupware" in part because of the technologically focused agenda which has been referred to at the start of the chapter (Bannon and Schmidt, 1992). An enthusiasm for the potential of the emerging technologies may fuel a desire to quickly describe new experiences with them, but part of the reason for the predominance of case studies is the recognised capability they have to *".. capture reality in considerably* *greater detail ..."* than other research methods (Galliers, 1992). Galliers and many other commentators (for example Bryman (Bryman, 1988)), identify the obvious main limitation of case studies as a research tool or method, the difficulty in producing valid generalisable conclusions. However, Bryman defends the use of case studies against an over emphasis upon generalisability as a determinant of validity in research:

'there are grounds for thinking that the "problem" of case study generalization entails a misunderstanding of the aims of such research. In particular, this misconception arises from a tendency to approach a case study as if it were a sample of one drawn from a wider universe of such cases. There are at least two reasons for considering this view to be misguided. First, within a case study a wide range of different people and activities are invariably examined so that the contrast with survey samples is not as acute as it appears at first glance, especially when the widespread tendency for survey researchers to draw samples from localities rather than on a national basis is borne in mind. Secondly, the issue should be couched in terms of the generalizability of cases to theoretical propositions rather than to populations or universes .... Case study data become important when the researcher seeks to integrate them with a theoretical context." (Bryman, 1988, p90).

In other words, survey data can sometimes suffer similar limitations to case study data and it is wrong to judge case study data as if it were intended to meet the same requirements as survey data. Case study data can be valuable when employed within an appropriate theoretical and conceptual framework, including a grounded framework.

In a sense the "generalisability" problem with case study data relates to the positivist research approach which the social sciences have inherited from the natural sciences. This approach leads inevitably to the precedence of quantitative data over qualitative ones. But, as will be argued in Chapter 3 of the present work, the insistence on quantification can result in the necessity of ignoring phenomena and data which are nonetheless real and have considerable bearing upon the research topic.

The case studies reported on in this section are derived from a variety of published sources and are introduced for three main purposes.

- To widen and broaden the perspective on co-operative information systems which has been developed thus far.
- To introduce specific examples of co-operative systems of the type to which this research addresses itself.
- To develop further insights into the nature of co-operative work and the technologies that may be employed to support it.

In order to provide a framework for discussion the typology proposed within the previous section and described in Figure 2.8. will be employed in appropriate circumstances to help mediate the discussion.

2.3.1. Small Group Decision Making

Key Findings
• The importance of a facilitator in structuring group interactions. • The lack of "group centred" strategies in use of the technology. • Evidence for formalisation of contributions to group decisions.
Comments
The case is typical of those reported that consist of implementation within a 'technical" environment where participants are very familiar with the technologies employed. Thus, not typical of the more general organisational environment in which most CIS are implemented.

In *The dynamics of small group decision-making using electronic mail* (Fafchamps, Reynolds, Kuchinsky, 1991), the authors describe a process of co-operative decision making by a team of software engineers using electronic mail. The process took place over a 3 week period leading to a finalising meeting and all the Email traffic involved was subjected to detailed analyses.

A notable feature of this research was the initial motivation;

"Our overarching research interest is to illuminate communicative strategies and group processes in remote communication. The motivation for this specific study arose during discussions with co-located design teams whose members had attempted to use e-mail to support their decision making during the requirements phase of system design. Their efforts had been short-lived, and team members could not explain why they had discarded e-mail as a channel for decision preparation. We filed our observations away until we heard about a success story." (Fafchamps, Reynolds, Kuchinsky, 1991, Introduction).

With the scene set thus, the authors sought to find out how, in the specific case referred to, the participants had succeeded in employing Email to help in the process of group decision making.

The first main conclusion reached was centred upon the role of one member who was the team manager. This person ensured that the on-going discussion continued and, in effect, acted as a facilitator to an extended decision conference mediated by Email. It is easy to see that in the absence of a facilitator to provide structure and coherence to the process, such a group decision making process would be more difficult to accomplish.

The second conclusion was related to the opportunity that the group had for other interactions outside of the Email environment. Because other interactions were possible the analysis of Email content showed that there were few uses of group centred strategies (for example group pronoun usage or the employment of conversational "disclaimers" within the text of Email messages). The researchers concluded that more research was required into how group centred communications strategies could or would be incorporated into Email conversations when group members were geographically separated such that interaction outside the Email "channel" was not possible.

Referring back to the discussion in Bannon and Schmidt it is clear that this example of a study into co-operative system use presents typical features of technologically focused research. A rather obvious point to make is that the organisational context of the study is that of a high technology business where software engineers would have been totally familiar with the use of the enabling Email technology. In these circumstances it is quite likely that barriers to effective use of such technology would have been minimised.

The type of co-operative work may be characterised as A4. This is to say that power and influence of participants is equal and determination of division of labour is local. Although the participants are co-located they are communicating as though they are distributed in space (as an aside, the effect of Email is sometimes thought to distance people as when colleagues send Emails "across the office"). Finally, the working mode is asynchronous.

An interesting exercise is to consider to what extent the mode of working will have changed from a situation where Email was not available. In this particular case, it is likely that some of the communications would have taken place but in different modes and locations (around the coffee machine for example?). The effect of the co-operative system technology has been to decrease the amount of synchronous interaction required by group members whilst providing greater separation in space (a form of "virtual" separation). This may have had the effect of allowing more considered responses and inputs from individuals since it would have been necessary for them to consider the content and phrasing of their Email inputs more carefully than they might have done in face to face speech. Indeed, there is some evidence of this in that the authors report one participant remaining silent over a period and then responding to the group giving their opinions and inputs on a whole range of issues relating to the decision. In effect what we commit to Email is thought through in a way that verbal interaction may not be, so that, to the extent that use of Email can increase the formalism of a discussion, it may be beneficial in this sort of application.

The paper is also interesting from the point of view of analysis methods used. In effect an extreme form of the "threads" approach (see discussion of Rudy in the preceding section) is employed. Email messages are broken down into their semantic atoms and analysed for content such as for example "initiating", "information seeking", "opinion giving", "co-ordinating" ......). This is an extreme form of reductionism where some numbers are forthcoming but they do not particularly illuminate beyond the broad conclusions reached which remain valid in themselves.

Finally, the paper is noteworthy for introducing a typology for Email conversations as follows.

An *island* conversation is represented by a single message with no responses.

A *dialogue* is, as its name suggests, a sequence of messages, exchanged between individuals as in a face to face conversation.

A *web* is a conversation where a message receives more than one reply and messages may reply to more than one other message.

Most messages in the case analysed were islands or parts of webs. Interestingly the webs were all formed towards the end of the decision making process, suggesting that information was exchanged between participants and that there may have been a "latency" period leading up to the time when the decision had to be made.

2.3.2. Shared Workspace and Active Email

Key Findings
• Manager facilitating work by allocation of work and structuring of tasks. • "Half way house" between Email and shared workspace system.
Comments
A case which emphasises the technical capabilities and requirements for the application.

In a *Active Mail - A Framework for Implementing Groupware* (Goldberg, Safran, Shapiro, 1992) the authors present a paper which is a good example of the technical and case centred nature of much co-operative system research. The central feature of the "active-mail" concept is a method of supporting a shared document space by means of "communications ports" which are opened into the document space as each new contributor becomes involved. An example described within the paper is the preparation of a report in which a task initially assigned by a manager draws several participants into an ongoing and dynamically linked dialogue. The analogy might be where someone is doing a piece of work in a room and various other people drop in from time to time to see how he or she is getting on, at the same time offering suggestions and ideas and also generating "spin off" tasks.

The authors of this paper are clearly very interested in the technology which is employed to provide the functionality described. In conclusions there is discussion of the software and operating environment employed and the need for technical features such as transparent document sharing.

The main significance of the active mail concept is that it seems to offer a halfway house between a specifically planned shared workspace system and a traditional Email system. In terms of the developed typology the example of active mail use offered is clearly a type B4 co-operative work support system, with control over the division of labour becoming prescriptive on behalf of the manager involved.

A final comment on active mail as implemented by Goldberg et al is that it does not appear to offer any more technical functionality in terms of document sharing than products such as Lotus Notes, and it is considerably less comprehensive.

2.3.3. Shared Workspace - Brainstorming

Key Findings
• Demonstration of un-blocking of brainstorming using a shared workspace so that the group approaches the performance using the nominal group technique.
Comments
A rigorously controlled experimental technique with potentially generalisable findings.

An example of more specific research into shared workspace applications is a paper entitled *Unblocking Brainstorming Through the Use of a Simple Group Editor* (Hymes and Olson, 1992). This reports what is essentially a laboratory investigation into the use of a shared text editor by small (4 person) groups of experimental subjects. It is noteworthy in being conducted with rigorous attention to the elimination of variables which might obscure the important parameters under investigation, for example gender differences and differences in experience with information technology.

The findings concentrate on differences in the rate and number of ideas generated during a 15 minute brainstorming session under three conditions.

A so called *Nominal Group* allows people in the group to generate ideas simultaneously and then exchange them with other participants rather than having to compete for "air time" in a meeting situation. Group meetings are seen as inferior to nominal groups because of a number of blocking and other adverse effects of the group situation. Hymes and Olson are worthwhile quoting in full on this.

"...... thirty years of research on brainstorming have led to a very clear and surprising outcome: For a given set of individuals, one can get both more ideas and more quality ideas by having them work by themselves and pooling their ideas (the so-called nominal group) than by working together as an interacting group ....

There are many possible reasons for this [6, 7]. Among the most commonly discussed ones are:

evaluation apprehension *- working in a group makes one's contributions visible to others, and despite the usual brainstorming instructions not to evaluate others" ideas, the members of a group can still be reticent to contribute their ideas.*

free riding *- individual members of a group might not expend the effort since other members of the group are contributing ideas.*

limited air time *- when only one person can speak at a time, there is limited time for each individual to contribute.*

production blocking *- because of limited air time, individuals often have to hold on to their contributions until they get a chance to report them, and as a result they might forget them, or they might decide not to offer them; in either case, the act of holding on to them will prevent them from thinking of other ideas.*

cognitive inertia *- at each moment only one line of ideas is being generated, since they are reported serially; groups will therefore tend to pursue fewer different kinds of ideas*

In general, while all of these factors might play some role, it looks as if production blocking (and its associated factor, air time) is the dominant reason for the reduced productivity of real interacting groups relative to nominal ones." (Hymes and Olson, 1992, p99).

The nominal group is, in effect, the control. The experimental situation allows a degree of interaction through the mediation of the group text editor which can provide both serial and parallel interaction. In serial interaction what is typed by each individual is simultaneously reflected in each group members workspace. In parallel interaction, the group members can see what others are typing but can also type themselves at the same time. The results for ideas generated under the two experimental situations and control were as follows.

Number of Unique Ideas Generated

Condition	*N*	Mean	Standard Deviation
Interacting Serial:	11	91.7	38.2
Interacting Parallel:	10	148.6	30.2
Nominal:	8	172.5	54.6

Figure 2.9. Results of brainstorming experiment, (Hymes and Olsen, 1992, Table 1).

The blocking of idea generation when people interact in a group is related to the need for them to develop protocols in the allocation of "air time". In effect, the social aspects of the interaction tend to get in the way of the productive brainwork. The results from the Hymes and Olson study bear this out in that the authors observed that, when groups were interacting in serial mode, protocols needed to be developed in order to prevent input from group members becoming intermingled in an unintelligible way with that of other group members. Thus, a conclusion from this study is that the parallel form of interaction more closely approaches that of the nominal group technique for brain storming. This preferred method of interaction can be classified as type A1 under the developed scheme. Groups are essentially co-located, operating synchronously and with equal power and authority to determine division of labour locally.

General observations arising from this research relate to the established conclusions about different brainstorming modes as it applies to linking co-operative workers via technologically mediated forms of communication. The ability of information technology to de-synchronise tasks which are normally synchronised may have an effect in minimising blocking when individuals are required to contribute creatively to a task. In the Hymes and Olson research the brainstorm was synchronous in the sense that the persons contributing to the session were working at the same time on the same task. However, their individual textual contributions were asynchronous so that they were not required to compete for air time with other members of the group. In the case where linear interactions were permitted a protocol of some sort was required to develop in order to mediate the inputs of each contributor (in effect this is analogous to a telephone conference call where confusion results if everyone talks at once). However, such a protocol was not required when parallel interaction was permitted so that production blocking was avoided and the performance of the groups in generating ideas approached that of groups using the nominal group technique.

The results of the research are interesting from a number of more general perspectives in relation to co-operative work and CIS.

A frequently voiced concern about the use of information technology to provide inter and intra group communication is that it may tend to eliminate the *human element* in communication. There seem to be two possible responses to this.

The first response is to argue that the special qualities that humans bring to face-to-face and spoken communication is a necessary part of the effective operation of groups in organisations. In this argument, any technology which is required to mediate co-operative and group processes should provide for the humanising of the medium by enabling and, if possible, enhancing the opportunities for more social forms of interaction. This leads inevitably down the route of providing technologically enhanced and supported versions of traditional modes of interaction. So, for example, video conferencing seeks to replicate the benefits of face to face meetings whilst overcoming problems related to persons being distributed geographically. This is precisely the argument outlined above where a type of co-operative task is allowed to approach its ideal type more closely (in the case of face to face meetings (type A1 and B1) can become types A3 and B3 with synchronous interaction occurring between distributed subjects).

The second possible response is to argue that certain tasks, even if they need to be completed by co-operating individuals, can be most efficiently and effectively completed if the possibilities for social interaction are limited or diminished. We are all familiar with the situation where a colleague wished to "get his or her head down" to complete their contribution to a shared enterprise. So, in this scenario, providing information to a group member about the progress and production of others, whilst limiting the distractions created by requirements for social interaction in order to complete the task, may be the most effective way to employ technology. It seems that Hymes and Olson have demonstrated this happening in the case of a pure brain storming exercise. It is also fairly common experience that the wide availability of Email in association with word processing software and the ability to exchange information easily seems to help shared writing projects significantly.

In actual practice situations it may be anticipated that the nature of various co-operative tasks which a group is seeking to perform may exhibit heterogeneous properties in relation to the ability of the technology to support it. In some cases the technology will help to prevent blocking and inhibiting effects upon individual contributions, allowing these individuals to contribute more effectively to the outcomes. In other cases, the technology may provide a closer approach to an "ideal" form of a co-operative task.

2.3.4. Time Management, Diary and Calendar Management

Key Findings
• Time management conflicts revolve around existing organisational structures, job roles and relationships.
Comments
A case which interestingly argues against the possibilities within CIS technologies to transform existing organisational relationships. This is cautionary with respect to the typically optimistic approaches of some commentators.

In *Time Management A case for CSCW* (Egger and Wagner, 1992), the authors examine the possibilities for technological mediation of time management protocols within a surgical team at a large University hospital. To quote the authors,

"Given the social character of time and the plurality of time reckoning systems in organisations, time management becomes a focus of organisational conflict and a mirror of organisational power. Actors have to engage in ongoing negotiation on how to allocate scarce temporal resources, often without being able to resolve the underlying conflicts. This makes time management a challenge for 'technology for collaborative work". (Egger and Wagner, 1992, p249)

It is certainly difficult to argue against the above. Indeed, Egger and Wagner spend a considerable part of their paper discussing issues relating to conflicts that can occur around resource, differences in power of participants and the individual views that they have on priorities allocation (surgeons favouring "their" patients for example..). It is suggested that benefits can be gained by involving more people in decision making about scheduling and resource planning, but this is itself a challenge to the traditional roles and power relationships within surgical teams. The authors are driven to conclude that organisational decisions and organisational learning are more important to implementing good time management practices than technology used. And that sources of bad time planning practice are not primarily technical but organisational.

Egger and Wagner introduce a useful summary covering organisational decisions/issues as they impact upon time management and in relation to the (so called) ethical aspects. (Whether these are truly ethical issues in all cases is open to debate, but the typology presented is certainly of interest.)

Organisational decisions and ethical problems	Ethical problems
Synchronisation	
Team versus pool, Group versus sequential task performance	Value of time of individual occupational groups
Pioritising and sequencing of operations • co-operatively or hierarchically • synchronous versus asynchronous	Right to dispose of the time of others, to voice temporal preferences
Using temporal "reserves"	Competing notions of efficiency, differential value of knowledge and activities
Allocation of temporal resources	
Flexible versus stable patterns of allocation	Benefits and burdens of flexibility of operation-time unequally distributed
Flexible versus standardised working time arrangements	
Coping with ambiguity	
Explicitness of priorities	Private versus public regions
Making the use of time transparent	Comparability of individual/ team performance and time discipline

Figure 2.10. Decisions and "ethical" problems, (Egger and Wagner, 1992, Table 3).

The principal thrust of the Egger and Wagner work is that organisational issues dominate co-operative time management. In these circumstances a possible conclusion is that technology can only work to improve existing patterns of co-operation rather than transforming co-operative work in any revolutionary way.

2.3.5. Diary and Calendar Management

Key Findings
• The ability to implement diary and calendar management may be limited by capabilities of both available technologies and organisations resource constraints. • Cultural and individual limitations will affect the ability to implement successfully.
Comments
Refers to 3 mini-case organisations. The comparatively broad time span covered and variety of technologies employed suggests that constraints upon implementation which are identified may have considerable persistence.

In Implementing *Software for the Facilitation of Inter and Intra Group Working, Group Scheduling, Diary and Calendar Management - Some Practical Perspectives* (Hassall and Macefield, 1995) the technological restrictions and implementation issues facing co-operative time scheduling are discussed. The study is based upon case study analysis in three organisations and develops a view of parameters necessary for successful implementation of group scheduling and diary/calendar management. These are;

(a.) Technical Parameters

Ability to update personal diary quickly and easily.

Keeping one diary.

Full coverage of the staff involved (all having access to the technology).

More or less "synchronous" scheduling system.

(b.) Cultural/Organisational Parameters

Disciplined staff who maintain their diaries consistently.

Ability to delegate diary functions (for times when staff are unable to access the computer network themselves).

Reasonable level of computer literacy.

Staff who are prepared to work (sometimes) to other people's priorities.

Skill in time budgeting (allowing for travel time for example).

Source, Hassall and Macefield, 1995, p104.

Given the nature of diary and calendar management the technological parameters may well be the most constraining in practical cases.

"It is difficult to get away from the essentially synchronous nature of the GS and diary management application. The only reliable way to make an appointment for someone is

by talking or communicating directly with them. The moment the scheduling of meetings and communications is delegated, either to another human being or to a piece of technology the possibility of conflicts and confusion becomes very much greater." (Hassall and Macefield, 1995, p105).

So, synthesising conclusions on time management, diary and calendar management and resource scheduling, it seems that in the case of individuals diaries we have a process that is essentially synchronous and that technology must emulate traditional ways of doing things. Success or otherwise of the time management *application* is then related to the organisational realities present. This is borne out by the forms of many automated diary systems, they are direct analogues of pre-existing paper systems and, moreover, suffer from the same deficiencies as traditional aids (plus a few of their own).

2.3.6. Groupware Implementation in a Consultancy Organisation

Key Findings
• The need to shift users technological frame when groupware is introduced. • Differences in training approaches between groupware and individual PC based personal productivity software. • How a culture based upon individual merit can mitigate against effective co-operative computing applications.
Comments
A feature of this case, apart from the clear conclusions and sound discussion, is the dominance of a optimistic view taken by senior management of the potential of groupware technology to foster co-operative working and shared knowledge which is in contrast to the reality of cultural constraints dominating actual use.

In *Learning From Notes: Organizational issues in Groupware Implementation* (Orlikowski, 1992) the author describes a significantly sized piece of qualitative research on the introduction of Lotus Notes to a large multi-national consulting firm. A key feature of the Lotus Notes technology is the very good provision for shared workspace applications and hence co-ordinating activities between dispersed workgroups, sharing of expertise and knowledge and facilitation of teamwork. In many ways Notes has been a precursor of all present and pervasive groupware technologies with very wide usage amongst large and medium sized organisations, often geographically and internationally spread.

The study reported by Orlikowski consisted of a total of 91 unstructured interviews across all users of the Notes network. The aim of the research was to examine *"... how the groupware technology is adopted and used by individuals and how work and social relations change as a consequence. "*.

It is clear from the discussion in this work that there was a rich interaction between both contingent and cultural factors within the organisation and the usage of the Notes technology. An early point to emerge was that the overwhelming requirement in consultancy firms to maximise individual effort on billable time, rather than spending time on *un-productive* activities, worked initially against individual use of the system. Staff simply did not see use of the groupware system as being relevant to meeting client requirements and so did not spend time using it. Little effort was put into developing formal processes which were linked to the technology, so there was little incentive to invest individual time in entering information. This basic problem was re-inforced by the culture of the firm which was (typical of the sector) very competitive at an individual level. In these circumstances there was little incentive for individuals to share information and knowledge because they were measured, received positive feedback and were promoted on their perceived contribution (*"this is definitely a competitive culture .. it's an up or out atmosphere"*). Therefore, a lot of effort was put into making sure that individual contributions were recognised as such. Sharing information of even the most mundane type in this sort of organisational cultural environment, let alone sharing hard earned experiences and knowledge, was clearly problematic.

Evidence is presented that senior members of the consultancy firm did not share the same set of values as their subordinates. At this level, perhaps because they have *made it* and therefore felt more secure in their positions, a more collegiate culture was discernible. It is likely that this cultural environment led senior staff to be overly optimistic about the capabilities for information and knowledge sharing within the organisation as a whole.

Orlikowski also comments tellingly upon the training given to users of Notes. This consisted in a combination of self study materials and individually targeted classroom sessions aimed at developing competence in the use of the technical capabilities of Notes. No time was spent upon the use of the technology for collaborative tasks and no discussion of the possible business value of the technology was undertaken.

In discussion the author points out a significant problem with introduction of new technologies as being unfamiliarity on the part of staff with the possibilities for effective application and exploitation.

"Because people act towards technology on the basis of their understanding of it, people's technological frames often have to be changed to accommodate a new technology." (Orlikowski, 1992, p367).

The conclusions evolved by Orlikowski in response to this are worth quoting at some length:

"Where a new technological frame is desirable because the technology is sufficiently unprecedented to require new assumptions and meanings, communication and education are central in fostering the development of new technological frames. Such communication and education should stress the required shift in technological frame, as

well as provide technical and logistic information on use. A training approach that resembles that used for personal computing software is unlikely to help individuals develop an appreciation of groupware. For individuals used to personal computing environments and individual applications, shared technology use and co-operative applications are difficult to grasp. In these cases, concrete demonstrations of group applications can help to provide insight. Further, learning groupware collectively may foster joint understanding and expectations. Where individuals learn a shared technology in isolation, they may form their own assumptions, expectations and procedures which may differ from those of the people they will interact with through the technology." (Orlikowski, 1992, p368).

So, a shift in peoples technological (or conceptual?) framework is important for successful exploitation of co-operative information technologies.

Orlikowski's discussion of cultural contingencies effectively concludes that norms underlying behaviours need to be changed to reflect the values of joint experimentation and co-operation if effective use of the groupware technology is to be achieved. Otherwise *".. groupware will likely be used primarily for advancing individual productivity."*.

Overall, Orlikowski's discussion on training and introduction of groupware technology is soundly developed and useful, as is the discussion on cultural factors affecting co-operative information systems use. However, the conclusions relating to the need to adjust cultural norms underlying individual behaviour, can be challenged on the grounds that they, in a sense, advocate putting the technological cart before the organisational cultural horse. Unless some advantage can be demonstrated to changing the cultural norms of organisations towards a more co-operative model (including an explicit understanding of what better shared knowledge can provide in instrumental business terms), the adjustment of culture in the way proposed would be, at best, an experiment with uncertain results.

2.3.7. Organisational Change around Groupware

Key Findings
• The capability of groupware to alter organisational activities is identified. • Users identify opportunities for use of the technology. • Existing organisational norms persist in cases where "technological" frames are not altered.
Comments
Demonstrates the potential of groupware to affect organisational forms roles and activities. But again, shows how existing cultural norms are a powerful influence.

Orlikowski has been very active in the area of (largely qualitative) research on groupware and it is useful to examine another, more recent, case reported by this author. In fact, *Evolving with Notes: Organizational Change around Groupware Technology* (Orlikowski, 1996) is one of a collection of seven case studies published together spanning a range of technologies employed within a number of medium sized and larger organisations. These studies are notable for their critical and reflective quality and the fact that the timing of publication pre-dates the current (late 1998) technologically focussed enthusiasm for research around multi and hyper-media, internet and intranets. It is intended to discuss a number of these studies and it is appropriate to start with the Orlikowski work.

The organisation in question is a software company with about 1,000 employees based within the continental USA. In the case Lotus Notes is again the groupware technology of choice. However, in contrast to the consultancy company of the earlier case, a very specific application was developed within the Customer Support Division (CSD) aimed at providing support for specialists and managers who were tasked with solving customer problems. The Incident Tracking Support System (ITSS) was developed in 1992 and the study of its introduction and usage was carried out by the author over the period 1992 to 1994. The research methods used encompassed unstructured and semi-structured interviews with Senior Managers (3), Managers (4), Specialists (20), Technologists (6) and other staff (developers, QA) (4) as well as analysis of information held within Notes and the ITSS databases.

Findings of this study were reported under a number of headings including;

Nature of specialists' work

Nature of managers' work

Distribution of work

Form of collaboration

Nature of global support

Inter-departmental co-ordination mechanisms

Knowledge utilisation

Some of the most salient findings are discussed briefly below.

Nature of Specialists' work

The study reports that, using ITSS, specialists were required to document their work more fully so that the outcomes (largely problems fixes and solution procedures) became available to their fellows. In general, and in contrast to the failure of consultants in the earlier (Orlikowski, 1992) case study to engage with the process of knowledge sharing, specialists were able to employ ITSS effectively in the manner designed. The reasons for this are several and include the fact that ITSS was specifically designed to address the CSD customer incident reporting process, the qualities of the Lotus Notes software which is particularly good at supporting document based case management processes, the fact that specialists were involved in the development of the system and it was able to be used in a flexible manner and the contingent situation of software and customer support where episodic information on the circumstances of faults is vital to the provision of fixes.

Along with the willingness to document incidents and share knowledge the author also noted that individual specialists began to show greater concern in how they documented incidents and how they articulated issues. It was felt that for example *"If you document well then typically the next person doesn't have to document again."* Further, individual specialists showed that they were very much alive to the usefulness of knowledge stored within the growing database of incident details. This also had the effect of re-enforcing the need for consistent documentation so that, firstly, the stored information was amenable to searching by others and, secondly, sufficient "cues" were present within the incident details so that useful information could be sifted from less useful.

Nature of Managers' Work

Managers reported finding ITSS useful in improving their ability to allocate resources and to monitor how well customers queries were being dealt with. This meant for example that it was clearer to managers which staff had a particularly high workload of incidents to be resolved, and additional resources could be deployed. The fact that the "work in progress" was now clearly visible to managers meant that specialists were aware that their work was under increased scrutiny. Interestingly, in this environment, this does not seem to have presented as a particular problem with respect to the monitoring of work rate or performance per se, but does seem to have led to concerns about the possibilities of managers and supervisors attempting to "meddle" in the nature and extent of actual knowledge based tasks being performed.

"You know, they talk about big brother, but, I mean, your boss is supposed to know what you are doing, so what's the big deal? But the real issue is, are they going to start micromanaging the volume? Are we going to be measured strictly on volume, or are we going to be measured strictly on how quickly we dump calls? I think that's a concern, it's a professional, personal, self-image thing." (Orlikowski, 1996, p37).

This is a concern that reflects the belief that professionals should be left to determine their own best practice and, to an extent, regulate the quality of their own outcomes. So, revealingly, this represents a further barrier to the sharing of knowledge within an organisation that is mediated by current groupware technologies; it is a desire to protect self regulation within a professional role which is separate in quality from any desire to protect the competitive advantage that particular knowledge might afford (as in the consultancy company).

Orlikowski points out that there was a general acceptance by most specialists that work monitoring came with the job. The author puts this down to the *"co-operative culture"* in

CSD and also that staff were aware that statistics and other information available from the system could be used positively by management in the performance evaluation and appraisal systems.

Change in Distribution of Work

A striking feature of the reported study was that, because of the capabilities of the new software technology to create effective shared workspaces, a fundamental change in the work organisation and in the actual distribution of work took place. Prior to introduction of ITSS, most customer incidents were dealt with and followed through by specialists working individually. When the new system was implemented however a change took place.

"When managers realised the potential of the groupware technology to facilitate distribution of work within CSD, they opportunistically initiated a change in the department's division of labor by establishing the position of support partners. This distribution of work, however, ran into some unanticipated difficulties, and managers responded by initiating further structural change which established the roll of intermediary." (Orlikowski, 1996, p38).

Support partners were more senior and experienced staff passed problems by less experienced junior staff who were responsible for "frontline" handling of customer calls. This two tier approach was desirable from the point of view of maximising the effectiveness of available expertise as well as improving the responsiveness to customers. However, it was found that the flow and allocation of work did need some facilitation and hence the development of intermediaries who monitored the work loading and distribution of work to ensure that for example frontline staff were not holding on to work and thus becoming needlessly overloaded.

The way in which the new form of work organisation and division of labour came about is a very clear indication of how the availability of particular technological infrastructures can have an effect on how an organisation functions. It is in marked contrast to the situation described in the earlier case study (Orlikowski, 1992) where it was concluded that little spontaneous (or contingent?) change in working practices had occurred which could be related to implementation of the technology.

Change in the Form of Collaboration

In addition to the changes in the distribution of work and division of labour, the study noted that forms of collaboration altered from a reactive to a more pro-active form.

'sometimes, if I see something that's open on somebody's calls which I've seen before, I may put a note in the incident and say "Hey, I think I've seen this before, this might be this and this." Everybody does that, everybody snoops on the calls and says, you know, 'try this," or whatever. And I find a couple of times that's really been helpful for me." (Orlikowski, 1996, p42).

This change in the nature of interaction between work colleagues must represent a shift in the way in which both the work content and the social environment are constructed.

And this is further re-inforced by the finding that exchanges between colleagues now tended towards greater online interaction and less face to face interaction. This was marked to the extent that managers and other individuals, feeling that a too great reduction on face to face interaction would be a bad thing, went out of their way to schedule times for face to face meetings both formal and informal.

Change in Nature of Global Support

With the implementation of ITSS the software company were able to share their US based incident databases with their overseas subsidiary offices in UK, Europe and Australia. Specialists noted the improved capabilities for co-ordination that the new technology offered, particularly the ability to develop, in effect, a global "virtual workspace" which overcame the limitation of geographical distances and time zone difficulties. In effect, sharing of information asynchronously was rendered possible to much greater extent than previously. This meant that the software specialists working for the subsidiaries now had access to a complete set of incident details and bug fixes and, in principle, were in position to contribute to problem solving and be more self sufficient than when the main route for communicating incident details was via Fax and Voicemail. In practice, it was noted that these overseas workers were reluctant to change their mode of working, still seeing the US centre as being the source of solutions and thus not being pro-active and joining in with the collaborative work ethic which was emerging so strongly in the parent company. This was recognised as a problem by management and some steps had been taken to address this perceived shortcoming. Orlikowski comments ....

"While the norms and expectations of electronic work distribution and collaboration were well established in the US office and the specialists applied these to interactions with their overseas colleagues, it was not apparent that specialists in the overseas offices shared these same norms and expectations. As a result, some global use of the groupware technology was not working as effectively as it could. In response the CSD managers had been in touch with their overseas counterparts to try to promote a more common and collaborative view of global support." (Orlikowski, 1996, p44).

Change in Inter-departmental Co-ordination Mechanisms

With the introduction of Notes technology it became possible to evolve new ways of co-ordinating activities between departments. The author focuses in the case study analysis on the area of bug tracking, the process by which problems with the software products are communicated between departments and progressed. It is clear that a number of useful developments evolved around this area and it is reported that the support specialists within CSD as well as the product management and quality assurance departments were generally enthusiastic about the capabilities of the system since it enhanced transparency on the status of bugs and fixes and thus presented real labour savings for these essentially customer facing areas.

"[Before] there was no sharing between the different groups. And the only way we saw it to have consistent recording between the groups and to be able to share information

more easily is if everybody was on Notes. And I think that once we got there we were really excited about it." (Orlikowski, 1996, p45).

The software developers were less enthusiastic and their reactions were instructive Firstly, the focus of work in development was seen to be production of software product In this situation anything that diverted attention towards less central concerns was seen as detrimental to the main task. Secondly, the existence of tight deadlines within software development meant that training on Notes was not seen as a priority. And, in any event, software developers were much more likely to be interested in technical aspects of software than learning to employ all the various user features. Finally software developers were often critical of the technical features of Notes, perhaps seeing it as an "inferior" product in need of improvement and thus not worthy of consideration in terms of the business tasks it could perform.

The disparate reactions of the software developers and the other departments can be usefully related back to the point observed by Orlikowski in the earlier, consultancy organisation, study (Orlikowski, 1992) in which she noted the necessity for users of new groupware technology to adjust their technological frame in order to understand what the technology could do. A synthetic view of this could be that the software developers were seeing the new Notes system as a software product and evaluating it as such whereas the other workers were seeing it as a useful business tool that had the potential to make their jobs easier.

Change in Knowledge Utilisation

Orlikowski reports some significant opportunistic uses of the new technology in the area of knowledge use and dissemination. For example, the ITSS system provided the capability to build up not just a database of bugs and fixes but also information on how the progress of a particular fix had been achieved. This led in time to the evolution of a specific training database which newly hired support specialists could practice on before being "turned loose" on real customer problems. The database was particularly useful in developing professional standards and presentation so that the new team member could become more quickly incorporated and provide useful input to the department later on.

"*When got hired we went over the formalities of how we should present ourselves on the phone and in the Notes. And how to be professional as well, and that is why they gave us a demo database, the demo for us to play with, and so the reviewer, more like a mentor, would look at it and say, "Okay, this is the way you should say it. You have the right answer, but you're not presenting it well. Here is the correct way, use it as a reference.*" (Orlikowski, 1996, p48).

Unsurprisingly perhaps, the new system was also found ideal for the rapid dissemination of technical Support notes to field customer support personnel. This was found to work well since the production of such notes ensured a very visible form of recognition for the support specialists, so that it was perceived a "good" thing to author a note.

The unplanned nature of developments in knowledge utilisation is one of the most interesting aspects of change related to the introduction of groupware technologies. Creative staff are likely to find a variety of ways of using the technology to enhance their effectiveness or efficiency (or, as partly the case with the technical notes, further their recognition within the organisation). But the transparency that knowledge sharing and dissemination offers does not come without its problems and the study reports two important ones.

The first problem is the degree to which any knowledge has to be constrained and tidied up if it is to be made widely available. This is discussed in the context of the possibility for allowing customer access to certain information. There is no doubt that it can be beneficial, not least in resource terms, to allow customers access to information. For a software company the ideal way of providing service would be for customers to provide it for themselves based upon a appropriate database of fixes. But the time required to tidy the information, to filter it and (to an extent) "sanitize" it was seen as an obstacle.

'the reason that it hasn't really gone anywhere is time commitment again. Who is going to do the clean up? Who has got time? Everybody is pretty stressed out as far as time, especially in support. [ITSS Publishing] is going to be the kind of thing that is going to take a lot of editing." (Orlikowski, 1996, p50).

In part related to this perspective was the internal problem of allowing staff to see work in process by other people. Thus a balance needed to be struck between the benefits to be gained by sharing experiences as early as possible and not allowing other staff to be misled into possible wrong approaches. The possibilities for interference with the way staff performed their job (as reflected earlier in discussion of professional concerns) and inappropriate monitoring also surfaced. To quote in full:

'there's some reluctance to give full access to ITSS. I mean this is people's work in progress. Sometimes the stuff they do isn't correct. I don't want someone jumping down someone's throat because maybe they didn't give the right answer right out of the starting gate. And there is some worry that that would happen. And if they had access to ITSS, they could see who had calls open. And I don't want somebody calling and saying, "Hey, why haven't you answered this call yet?"... There is a vulnerability and you want to protect the people that work in support."

"I have had situations where other departments want it as their knowledge base to solve their own problems, and I don't like to give it to people for that reason, unless they do support. And the reason is because this isn't really a knowledge base; this is a history of all the problems we take in. And just because one incident might tell you to do something one way doesn't necessarily mean that's going to solve that particular problem. And as a support professional you know that.... But somebody in the marketing group is not going to understand it, or the sales group, especially the sales group. Because they will read and they"ll take it as gospel, and it's not." (Orlikowski, 1996, p50).

This led to a range of protocols and rules being developed by CSD managers to ensure that people who could see others work in the database were trusted, a behavioural trait which mirrors the comments of Rudy about how we may interpret communications received on the basis of our prior experience of the sender (Rudy, 1996).

In contrast to the study within the consultancy company Orlikowski's broad conclusions are that the implementation of the Notes groupware technology has delivered a number of benefits to the software company and allowed it to deal with increased workloads whilst offering improved quality of service to its customers. The benefits have stemmed from the evolutionary nature of change resulting from possibilities inherent within the technology and have been both anticipated and unanticipated. The author provides a useful commentary summarising what has occurred near the beginning of her conclusions, quoted at length below.

"the findings suggest that over time the groupware technology in the department was used to enact a number of significant changes in the nature and distribution of work, the form of collaboration and interaction, the coordination among units, and the utilization of the knowledge accumulating in the groupware repository. These changes had not all been anticipated or planned by the department in question, rather some had emerged as the department evolved in its understanding and experience not only of the technology, but of how the technology could be utilized to modify and improve the department's work structures, processes, and policies.

With respect to the work itself, the technology was deliberately designed to produce documentation of the process. This changed the nature of support work from primarily problem solving to both problem solving and documentation. This groupware - based documentation offered managers a full audit trail of the work accomplished on all calls taken within the department, increasing their accountability and ability to dynamically balance work load, redesign schedules, and justify headcount increases. Interestingly, the documentation also enabled other changes. By providing a shared window into the nature and status of all the work needing attention in the department, the technology facilitated spontaneous forms of help-giving that had not been possible previously. Such a shared window allowed, for the first time, a truly group view of the work being performed by all the specialists, and thus the possibility of proactive collaboration. Even though work continued to be executed individually, the shared window facilitated by the groupware technology had begun to blur the distinctions of individual and group work in important ways. When customer problems (calls) were individually documented on private scratch pads, then researched and resolved individually (with occasional face to face consultation of others), the notion of individual workspace, responsibility, and ownership are clearly defined. When customer problems (calls) are recorded in a public electronic space that is accessible by the rest of the group, then researched and resolved by any of the group members, the work is no longer sensibly understood as individual. It has become shared, the joint responsibility of the group." (Orlikowski, 1996, p53).

The transformational possibilities for co-operative information systems are thus revealed within this study. The technology affects the nature of the work tasks and the organisation is seen to respond by affecting appropriate adjustments to organisation, policies and procedures. The process is thus a two way one, possibilities inherent in the technology being used both to explicitly alter what is done and how it is done and to create opportunistic and emergent changes within the work-task environment of the organisation.

Comments upon the possibilities for "Knowledge Management"

Before proceeding to summarise the next case some comments will be made upon the subject of knowledge management. The ability of organisations to manage knowledge of one sort or another is assuming great importance both in practice and, increasingly, within the research community. The case of the software company described by Orlikowski is one where various aspects of knowledge management are referred to including, most notably, storage and dissemination of both **factual** and **process** based knowledge.

In the case, factual knowledge includes the details of fixes for bugs in software and the technical notes produced by support specialists. Process knowledge, is included within the historical records of how bugs and problems were actually addressed and most usefully applied in the case of the training database described. (Another way to consider this is that process knowledge may consist of factual knowledge or data linked within some form of episodic framework).

Improved knowledge management is often talked about by researchers in relation to the application of co-operative information systems including groupware technologies. But, as we have seen from this and other cases, implementation of such technologies is highly contingent upon cultural and organisational factors within the specific situation. Possibilities for affecting knowledge management will differ between organisations, departments, groups and individuals depending upon a wide range of factors. Knowledge management is therefore clearly not purely a technological issue although it is sometimes discussed as though it were.

2.3.8. Groupware and Teamwork in New Product Development

Key Findings
• Clash of system rationale with organisation rationales. • Persistence of culture. • Need for formal written communications skills.
Comments
In this study the technology implemented has offered the potential to increase a large organisations capability to innovate by mobilising the inherent market awareness and flexibility of the subsidiary operations. This was to have been achieved through an innovation funnel with the CIS technology providing the essential communication and information sharing medium. The results of this have proved disappointing because staff have tended to see the implemented system as a centrally controlled and formal one, constraining their attempts to be innovative and flexible;... surely an interesting case of differing interpretation from differing perspectives?

If co-operative work is about the things that can be produced by people working in teams, then the case of new product development might be expected to be particularly illuminating. This is an explicitly creative process, and it has been seen that research into the way in which ideas can be generated tends to favour the use of appropriate information technologies in unblocking creativity (earlier case study, Hymes and Olson, 1992). In *Groupware and Teamwork in New Product Development: The Case of a Consumer Goods Multinational* (Ciborra and Patriotta, 1996), the authors describe the use of a system called IPM for Innovation Process Management at Unilever. The underlying technology employed is again Lotus Notes.

Conceptually the new product development is segregated into *below the line* and *above the line* activities. The above the line activities are explicit activities aimed at bringing an idea to market, activities below the line incorporate the competing possibilities for alternatives at various stages in the innovation process. An activity above the line is achieved by moving through a gate, whereby the successive ideas spawned from competing below the line activities are legitimised and supported. The trick to successful (profitable) innovation is to widen the opening of a notional funnel to allow more competing below the line activities whilst narrowing the neck to make sure that only the very best ideas are funded to fruition. Roles relating to this are the project workers, whose activities are largely below the line, the project manager who has the key responsibility of documenting and formalising all the below the line activity and the gatekeeper who decides which ideas make it through the funnel to become embodied within legitimised above the line activities. Of course, it is appropriate to think of the overall innovation process in any organisation as consisting of a range of different funnels operating at various levels.

Essentially, the objective of IPM was to provide a medium for the innovation funnels to work, enabling interaction both below and above the line and providing communications between gatekeepers, project managers and project workers. The main findings of the study into this groupware implementation were as follows.

Global vs local issues

The funnel is a very strong metaphor for what happens to ideas and information flow within a large organisation. In Unilever it had always been recognised that the periphery of the business was much better at creating innovation than the centre. The ideal therefore is to filter ideas so that the centre can make appropriate gate-keeping judgements and then apply resources as required to bring good ideas to fruition. Ciborra and Patriotta found that:

"At Unilever the tradition was that many good ideas and innovations came from small companies located at the periphery. In other words, small peripheral companies seemed to be more active and creative than large, central units. The introduction of a new philosophy of product development based on the funnel and Notes as an enabling tool modifies the patterns of exchange between centre and periphery, which have now become more ambiguous. As mentioned above, the shift from a local strategy in product development to a global one creates the need for a strong centralization in order to co-ordinate better the actions of different players operating at local level." (Ciborra and Patriotta, 1996, p131).

There was a danger now of killing the goose that laid the golden egg because the local innovators were required to link with and contribute to a more centralised system and effort.

"Earlier on, when new products were developed locally, people used to see the results of their actions very quickly. One felt in control of success and for the organization it was easier to reward. Today, as developing a new product takes longer, people have to wait much longer to see the results of their efforts." (Ciborra and Patriotta, 1996, p132).

The attempt to introduce an innovation system which spanned the whole multinational, in effect a single funnel, led to a number of reactions which can be attributed to both organisational and national cultural characteristics. For some previously active innovators a tendency was observed that, in effect, said, *"now the centre has taken responsibility for innovation it is no longer my responsibility"*. In this case the presence of the technology so obviously associated with the central part of the organisation caused individuals and groups to marginalise themselves. In other cases, local funnels were set up which meant that local gatekeepers determined which ideas and projects moved to the global level innovation funnel. In yet other cases it was apparent that the local project workers, managers and gatekeepers behaved as if they had the power to move projects along without recourse to the mechanisms put in place at the total organisational level.

Ciborra and Patriotta comment on the importance of organisational culture.

"Despite the fact that teamwork is introduced in a corporate environment, where supposedly the actors are aware of their belonging to a multi-national organization, its impact can be quite astonishing. An explanation lies in the pre-existing organizational context, characterized by the habit to work nationally, with impermeable departments, each one facing its own market. Here, again, it is important to stress the role of the pre-existing organizational culture and the presence of established routines and practices (infoculture) in fostering or hindering the adoption of the new groupware system (infrastructure)." (Ciborra and Patriotta, 1996, p133).

This is something like the observations made by Orlikowski in respect of the global support implications for the software company (Orlikowski, 1996), the unwillingness of some subsidiary support teams to become fully and actively involved in the whole process of software support.

(To reflect upon this point for a moment; the concept of **a virtual team** where the mediation is provided by groupware and communications technology, seems to have emerged in a variety of contexts. Ciborra and Patriotta, Orlikowski and others seem to be saying that the generation and maintenance of such teams can be quite difficult, particularly when the organisational cultural context is considered. Simply providing a mediation mechanism cannot build such a team. That this conclusion has been reached in studying large, sophisticated and generally innovative organisations may lead to a cautious view of the potential of co-operative information systems technologies to bring about significant cultural change in organisations without these characteristics or equivalent levels of resources.)

Perhaps the most interesting part of the Ciborra and Patriotta discussion is that around the instrumental use of the IPM technology by project workers in a variety of contexts rather than the (largely synthetic) conclusions which have been reported thus far. Evidence is presented that indicates users see the IPM system as a medium which is qualitatively different from other forms of communication available to them. For whatever reason, input of information to IPM is seen as being a formal process whereas communication in conversations, telephone calls, faxes, and Emails, is seen as informal. For this reason IPM is employed for *above the line* activities and for retrospective documentation and formalisation of information. In effect, this destroys one of the bases of using the system at all for innovation in that it cannot become a rich medium of exchange for the creative process.

"to conclude, the groupware applications seem to suffer from the following paradox: the most informal areas of the work, the ones which should be the more open and integrated with the daily practices, are the ones less utilized and more incongruous, at least for the moment. On the other hand, the above-the-line is consistently used, though in a reporting perspective. This betrays somewhat the spirit of the application, because the part above the line is the filtered, formalized version, that arrives too late and does not really help. A potentially "informating" application is used paradoxically according to the design principles of a traditional, "automating" MIS. As a result, information is distributed but with losses of time and difficulties of various sorts. Also, it does not come as a surprise that at present informal comments to projects are rare (forums are underutilized) and that IPM has not yet entered the mentality and the daily practices of users, or at least not up to the point where it substitutes for the other competing tools." (Ciborra and Patriotta, 1996, p134).

In the above, *Informating*, is contrasted to *automating* in the sense originally intended by Zuboff who first coined the term (Zuboff, 1988). This can be related back to the hidden essence discussion earlier in the chapter, that which co-operative information technologies are assumed to be aimed at and capable of delivering to co-operative work.

Because the IPM is seen as being an essentially formal medium of information exchange and documentation, users are aware that their input may be scrutinised by others. This leads firstly to an inhibition about entering information and secondly an emphasis upon a more formal and considered modes of expression. This had led to an effort to structure the contents and access so that different groups and individuals can see different information in different contexts; what the authors engagingly characterise as *"Let's create an umbrella where to hide, so that they will not see us."* (sic). Other users have voiced concern over the duplication of effort. Because other mediums for exchange of information (Email, Faxes, Reports) have been used some users view their interactions with IPM thus..*"We are becoming like secretaries, who spend there days writing in front of the computer."*.

The introduction of IPM and the requirements to document have led to a situation where writing skills are perceived as necessary and important. A certain sensitivity has built up amongst users who are aware that, since everything they write will be seen by others, and often by audiences which hitherto might not have seen such material, they need to be able to express ideas appropriately and coherently: this takes time.

"Before things moved faster. There was less formality. To communicate a decision, say, to decide about the details of a tooth brush, it was sufficient to send a fax or an e-mail message. With IPM I have to specify when I took the decision, how, why, and so on. In short, I have to write an "essay" about the details of the product, and this takes a day. Sometimes, you know, I have to plan for my "IPM day".(Ciborra and Patriotta, 1996, p136).

Towards the end of this case the authors reflect upon the disparity between the ideal of the IPM system and funnel innovation approach and the reality of a multinational organisation with entrenched cultures and attitudes spread around a number of local innovation centres (ICs):

'to conclude, consider the following asymmetry between technology and organization. While the tool is neutral, grants equal access and conveys the same information, the organizational background does not have the same properties. On the contrary: some functions (Marketing) have a dominating effect; the role of different organizational units has changed during the project life cycle; some ICs are more important than others; not to mention the multiple hierarchical levels that from London to India can scrutinize the product information. All these asymmetries reflect themselves on the inner equilibrium of the international development teams, and are gradually discovered by designers and users as dysfunctions of IPM. The system's logic is frequently at odds with the complex, and especially uneven organizational background. Possibly, this should be looked at as a situation of transition........." (Ciborra and Patriotta, 1996, p138).

..and again possibly not. The parallel with the Orlikowski study of the consultancy company seems to be particularly strong (Orlikowski, 1992). In the consultancy company the senior management (principals) had a view of the organisation in which sharing of knowledge was a beneficial potential. However, this was not instrumentalised to the level of asking how such knowledge was currently shared or how it could be shared. Instead a technological fix was applied which, in retrospect, can be seen to be totally at odds with the prevailing culture amongst the knowledge workers of the organisation. Unsurprisingly, the results in the consultancy company in relation to knowledge sharing were not convincing. In the case of Unilever its seems that something very similar has happened. The seductive model of the innovation funnel has led the organisation to seek a medium, an enabling technology, to allow it to be implemented on a global basis across a number of ICs. Again, prevailing culture, re-inforced by individual responses to the technology and existing means of communication and mediation are at odds with the new vision.

(A further reflection at this point is the tendency of, particularly large organisations, to see flagship projects and systems as ways of bringing about significant organisational change. By contrast it can be seen that the change achieved by evolutionary means within the software company described in the second Orlikowski study has proved effective when initiated through individual and group responses to the potentials of the new technology.)

2.3.9. Groupware for Decision Conferencing

Key Findings
• The generally positive view of electronic meeting room systems (EMS) held by people who have used them. • Meeting room systems are better for divergent tasks than convergent tasks. • Extrinsic organisational and personal factors can influence behaviours in using meeting room systems.
Comments
Although the author demonstrates a generally positive reception by users of the EMS, it seems unlikely that a great organisational effect has been felt. The positive benefit for creative/divergent tasks (due to various unblocking effects) is perhaps the most interesting finding.

In *Groupware at The World Bank* (Bikson, 1996) the author describes a particularly interesting application of co-operative information technology, that of the so called *electronic meeting room*. This case study contains a description of the software and the history of the overall project together with a number of observations about the role of various actors within the implementation. Since the main interest of the current study is the application of the technology, it is intended to confine the present discussion to present the main findings both quantitative and qualitative of the evaluation process.

The electronic meeting room was established at the World Bank using software called "GroupSystems V". This software incorporated a range of features and facilities aimed at supporting the group meeting process including activities of various sorts including *"..anonymous concurrent brainstorming, group structuring of meeting comments (e.g. by outlining), assessment of decision alternatives (e.g. by ranking or voting) and real-time feedback (e.g. by visual displays of graphs, charts, trends, percentages, counts, ranks and the like as well as text)"*. After an initial pilot period the room was put in to regular use and formal assessments were made by 500 users of the room during 1994. Quantitative results are reported from the user assessments of the technology including the following table.

GroupSystems Sessions Compared with Traditional Meetings (500 respondents)

5-Point rating scales	Groupware mean	Traditional mean
Degree to which you learned about the meeting subject	**3.8**	**3.2**
Degree to which you participated in the meeting	**4.2**	**3.1**
Degree to which you learned about views of other participants	**4.1**	**3.0**
Degree to which you affected the meeting outcome	**3.4**	**2.8**

Figure 2.11. GroupSystems and Traditional Meetings, (Bikson, 1996, Table 6.6.).

This appears to be an endorsement of the electronic meeting room when compared to a traditional meeting, although, as the Bikson points out, this could simply be a ramification of the Hawthorne effect in terms of a positive response to what is perceived as new technology intended to help the users. However, it does at least indicate a positive reaction to the meeting room technology relative to traditional meetings. And, the case suggests, little attempt was made within the evaluation to assess the performance of traditional meetings *independently* of the evaluation of the meeting room technology. In other words, participants were implicitly being asked for a comparison. It is certainly possible to interpret the results (perhaps cynically) as the participants rating normal meetings as "so-so" or "business as normal" and the electronic meeting room as "something a bit better". (Note also that the 5 point scale might be expected to encourage an average response in the middle).

Other quantitative results are included within the case but overall these were rather banal. As an example, it is difficult to know what to conclude when 58% of respondents judge that meeting objectives were achieved and 39% that they were partly achieved, or that 64% judge the use of groupware to have contributed to achieving the meeting objectives! It is easy to see that some of the evaluation questions posed might have been likely to result in a self fulfilling response.

Perhaps the most striking outcome of this study are qualitative observations made about the use of the electronic meeting room for, respectively, *divergent* and *convergent* cognitive tasks. Divergent tasks are assumed to include the generation of ideas, plans, explanations, proposals, solutions to problems and other essentially creative processes. Convergent tasks include making decisions, resolving conflicts, allocating scarce resources, which require closure rather than divergence. In broad terms, the qualitative finding is that the electronic meeting room is much better at supporting divergent tasks rather than convergent tasks. (Surely a blow for those who advocate the benefits of group decisions support systems and meeting rooms for making decisions?).

In performing divergent tasks such as brainstorming the author notes that the electronic meeting room facilities can encourage more contribution for individuals because it *"releases the constraints on floor time"*. This is precisely the "un-blocking" effect previously noted by Hymes and Olsen. Also, anonymity of input can encourage ideas because participants are not concerned as much about political and power factors which might come into more traditional meetings. By contrast, some concern is expressed that synthetic outcomes may be reduced if people spend too much time working on their own ideas rather than reading and absorbing the ideas of the other participants. This can be made worse by the limitations on how fast people can absorb information, particularly if it is in a relatively unstructured form. This, it is observed, can lead to some peculiar characteristics of electronic brainstorming sessions.

"As a natural reaction, use of the electronic brainstorming tool often occurred in waves, or bursts of simultaneous commenting, followed by lulls when participants read each other's views; lulls, in turn, were followed by new waves of commenting "during which participants began to refer to what others had written. and in which some synthesizing of ideas took place" ....). Subsequently such waves have become planned parts of agendas involving brainstorming. A new benefit associated with GroupSystems meetings ensued: participants, unconstrained by outside pressure and scrutiny, said they also felt "freer to "listen"" than they do in traditional meetings; that is, they were able to consider others" opinions more thoughtfully and 'to better engage in dialogue............". (Bikson, 1996, p168).

Intriguingly, this seems uncannily reflective of the observation by Hymes and Olsen that persons working in a group may, in some sense, need to apply social structuring of activities in order to produce appropriate co-operative outputs, particularly in creative scenarios. The Hymes and Olsen observations applied to the need to produce a pseudo-nominal group in order to prevent blocking. But Hymes and Olsens work was in effect a controlled experiment of limited duration. It seems likely (perhaps obvious?) that some form of social structuring dynamic will occur in any group bought together to perform a task, whatever the mediating technology. Is the challenge of producing and implementing effective co-operative information technologies merely a case of providing a rich range of alternative mediums for communication and co-ordination and then letting the groups emerge, engage and evolve themselves in a natural manner?

In a discussion of the convergent cognitive tasks, largely decision making, a number of points are drawn out. Firstly, the use or not of the electronic meeting room for decision making may relate to cultural perceptions of who makes decisions and how they are made. It is suggested that at The World Bank, managers reserve important decisions for themselves and their peers, they do not see decision making as a committee activity, or necessarily one that involves a high degree of semi structured or unstructured input as in a groupware mediated conference. The decision making process is described as *"extremely thick, dense and harder than expected to break down"*. So that:

"Further, in interdisciplinary groups "different experts are not sure that all participants should have a voice". As a consequence, tools for voting or ranking, and even tools for categorizing and outlining, are not always viable. To facilitate decision making no matter what the technology, is "very hard to do right" in this context." (Bikson, 1996, p169).

It is also noted that use of the electronic facilitation tools tends to speed up decision making and that the decisions thus made can often come unstuck or be undermined by individuals outside of the meetings. In the case study, difficulties in getting decision conferences to work led to the development of facilitation processes and skills which were unconnected with the actual technology per se. The foregoing leads on to Bikson describes as *socioemotional dimensions*. This awkward label seems to mean the way people feel about working in certain group situations. As an example, the point is made that at The World Bank people tend to work within the organisation over a relatively long period of time, thus placing a premium on getting along with their colleagues who are likely to be such through different departmental and career shifts. So, when meeting to make a decision, behaviour is likely to be conditioned very heavily by extrinsic factors to the actual task at hand. In the circumstances it was felt that the most positive effects of the electronic meeting room technology might be in overcoming the conspiracy of silence which could prevent negative reactions to ideas being voiced. Technology that eases the explicit feedback of negative reactions to ideas has been found to be beneficial to outcomes the study reports but, paradoxically, this can lead to a lowering of satisfaction of the participants with the overall process.

A further point is that, during a meeting, the appearance of an issue on the screen can, in a sense, ligitimise discussion of it. Many of us have had the experience of listening to a discussion within a group and gradually realising that we have a point which we are unsure whether to raise or not. If someone else raises an identical or similar point we immediately become more comfortable and ready to discuss the specifics of our own idea. The potentially anonymous medium of the electronic meeting room should make this entire process of legitimisation easier, and indeed the Bikson study suggests that focus groups on staff attitude surveys were amongst the most useful applications in this case.

The study of The World Bank is valuable in that it introduces a co-operative information technology very different in functions and focus to the Email, Network, Shared Workspace world of Lotus Notes and other mainstream groupware products. At the same time, parallels can be drawn between the use of a shared medium of discussion where the (more or less) synchronous interaction of the participants can be simultaneously distributed and the distributed situation where shared information is separated both in space and time as teams interact with it and with one another. We can see phenomena such as blocking and un-blocking, the establishment of social processes, concerns over publication of contributions and concerns over the boundaries of the process (in the case of the World Bank, who makes the decisions; in the case of Unilever, who are the gatekeepers for the innovation process). Is it therefore possible in some cases to dis-aggregate many of these phenomena from the specific technology being considered, thus making possible meaningful comparisons of performance between technologies and specific applications?

2.3.10. Manufacturing Estimating

Key Findings
• Designed applications can be beneficial in helping structured work in small professional groups. • Participation by users in design contributes to success in implementation.
Comments
This illustrates the very instrumental end of the CIS continuum. The application can be classified as a combination of work-flow with shared data system.

During the period 1991 to 1992 the author assisted in the development and implementation of a group mediation application intended to support the work of estimators at a manufacturing company, HDA Forgings Ltd. This work is described in detail in *Manufacturing Estimating with Graphical Interface* (Kingston and Hassall, 1992). The system was intended to support a co-operative work task involving a number of estimators who were required to contribute to the production of a formalised estimate document based upon both individual and shared knowledge and skills. The application was highly structured in the sense that the output had to be presented in a clear and consistent fashion whilst ensuring that a useful repository of prior experience and knowledge could be built up. The extract from the paper quoted below gives a useful introduction to this application.

'the visual programming toolkit has allowed a design based upon a pictorially meaningful model of an estimate. The estimator may enter information to any part of the estimate and may receive help in the form of "pop down" lists from which he may select the appropriate item. Creating and amending an estimate is to a great extent intuitive to the estimators since the basic structures and procedures have been captured within the system. Completed estimates are printed to a very high standard of appearance. Estimators have taken very rapidly to using the windows interface and are actively seeking applications for other Windows facilities." (Kingston and Hassall, 1992, p5).

This application provided the benefits of a shared workspace with the ability of different users to work upon their own part of the co-operative task in a flexible and intuitive fashion. In terms of the co-operative work classification schema, this is a situation where A1 and C1 type tasks are effectively transformed in to A4 and C4 tasks. The emphasis is upon the space and time dimensions of Figure 2.8. in this case.

This particular application exhibits a number of interesting features when placed in the context of earlier discussions. A **design** theme is clearly very dominant in this case, the application being developed to meet a determined need with clear co-operative work outputs in mind. The development itself however resulted from an **emergent** theme, whereby the estimators were enabled to articulate their requirements through a prototyping approach.

2.3.11.Lotus Notes Network (previously unpublished case)

Key Findings
• In general training is of key importance for any CIS system implementation. • People find it difficult to move swiftly outwith their "technological" frame. • Success of systems is often decided swiftly by how they are adopted in the early part of their implementation and whether they are championed effectively. • Existing culture, job roles, processes and norms of behaviours cannot be adjusted by the implementation of new information systems alone.
Comments
The author experienced this case through consultant-client involvement over a number of years. Also, similar events and impressions to the ones reported here have been experienced and gathered within other consultancy situations.

The unpublished case study discussed below is based upon material gathered during the process of consultancy by the author. In this case both the quality and quantity of information gathered is variable so that the decision to include some of the materials has necessarily been a subjective one. Nonetheless, all of the material presented and discussed is deemed relevant to the research by providing depth to the context and experiences which inform development of the thesis.

During the period 1995 to end 1997 the author was actively involved in the development of information systems for a Training and Enterprise Council which were largely based upon Lotus Notes technology. During this period a variety of applications were implemented within the organisation of approximately 80 people with varying results and degrees of success. The applications included;

Office Support (Word-processing, Spreadsheets and Presentation Support)

Email

Diary and Calendar Management

Client Support Database (Business Database)

Marketing Database

MIS

The last three applications are examples of the design theme in co-operative information systems implementation and the experiences with each is dealt with in more detail below. Initially, some time is taken to examine the more generic uses of the available systems as they apply to co-operative work. This discussion is related to a survey of IT usage which was carried out towards the end of 1996 and reveals some useful data.

Document preparation and management

Anecdotal evidence, supported by casual observation suggested that, despite the capabilities of the available technology to support document sharing and management across teams, relatively little use of it was made for this purpose. In the survey 67% of respondents claimed that they **always** prepared their own letters using the word-processor but only 19% that they used the system to manage contributions by several people to a shared report.

The overall conclusion was that document preparation and management was viewed overwhelmingly as an individual activity rather than a co-operative one. Consequently, the individual aspects of the technology were viewed as more important than the group oriented ones and there was little incentive to allow user defined, emergent usage of the technology to arise.

Diary and Calendar Management

Continuing from a consideration of document management it was clear that a dichotomous situation had evolved in the use of the diary and calendar support systems. In the survey, nearly 52% of respondents claimed to use the system facilities as a "main working diary" or a "positive way of managing my time better"; whereas 35% never employed the facilities. This, again, tends towards the conclusion that there was little emergent development in the use of the IT facilities to support co-operative tasks.

Email communications

Email is, as we have seen with the work of Finnegan and O'Mahoney (Finnegan and O'Mahoney,1996) generally accepted as a normative technology. It is not surprising to see in the survey of TEC IT users that 88% of respondents used Email very often or almost always for communications with colleagues internal to the organisation. But when the use of Email in a team related task is examined the results are somewhat more ambivalent. Respondents were asked to judge whether they "used and/or developed Email lists to communicate with different teams of people". Almost 38% of respondents said that they never did this and a further 41% that they only did so occasionally. Taken together, and having consideration to the different job roles and management levels represented within the survey, this tends to paint a picture of both individuals and teams who are unaware of the possibilities for structuring and organising tasks around varying configurations of communication.

The conclusion that the potential of the technology was not being employed to any great extent to facilitate the co-ordination and collaboration on team tasks was further supported by the survey as a whole and by anecdotes and casual observation. For example, despite the potential to capture telephone and other messages within the system and pass them easily to colleagues for later action, a recurring feature of some of the office workstations was the festooning of PC monitors with small "post-it" notes. In this context, there seemed no single reason why individuals and groups had failed so conspicuously to engage with the positive possibilities of the technology but a number of possible factors suggested themselves.

Firstly, and reflecting the theme identified by Orlikowski in the study of the Consultancy company (Orlikowski, 1992), users technological frame was such that they simply did not appreciate the potential of the systems to facilitate the process of co-operative work.

Secondly the nature of job roles and responsibilities exhibited a polarisation between those staff who worked in a routine fashion, processing information within a defined sphere of activity using simple data processing tools and those who spent a lot of their time out and about in meetings and live action situations. The first group were probably constrained by experience to see IT as being mainly for the automation of routine tasks. Therefore, if no specific system or process had been established it was unlikely that they would see it as their responsibility to think creatively of establishing it. The second group by contrast might see the IT as a problem, since it did not appear to be capable of offering support for their most important activities. Their reaction was to ignore the system except when they were forced to engage with it, hence no creative use was possible. (Paradoxically, at the time this was happening, Lotus Notes offered perhaps the most functional, robust and flexible solution to the needs of mobile workers had only the correct applications been developed!)

Another reason for the lack of creative use of the available technology was the reactions of the IT support function which was relatively under resourced. Once the development of the system had moved beyond the initial Business Database (see below), further developments presented a problem to the IT support personnel since more active users implied higher support workload. The development activity thus tended, in the absence of any real push from users, to focus on the technical end of the network (upgrading PCs, installing new revisions of software, developing the networking infrastructure) since this was both technically interesting and did not involve the (typically) lengthy and frustrating interactions with users that application development would have involved.

Training and other initiatives

In recognition of the need to change the technological frame owned by the majority of users a number of initiatives were attempted. This included development of documentation templates for reports and letters and the delivery of training to users which emphasised the possibilities for supporting team working through co-operative document development, shared filing and standardisation of reporting formats. The rationale was that "once people realise the power of the technology to help them produce better quality outcomes they will be encouraged to use it more and more creatively".

Experience with the templates and training was mixed. In some ways the reaction was a mirror of the dominant attitude to co-operative work within the organisation. People saw their jobs as being largely individually defined, so, naturally a number of individuals were pleased with the training since it helped them personally to be more productive. Further, some people found it relatively easy to generalise the benefits of more standardised and shared documentation processes to the level of the organisation; in other words, they could appreciate what the benefits would be if *the organisation* or *other teams* were to engage with the process of using the technology to support better and more integrated approaches to the co-operative effort. Individual reactions to changing their own processes and work tasks were less positive. For example, it was easy to sell the *idea* of a standardised letter format for the organisation. But actually implementing this foundered; firstly because it proved very difficult to agree any process whereby the format could be agreed. It was generally agreed that the overall responsibility to define a corporate style belonged to the Marketing department, but since various other departments also saw themselves as having business development and marketing responsibilities, they could not easily agree that a (perceived) important presentational issue should be decided elsewhere. A second reason the templates idea was of limited success was that certain secretarial and administrative staff resisted the idea that format and layout should be determined for them, paraphrased as, *".. the layout of a letter is part of a secretary's skills and you are proposing to take this away..."*. This is uncannily reminiscent of the professional issues identified by Orlikowski

".....it's a professional, personal, self-image thing." (Orlikowski, 1996, p37).

So, a management desire to provide standardised, high quality ways of performing routine business tasks was quite easily frustrated by the desire of people to retain control over their own output.

Client Support Database (Business Database)

By contrast with the generality of users on the Lotus Notes system during the period under discussion, the relatively small team forming the BusinessLink part of the organisation had available, almost from day one, an application developed specifically to support their activities. This Business Database system was intended to store details of all businesses within the relevant geographical area and provide for documentation of the activities carried out with each organisation by business advisors (whose role was to market BusinessLink services).

The development of the business database system was heavily constrained by operational considerations which were linked to the mission of the organisation. Thus, an essential operational requirement was the storage of basic contact information for all businesses within the geographical area covered and the targeting of certain sized businesses in order to encourage their take-up of business advice, (hence improve growth and employment prospects within the region). The development of the organisation was placed under a highly motivated individual, a hired consultant, whose success and continued employment was dependent upon demonstrating activity which was relevant to the defined organisational mission. In the context of demonstrating activity the Lotus Notes database system was particularly strong in this area because of its document management capabilities. The hired consultant pioneered the development of structured reports covering key issues which were identified by the various business advisors and consultants during the process of their visits to firms in the region. These reports began to assume the qualities of a dynamic knowledge bank of currently "hot" business issues for the region, allowing the BusinessLink to tune its messages, products and services to local needs.

The business database, in so much as it included a knowledge management capability, exhibited a particularly useful feature of certain groupware technologies in being capable of facilitating both the storage and use of textual material in a way that proved effective in influencing the activities of a flexible and mobile workgroup.

Marketing Database

At about the time the survey reported above was conducted it was clear that the implementation of Lotus Notes technology within the TEC/BusinessLink structure had succeeded where the business database was concerned but had been less successful in penetrating other parts of the organisation. A proposal was now brought forward to implement a Marketing Database and to link this with the process of answering customer enquiries. The idea was to embed new processes within the organisation by providing an essentially mechanistic solution within Lotus Notes. Staff would be empowered to respond to customer enquiries and concerns and provided with a horizontal *knowledge base* across all the provision areas of the TEC/BusinessLink.

This initiative was attempted but, by and large, was not successful. In retrospect it could be seen that this was for a number of reasons. Firstly, it was clear that having to contribute departmental knowledge and information to a centrally available repository, (again) presented a problem for some groups. Also, the prevailing ethos within the organisations was product focused rather than customer focused. This meant that it was not easy for staff to think about "owning" a customer, even for the brief while that they were a telephone enquirer, so the system put in place was simply too far removed from existing practices to be easily accepted. Finally, it was realised too late that the level of training and expertise was generally too low for the creative and flexible new use the system was intended for.

The marketing data base was not a success, although it was subsumed into another project (providing product information via the World Wide Web) in due course. The experiences gained from trying to implement it in the original form were however instructive to both consultants and staff involved.

Lessons Learnt

The lessons learnt from this undocumented case were many and detailed. The main conclusions however can be briefly summarised.

In general training is of key importance for any CIS system implementation.

People find it difficult to move easily outwith their "technological" frame.

Success of systems is often decided swiftly by how they are adopted in the early part of their implementation and whether they are championed effectively.

Existing culture, job roles, processes and norms of behaviours cannot be adjusted by the implementation of new information systems alone.

2.4. BROADER VIEWS AND INTERPRETATIVE WORK

Rather than attempt to come to grips explicitly with the effect of co-operative information systems in specific organisational contexts some commentators have chosen to take a wide perspective and attempt to interpret the phenomena of new information technologies as they affect organisations as a whole. Looking at what these researchers have to say is important because it will allow the expectations which managers have of co-operative information technologies to be placed in context.

2.4.1. Business and Organisational Transformation

It is impossible to stray far into the literature relating to emerging information technologies without coming up against the idea of Business Process Re-Engineering (BPR). In some ways this concept can be seen as a rather traditional view of the way in which technology can transform organisational life by providing new and more efficient ways of performing existing business tasks. More recently, ideas about the actual efficacy of information systems enabled BPR have been challenged (e.g. Galliers, 1997). But prior to this a number of workers have transformed the mundane notion of changing and automating the way business is carried out into a number of wider (and in some ways more fanciful) directions.

In order to understand the sense in which researchers in this area argue, a start is made with the work of Venkatraman (Venkatraman, 1996). Venkatraman has developed a model describing the way in which successive generations of information technology may be seen to affect the workings of the firm or organisation. This is a progressive model with five stages as follows.

Localised Exploitation - in which information technologies are employed to perform tasks more efficiently but without significantly changing the internal economy of the organisation.

Internal Integration - in which interdepartmental links are established to improve business processes across the organisation through integrated information systems (for example databases).

Business Process Redesign - in which the focus shifts from the existing organisational forms to improving, re-designing and implementing business processes to serve customers, often with profound organisational changes.

Business Network Redesign - in which communications technologies take centre stage so that improved interaction is possible both within the organisation and with customers and suppliers.

Business Scope Redefinition - in which the possibilities of the information and communications technologies being employed create new organisational forms including the extension and re-definition of the scope and nature of the business.

The stages will usually run into one another, or perhaps, not be particularly well delineated; Venkatraman also suggests that the range of potential benefits to the organisation increase as successive stages are reached. It would be necessary to understand exactly what was meant by a benefit in order to judge this assertion. However, it is worth noting here that it does appear to chime with a common theme in discussing information systems investments where reference may be made to critical paths, key stages and threshold levels.

The approach adopted by Venkatraman is very much a modernist (and formist) approach which sees improvement, or development, facilitated and driven by technological change moving through a number of definable (if difficult to delineate) stages. In this approach he is heir to the Marxist historical tradition, the grand narrative of history. Also visible is the strong instrumental vision of technology often adopted by commentators based in the United States from which much of the new technology originates.

The idea of a stages or eras type of model for information systems developments and effects within organisations is, as has already been remarked, a popular one. A recent synthesis is included within *Information Technology: Transformer of Sink Hole* (Willcocks and Lester, 1999) in which information technologies and applications are grouped into 4 eras. As we have seen in section 2.1.4., CIS can be seen as fitting into the *"Network centric"* era in the Willcocks and Lester scheme. This era is characterised as follows.

"Although the Internet has existed for nearly 20 years, it was the arrival of the Mosaic graphical interface in 1993 that made possible mass markets based on the Internet and World Wide Web (WWW). This era is being defined by the integration of worldwide communications infrastructure and general-purpose computing. Restricting as it does

WWW graphical capabilities, communications bandwidth begins to replace microprocessing power as the key commodity. Attention shifts from local area networks (LANs) to wide area networks, particularly intranets. There is already evidence of strong shifts of emphasis over time from graphical user interfaces to Internet browsers, from indirect to on-line channels, from client server to electronic commerce, from stand-alone PCs to bundled services, and from individual productivity to virtual communities...." (Willcocks and Lester, 1999, p17).

The conclusions of this discussion are that critical mass in terms of demand for connectivity is driven by large organisations as they seek connectivity with clients, suppliers and other organisations. This shifts the focus for IS development towards externally motivated rationales rather than internal automising ones, clearly linked to the concept introduced by Venkatraman of business scope re-definition.

In terms of a consideration of networking and CIS use within organisations its is clear that heterogeneous organisations may exhibit a microcosm of the broader world. In these cases we might expect to see adoption patterns internal to organisations that mirror the critical mass arguments introduced by Wilcocks and Lester.

Before moving on however, it is worth referring to some recently published work by Whitley and Bouzari, *An Anti-Essentialist Reading of Intranet Development: What is the Role of Technology* (Whitley and Bouzari, 1999). By *Essentialist* Whitley and Bouzari seem to be referring to the study of technology in terms of specific recognisable features and facilities. By contrast, an *anti-essentialist* view is one which considers the social context within which technology is applied to be the major determinant of the outcome. Whitley and Bouzari mount a strong argument in favour of this view based upon secondary sources including an account of the development of an Intranet within Boeing Corporation from 1994 onwards. It seems that this development, internal to Boeing, preceded the explosive growth in interest in the World Wide Web and associated technology in the general business environment. The Boeing development then was the result of a specific vision and set of circumstances within the corporation itself. It may be seen from this work that opinions can be quite divided about the degree to which technology of any sort can transform organisational life without the strong influence of social, political and other factors.

2.4.2. Post Modern Organisations ?

The stages and eras visions, incorporating as they do the idea of a progressive but comprehensible history driven by technological change, may be contrasted explicitly with reflective stances taken by other commentators with a more post modern perspective.. For example Blackler in *Post-modern organizations: understanding how CSCW affects organizations* (Blackler, 1994), considers that the new technologies, particularly communications technologies, provide the capability to allow organizations to evolve in arbitrary and unexpected ways rather than as a result of planned development. Thus, the organisations move towards a "post-modern" rationale can only be understood with reference to a post-modern intellectual perspective. What is a "post-modern" organisation? Blackler provides the following contrast between modernist and post-modernist organisation theory.

Modernist organisation theory	**Postmodernist organisation theory**
Organisations as machines	Organisations as flux and change
Monologue	Dialogue
Planning	Improvisation
Homogeneity as strength	Heterogeneity as strength
Certainty	Ambiguity
Integration	Collective learning

Adapted from, Blackler, 1994, Figure 2.

As has been seen in the discussion of a number of the case studies, there is certainly a spontaneity about the way in which some of the co-operative information technologies are applied within organisations. It has also been demonstrated that organisational change may occur in an unplanned way in response to individual and group perceptions of both the instrumental and cultural value of the new systems. But it can be difficult to engage successfully with some of the post-modernist ideas since they do not appear to have great explanatory power. The example below is quoted from Blackler's paper in an attempt to illustrate the characteristic reasoning in relation to the post-modern perspective.

"Postmodernism thus provides a way of thinking about organizations which, as they become independent of geographical location, devoid of conventional hierarchy and with no obvious boundaries between themselves and other organizations, are becoming increasingly difficult to understand. Conventional (i.e. modernist) approaches to organizations as machines, it suggests, must be discarded. The assumption that advanced technologies are neutral tools that may be co-opted in the pursuit of established priorities is part of this imagery, as is the notion that organizations may be described adequately as structures (be these hierarchical bureaucracies, decentralized structures or matrix organizations). just as conventional distinctions between structures versus process become unhelpful so do other familiar dichotomies, such as goods versus services, management versus workers, domestic versus foreign, talk versus action, individuality versus collectivity and technical versus social. Familiar props to our understanding are also removed once assumptions about the centrality of rationality, harmony and planning within an organization theory are dropped. Then the nature of incoherency, inconsistency, paradox and dilemma in working relationships becomes easier to see. The emphasis on direction, control and technique that features within modernist orientations is, within post-modernism, replaced by an interest in the processes of knowing and interpreting and in the management of collective uncertainty." (Blackler, 1994, p133).

So, in place of the modernism of Venkatraman we have what? It seems difficult to escape from the purposeful nature of organisations, however geographically spread and ill defined. We can view them as being heterogeneous, distributed, networked and interconnected but there are guiding rationales, and, management's function has always been to manage uncertainty (collective or otherwise). It is certainly possible to see commentators such as Blackler raising important issues about the highly complex, variable and heterogeneous nature of modern organisations. Moreover, it is likely that technological possibilities and potentials can generate more uncertainty through the possibility of rapid change and the evolution of more types of organisational form. But, as has already been demonstrated, the machine is only one metaphor (or image) of the organisation, an equally good one being the organism which evolves and changes over time in response to internal and external exigencies and constraints.

In considering the extent to which (in Blacklers words quoted above), *" Familiar props to our understanding are also removed once assumptions about the centrality of rationality, harmony and planning within an organization theory are dropped."* , planning for information systems may start to look very difficult. In response, various authors have attempted to consider critical and deconstructive schemes to help the process. Watson and Wood-Harper for example, (quoted already in 2.1.4. above), consider that methodology may be subjected to a de-constructive approach in order to generate insights and perspectives which are potentially useful (Watson and Wood-Harper,1996).

The examination of language and context which deconstruction implies may be useful for the researcher but it can be difficult sometimes to see how it can be applied in practice. Since, as Watson and Wood-Harper note, context is infinitely expandable, the meaning of particular methodological acts, or terminology, may be infinitely subject to revision. In a way, the deconstructionist or post modernist position with respect to IS may be seen as an extreme form of interpretivist approach which undermines its own position; as such it is only capable of providing a critical perspective and not a useful model.

2.4.3. A Broad Interpretative Approach - Time and Space

A broad and useful interpretivist model is exactly what the author is seeking to develop in *"Implementation of Information Technology: A Time-Space Perspective"* (Sahay, 1997). Sahay is concerned to develop an interpretative scheme which can be useful in information systems research. After discussing the origins and development of the interpretative approach in IS research, covering references to the work of Orlikowski and Walsham amongst others, Sahay proceeds to discussion and critique of various interpretative schemes, noting for example that the technological and the social aspects of information systems technology can be difficult to separate due to the tendency for technologies to become embedded in organisations. The immediate conclusion of the critique is the need to *" ....integrate 'time-space" in all facets of analysis.".* the suggestion is that technology, interacting with organisational forms and individuals has the capability to *"reconfigure"* social dynamics. In effect allowing a redefinition of "near and far" and "now and then".

Sahay next attempts to re-define what is implied by time and space within organisations by noting that, for example, time is mostly treated as an objective attribute of a situation whereas our subjective experience is that, from the individuals point of view, time is a rather more elastic construct. Space by comparison is *"neither absolute, relative or relational in itself, but it can become one or all simultaneously, depending upon the circumstances."*. Space is important in the structuring of social and organisational life and Sahay makes the link back to Giddens and Structuration already noted in the discussion of Walsham's work.

The author next develops a framework which is proposed as a set of perspectives by which IT in Organisations may be studied and interpreted. These perspectives are arranged within a grid as follows reproduced in figure 2.12.

Interpretative framework for IT in organisations

Temporal-Spatial Practice	**Accessibility and Distanciation**	**Appropriation and Use**	**Domination and Control**	**Production**
Experience: Material practices	IT facilitating the transfer of information, goods, resources and power across time-space situations; IT enabling people to access others across time-space boundaries; Providing the medium for distanciation-facilitating the transmission of social norms relating to access and response to networks across time-space boundaries; Redefining existing norms for social interaction.	Use of IT, for property management, taxation and other land-use activities; IT's like GIS and remote sensing monitoring land use activities over time; IT & telework, redefining work relationships between staff and the meaning of their respective turfs; computers at home, impacting family-based social norms; impact on gender relations; and those between members of society.	Privileged access to computer networks. Surveillance and policing of people; redefined social practices due to increased and changing forms of surveillance; creation of exclusive IT based communities with access to specialized information; related shifting balance of power; related changing nature of control which management exerts on employees.	Enhanced computer memory enabling storage of large amounts of data; increasing amount of data can be more easily stored on both individuals and their social practices; potential elimination of physical data storage spaces such as map-rooms, and the people who work there; data ownership; new technologies associated with data storage and issues of their access.
Perception: Representing space-time	The role of IT defining and redefining social, psychological and physical measures of time-space; IT enabling the creation and manipulation of maps; growth in multi-media, opening up new dimensions of human perception; the development of spatial, perceptual skills are emphasized.	Personal domains of time and space are created by IT; changing mental maps regarding domains within which one operates; changing representations of social hierarchies arising out of new temporal-spatial orderings; unequal access to computing resources, different perceptions of knowledge areas of the "haves" and "have-nots".	IT allowing the access of forbidden time-space domains, and also creating new domains; perceived domination over people who do not have access to computer based information; territorial imperatives; regional temporal culture; nationalism; geopolitics; hierarchies.	New systems of IT-based mapping; new forms of representation and communication; hyper-media producing additional time-space areas, new IT-enabled artistic & architectural "discourses"; 3-dimensional representation enhancing perceptions of production.
Imagination: Times and spaces of representa-tion	IT creating newer senses of attraction and repulsion to activities associated with, various time-space situations; changing perceptions about presence and	Familiarity with IT and its physical location; favourite tine-space situations for interacting with IT; IT enables networking with other people and information	Unfamiliarity with computing; IT providing visibility to material practices, and associated feelings as a result; creating a sense of property and	Utopian plans built around the use 01 computing; IT allowing tile creation of imaginary landscapes; science fiction anthologies associated with

	absence impacting upon our senses of desire; IT enabling different feelings about inclusion-exclusion to social practices; allowing the transmission of norms related to redefined senses of inclusion-exclusion.	over time and space; advertising of jobs, conferences, etc. over computer network; computer mediated exchanges affect the use of humour and boundaries of social interaction; role of hypertext in developing time-spaces of representation.	possession with Computing; rituals associated with different time-space IT domains; domains of repression are created by IT; symbolic barriers to IT use; construction of a time-space tradition around IT use.	transcending time-space boundaries; mythologies of time-space; poetics of time-spaces creating new time-spaces of desire; new forms of presentation of history.

Figure 2.12. Interpretative framework for IT, (Sahay, 1997, Table 1).

The breadth of the framework illustrated in Figure 2.12. is admirable and, in fact, provides a good basis for a research manifesto!

2.5. CIS, A SYNTHETIC VIEW

Up to this point a body of research in co-operative information systems technology, CSCW and groupware has been described and discussed. The purpose of this final section is to attempt to draw together a number of threads to provide a synthesis view of the main features of CIS as they relate to implementation within organisations. The aim is to inform the current research by providing a framework in which evaluative and comparative studies can be made of an example of CIS implementation.

2.5.1. Characteristics of Co-operative Work & Technology

Co-operative work by people in an organisational setting is affected by social and organisational issues to an extent that more traditional (and technical) work tasks are not. Because of this, it is not appropriate to regard organisations purely as machines to achieve particular outcomes. This conclusion, reached by many workers in the field of co-operative information systems, implies that an organicist model of organisations together with socio-technical design is important in the implementation of information technology applications to support such work.

Socio-technical design presents a problem. At one level it is a form of oxymoron, since social systems are nowhere near as amenable to design as many would like to believe. So, socio-technical design has come to mean the development of appropriate technical capabilities to fit with social and organisational realities (if senior surgeons in a hospital will not submit to the discipline of a scheduling systems which others maintain, not a lot can be done about it...). This is supported in the literature by, for example, (Walsham 1993), (Avison and Wood-Harper, 1990), (Mumford, 1991), (Kunda and Brooks, 1999). From this departure point the way is clear to develop rational frameworks which can be employed to enable the evaluation of technical options for organisational fit and social acceptability. It also leads to the trend to develop user-friendly systems (including such devices as the *Microsoft Corporation's talking paper clip*) in the hope and anticipation that they will be more easily assimilated into existing working patterns and practices.

An alternative perspective on co-operative system support technology is that systems should be developed (**designed**) to support the tasks and processes that the organisation requires. These tasks and processes are determined by authorities within the organisation and, in the extreme form of this view, the people are the *liveware* which complements the technology in delivering desired outcomes. This view does not necessarily de-value people; indeed, by emphasising flexibility and general transferable capabilities it depends for its effectiveness upon staff who are prepared to be pro-active and develop a portfolio of necessary and adapting skills.

Whichever basic stance is taken, consideration needs to be given to the differing nature of co-operative work tasks. It has been shown that it is possible to develop a 16 fold typology of co-operative tasks based; firstly upon whether division of labour is local or pre-determined and co-operating individuals are of equal or un-equal power and influence; secondly upon location (same or different) and time (synchronous or asynchronous). It has been argued that certain co-operative tasks may benefit by changing their type or by allowing them to approach their *ideal* type more closely. In this context video conferencing is a particularly good example, where a face to face meeting can be effected even though the group members are geographically distributed. In contrast, certain co-operative tasks might be expected to be very resistant to certain type changes and in these cases technology needs to support the task in its original form with updated forms of technology. For example, a personal diary can be co-ordinated with others over the telephone (A3); a suitable network linked electronic personal organiser could do something similar and allow a degree of de-sychronisation of the task as well.

The importance of time and space in understanding CIS has been illustrated by authors ranging from those with a mechanistic view through to those having a contextual and interpretative view. For example, discussions by Mentzas (Mentzas, 1993), Bikson (Bikson, 1996) and Orlikowski (Orlikowski, 1996) have all discussed the effects of technologies in enabling changes to work distribution and organisation in time and space. Clearly, time and space are important aspects of any CIS implementation. Moreover, in the synthetic framework proposed by Sahay, ideas of power relationships, work roles and division of labour over space-time and time-space are described.

A further consideration of changes in the typology of co-operative tasks involves situations where un-blocking of individual contributions can be effected by suitable use of technology and where efficiencies can be gained by allowing individuals to work on their own contribution to the co-operative task without being unduly restricted by social constraints or the need to compete for resources and air-time.

A developed model of co-operative information systems task types is essayed below before proceeding in the next section to discuss a number of broader research findings relating to the emerging information technologies and applications.

		Asynchronous		Synchronous	
	Division of labour	Equal power	Un-equal power	Equal power	Un-equal power
Distributed	**Local**	**A4**	**B4**	**A3**	**B3**
	Pre-determined	**C4**	**D4**	**C3**	**D3**
Co-located	**Local**	**A2**	**B2**	**A1**	**B1**
	Pre-determined	**C2**	**D2**	**C1**	**D1**

Figure 2.13. Co-operative work typology.

2.5.2. Key Themes In CIS Implementation

In different implementations of CIS technologies and groupware we have seen a range of approaches from the highly specific application to fulfil discrete tasks to the highly aspirational approach signalled by the desire to improve knowledge management within an organisation as a whole. Also, interpretative and stages/eras models have stressed the developmental capabilities of CIS with respect to organisational forms, job roles and production. It is now appropriate to draw together the themes which have been explored and to attempt to make some sense of them, in effect to attempt a synthesis.

The *Hidden Essence* in Co-operative Work and Information Systems

In reading the various research papers about CSCW and Groupware, as well as some of the presently emerging work on Intranets, Internets and other forms of inter and intra-organisational communication, there does seem a consensus amongst commentators that effective co-operative information systems can be of benefit by enabling teams of people to work more effectively together. Bannon has noted amongst other points that an important research consideration is the forms of co-operative work and work roles that emerge when CSCW technologies are implemented (Bannon, 1998). The technology enables certain capabilities and what these capabilities are points to the added value of the technology. Thus we can see a co-operative information technology as providing a *potential* through which work-groups are able to better perform the tasks they have, and perhaps, enable them to perform new tasks for which they previously did not possess the capability. In relation to the discussion by Walsham of structuration (Walsham, 1993, pp60-66), we might say that CIS will affect the *modalities* by which social action within organisations is linked to organisational form. So whether workgroups actually exploit the CIS technology seems to be related to the social, political and cultural environment in which they find themselves. This is the broad message confirmed by numerous studies, including Orlikowski, Ciborra, Hassall and Macefield amongst them.

The first main theme then may be characterised as the **emergent** mode in CIS implementation. When the technology is installed the aim is to facilitate a potential within workgroups which will lead to more effective modes of co-operative work between the people within the organisation. Moreover, it is recognised that such emergent capabilities will be constrained by social, political and cultural factors, what might be called normative considerations for the organisation. Normative constraints may be addressed at a number of levels, including at the organisational level and at the individual level, but *emergent* use of new co-operative information technologies cannot be expected to take a single or singular path in all organisations, at all times and in all places.

The Task Space Theme in Co-operative Information Systems

A second theme that is found in many discussions of co-operative information systems and technology emphasises how CIS technologies can change the nature of tasks at a more or less detailed level. The issues around this theme are not easily disentangled from what has been labelled normative in the preceding paragraphs, but the discussion of these issues leads inevitably to discussion (largely) of the technical and instrumental issues that have been presented in the task typology diagram Figure 2.13. Thus we have seen that we can allow for a task being performed **synchronously** or **asynchronously**, being performed by participants in the **same** or **different locations**, by participants of **equal** or **unequal power** within the organisational context and, finally, on the basis of a **pre-determined** division of labour or a **locally determined** one. The extent to which co-operative information systems technologies are able to influence the nature of tasks provides a way in which their instrumental effect upon the work of the organisation can be evaluated.

The task space theme is really the sphere in which discussions and evaluations into the technical development of co-operative information systems technologies can take place. If, for example, a technology is launched which automatically and instantly enables entries within a personal diary to be reflected within a publicly available diary even when the owner is travelling away from their normal place of work, as is very nearly the case in mid 1999 as these words are written, it will enable certain types of use and application which are not easy to accomplish at present to become possible. This will have the effect of increasing flexibility through allowing greater freedom of location for certain co-ordinating tasks; a new technological frontier will have been created.

Design Theme

The final theme which is clear is what has already been described as the *"...business as usual..."* **design** theme. Growing out of the potential of co-operative information technologies is the desire to automate and improve business processes along the lines of earlier IT implementations. As has been clearly seen in some of the studies discussed, most groupware/CSCW products allow the development of applications aimed towards the achievement of explicit functions and benefits. For the moment we note that the more positive results and reactions from implementation of CIS technologies appear to flow from situations in which there was a significant element of design in the process; for example the BusinessLink in Hassall and Macefield (Hassall and Macefield, 1995) and the Software Company in Orlikowski (Orlikowski, 1996).

2.6. A CONCEPTUAL MAP OF CIS EFFECT

The picture of co-operative information systems effect which emerges from the foregoing discussion may be described on a number of levels depending upon whether, firstly, a technical view based upon task organisation is adopted or, secondly, a more global view of the effect on the organisation as a whole. The purpose of this section is to describe a coherent framework within which to set the remainder of the work reported in this thesis. In order to make sense of the various published materials which have been examined it has been useful to consider a small number of themes and issues which are now summarised as:

1. The importance of a hidden essence in co-operative work which may be affected by the nature of CIS implemented.
2. The emergent nature of applications of CIS as users engage with the technological possibilities presented. **(emergent application)**
3. The importance of organisational culture in affecting the nature of the emergent applications of CIS. **(normative culture)**
4. That CIS applications can be designed to meet particular requirements in the same way as more traditional information systems may be designed. **(designed application)**
5. That design for CIS should adopt a socio-technical approach. **(socio-technical design)**
6. That the nature of co-operative business tasks may be influenced by technological capability, particularly in relation to timing, location and division of labour. **(co-operative tasks)**
7. That individual reactions to CIS may include such socio-psychological phenomena as unblocking, free riding, isolation and exclusion depending upon both intrinsic and extrinsic factors. **(individual reactions)**

In selecting a focus for more detailed research into the effect of CIS at the organisational level it seems clear that not all these themes and issues are equally important for consideration; neither are all themes and issues as amenable to study. For example, the area of socio-technical design has received a lot of attention in the IS and IT research community. A number of comments have already been made about socio-technical design and it is clear that its main concern is the effective implementation of technologies within cultural and social constraints. The present research is attempting a more neutral position where the effect of CIS on the organisation as a whole, its working and co-operative production, is of principal interest.

In looking at the overall effect of CIS technologies on an organisation the main themes of relevance are, firstly, the emergence of application of the technology, secondly, the way in which co-operative tasks performed within the organisation are changed by application of the technology. The unit of study is the organisation as a whole including the variety of co-operative tasks and functions performed by individuals within the organisation. In this view the culture of the organisation is a largely independent (environmental or normative) factor which will not be addressed in depth. Similarly, the details of individual responses to the CIS technologies is not a primary focus. In other words, we may be interested in how individuals within a department interact with and use the technology but details of individual experiences will not be primary.

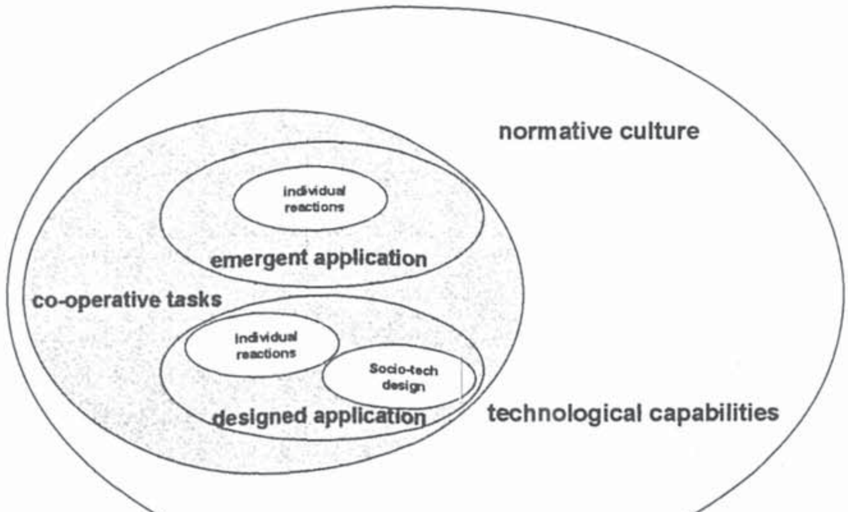


Figure 2.14. Conceptual Map of CIS Effect.

Thus, the diagram shown in Figure 2.14. above is intended to illustrate an interpretation of how CIS technologies affect organisations as follows.

The primary way in which CIS technologies affect organisation is through the changes to the natures and ways of carrying out co-operative business tasks. These tasks may be affected through two main processes which are **emergent application** and **designed application**. In **emergent application** co-operative tasks are affected by the way in which individual users and groups of users exploit the capabilities of the available technology acting under the influences of normative culture and their own individual reactions to the technology. In **designed application** a purposeful exercise is carried out to employ the available technologies to meet a defined business need. As in the case of emergent application the actual effect upon co-operative tasks will be conditioned by normative culture and individual reactions to the technology. However in the case of designed application the possibility of addressing both cultural and individual perspectives through explicit socio-technical design approaches exists.

In seeking to further the research, a path forward then is to define a number of co-operative business tasks and then measure to what extent they are being affected by the CIS technology which has been implemented. If this approach is followed it may be possible to look at both emergent and designed application tasks and the balance between them.

Critique

The conceptual map developed can be criticised in a number of respects including most obviously the focal separation of co-operative tasks into **emergent** application and **designed** application. It may be felt for example that there may be applications of CIS which exhibit a confused combination of designed and emergent features so that it is not easy to determine which tasks are of which type. Two supporting arguments are offered.

Firstly, from the experiences of consultancy, partially documented in the last two case studies above, it seems often the case when talking to managers and professionals who are considering the implementation of CIS that two sorts of objectives are expressed. On the one hand specific business functions and systems are referred to in the context of how the new technology will be effective. On the other hand, broad aspirational statements are made about building *virtual* teams, encouraging flexible working and improving communication. The separation into designed and emergent theme application thus reflects a dichotomy between explicit and aspirational objectives in CIS implementation.

Secondly, the possibilities of quantification and measurement make it essential to determine some classification of elements which may be studied with a degree of rigour. As has already been noted, research on CIS, CSCW and groupware has tended to be concentrated upon qualitative studies of specific cases. Where quantitative studies have been essayed they have tended to consist of fairly high level comparisons of technology across and between industries (e.g. Finnegan and O'Mahoney, 1996). The present work is intended to strike a balance between producing further qualitative study based casework and developing yet further broad survey information. Instead it is intended to develop quantitative measures across an organisation of how CIS has affected co-operative tasks and co-operative production. Classification of co-operative work tasks into elements is justified in terms of building a comprehensible model through which meaningful intra- and ultimately inter- organisational comparisons may be made.

3. DEVELOPING THE RESEARCH

"The one principle, my friend, is to design them so that they give an answer."

Professor David Keilin speaking to C.H.Waddington about experiment design.

The aims of the current research are essentially synthetic, the outcomes which are sought being.

1. To articulate generic ways in which co-operative information systems may be said to affect organisations.
2. To devise a method of evaluating performance of a typical co-operative information system.
3. To trial the evaluation method.
4. To conduct a study within an organisation using the developed evaluation method with the aim of understanding organisational effect of CIS in a live situation.
5. To draw conclusions relating to both the organisational effect of CIS and the usefulness of the evaluation method.

In this context I now discuss the development of the research dealing firstly with issues of methodology and method (section 3.1.), next with evaluation of information systems (section 3.2.) and then with the specific approaches adopted within this work (sections 3.3. through 3.6.).

3.1. METHODOLOGY AND METHOD

3.1.1. Research Approaches and Perspectives

Research methodology in the social sciences and, by extension, within information systems, is an extensive topic for debate aimed at determining how valid knowledge is to be obtained. The debate is often promulgated around various dialectics such as positivist/post-positivist (Baskerville and Wood-Harper, 1996), qualitative/quantitative (Bryman, 1988), (Smith, 1990) and, more all embracing, scientific/interpretivist (Galliers, 1992).

The scientific perspective on research methodology is easily explained in terms of the tradition of research in the natural sciences and an example of a clear discussion of so called *scientific method* is provided by Waddington (Waddington, 1977). The author, who is concerned in the text to discuss how complex problems in management and organisations can be tackled in a rigorous fashion, refers to scientific method as the *"method of strong inference"* subsequently formally described thus.

"strong inference consists of applying the following steps to a problem in science, formally and explicitly and regularly: (1.) devising alternative hypotheses; (2.) devising a crucial experiment (or several of them) with alternative possible outcomes, each of which will, as nearly as possible, exclude one or more of the hypotheses; (3.) carrying out the experiment so as to get a clean result; and recycling the procedure, making sub-hypotheses or sequential hypotheses to define the possibilities that remain; and so on." (Waddington, 1977, p118).

Galliers (Galliers, 1992) refers to this approach as the *"empirical-analytical"* method and discusses limitations which arise from its dependence upon repeatability of observations, reductionism and refutability of hypotheses in the face of social reality which includes;

"the possibility of many different interpretations of social phenomena;

the impact of the social scientist on the social system being studied;

the problems associated with forecasting future events concerned with human ... activity [given the fact that] there will always be a mixture of intended and unintended effects and ... the danger of self-fulfilling prophecies or the opposite." (Galliers, 1992, p148).

A scientific method of research seeks generalisable conclusions and thus places great emphasis upon repeatability and reliability of observations. If observations tending to support a hypothesis are repeatable by different observers at different times and in different circumstances this leads to greater confidence in the hypothesis validity. The principle of reductionism means that the scientific approach will seek to explain phenomena in the simplest possible terms, and to explain gross behaviour of complex systems in terms of the interactions of behaviours of many simpler component parts. A problem with this is that the definition of which component parts to study may, in social systems, prove difficult to agree.

The final point is that the scientific perspective seeks to establish tested hypotheses which are refutable. In other words, if a hypotheses can be disproved by a simple experiment yet the experiment, conducted on a large number of occasions, fails to disprove it, greater confidence can be placed upon the validity of the hypothesis. By contrast, a hypothesis for which it is not possible to design an experiment to disprove generates little confidence.

An extreme position on research would be that only *scientific* research is capable of generating valid knowledge, a position that seems (at least pragmatically) untenable in relation to social reality. The requirement for reliability and repeatability of observation leads to an insistence upon counting and measurement and thence to the illogic that every real phenomenon is assumed to be measurable, so what is measurable must be real and what is not measurable must not be real.

Positivism, the implication that there are *true* descriptions of the world which can be discerned through the process of scientific enquiry, is also sometimes used as a label for the perspective of scientific method. Associated with this position is the assumed value free nature of scientific enquiry which has been challenged most effectively by Kuhn through his now very widely known model of scientific progress (reported in Galliers, 1992, pp 62-71). Kuhn considers scientific progress to proceed via a number of revolutions during which the dominant paradigm, representing an accepted view of what is appropriate science for the field in question, is changed. Implicit in Kuhns work is that the paradigms are social constructions, hence science, in the Kuhnian model, cannot be value free. By extension, value free knowledge is an ideal to which scientists can only aspire.

The demolition of the positivist view of a value free form of enquiry, which seeks objective knowledge, means that the path is now clear for alternative methods of enquiry which recognise that researchers are bound to bring their own interpretations to bear upon observations and events. Before attempting to summarise, a brief discussion is offered of the two broad streams of interpretivist rationality which have been presented in recent years as appropriate approaches to research in information systems and related spheres of social activity.

The first form of enquiry proposed is, essentially, some form of passive observation or data gathering. By passive is meant that no prescriptive structure is sought to the observation, so for example if questions are asked of persons in a particular situation they are generally open in nature and intended merely to prompt a response. All observations, data and responses are recorded exactly as they occur for later analysis, a strong principle of this sort of enquiry being to allow issues and themes to emerge naturally without being forced by any particular hypothesis. In general, forms of enquiry which fit into this category are described as *qualitative* in contrast to *quantitative* (Bryman, 1988), this dichotomy representing a further dialectic in the research methodology debate.

Qualitative researchers often talk about their research being *grounded*, meaning not contaminated by any theory prior to data gathering. A discussion of the details and origin of *grounded theory* will not be attempted but the basic rationale is clear in many writings. This rationale is based upon the desire to capture data and phenomena as nearly as possible in their natural state so that theory can be allowed to emerge uncontaminated by the researchers pre-conceptions (see for example (Gill and Johnson, 1991, p33) and, in the information system field, (Howcroft and Hughes, 1999)). However, every observer must bring prior experiences and prejudices to a situation and selection of the themes and issues which evolve from the research data must therefore be acknowledged to be a subjective interpretation. Moreover, it cannot be assumed that the mere presence of the researcher as social actor will not influence behaviours in any given situation. Indeed, Howcroft and Hughes consider that....

"If it is accepted that Grounded Theory lacks any overarching philosophical perspective ......, then perhaps the qualitative data analysis which proceeds is attributable to the researcher's own mental constructs as opposed to the method itself." (Howcroft and Hughes, 1999, pp136-137).

If the researcher is inevitably going to affect the research situation why not acknowledge this and attempt to deal with it within a suitable methodological framework? The second broad concept in research, particularly relevant for information systems research, has been the *action research* rationale. Many authors and researchers have seen action research as suitable for information systems research projects, for example (Baskerville and Wood-Harper, 1996) consider that in the ideal process of action research...

'the type of learning created by action research represents enhanced understanding of a complex problem. The researcher obtains information about a particular situation and a particular environment. This then, gives a contingent value to the truth learned. The researcher expects, however, to generate knowledge which will further enhance the development of models and theories. The aim is the understanding of the complex human process rather than a universal prescriptive truth." (Baskerville and Wood-Harper, 1996, p239).

The action research agenda in information systems has been greatly influenced by the soft systems methodology developed by Checkland and others (Checkland, 1981), (Checkland and Scholes, 1990). An observation is that many research papers which are presented often seem to have an implicit action research theme in that the author has clearly been involved in some form of collaborative exercise. This is particularly the case where implementation of new technologies is concerned and may be noted in relation to some of the cases discussed in Chapter 2, for example (Goldberg, Safran, Shapiro, 1992), (Kingston and Hassall, 1995), (Bikson, 1996). Action research emphasises the importance of the researcher as an *involved actor* seeking to improve a problem situation and valid research findings are achieved through *learning* within the situation. This can be seen as a common sense view of research and is supported by a number of authors as a valid way of proceeding in a real world situation. For example, Checkland and Scholes regard the Soft Systems Methodology (SSM) as an appropriate framework in which to perform action research and obtain improvements within a situation.

"SSM is a structured way of thinking which focuses on some real-world situation perceived as problematical. The aim is always to bring about what will be seen as improvements in the situation, and this is true whether or not the work done is part of normal day-to-day managerial work (defining "managerial" in the broad sense ....) or a special highlighted study." (Checkland and Scholes, 1990, p286).

So, in this case Checkland and Scholes have moved a long way from the ideal, value free, scientific research paradigm to a position where, as is made clear elsewhere in their text, the framework for thinking about the actions and experiences is what legitemises the outcomes of the research. Moreover, the action researcher cannot be neutral and, indeed, has a responsibility to advance the situation in a beneficial way.

'the action research approach ....is included as a separate approach in view of its underlying philosophy which sets it apart from (these) scientific approaches .... This relates to the fact that the action researcher knows that their very presence will affect the situation they are researching. Indeed, their role is to actively associate themselves with the practical outcomes of the research in addition to seeking to identify theoretical outcomes." (Galliers, 1992, pp 157.)

So, in action research the researcher seeks to influence the situation and to extract valid theoretical insights by seeking to place the learning experience within an appropriate framework.

3.1.2. Utility of Approaches

Within the broad rationales described above a range of possible research approaches, methods and instruments become applicable. Galliers summarises the main ones applicable to information systems research in the following table (Galliers, 1992).

Information systems research approaches in the context of the scientific and interpretivist philosophies.

Scientific	**Interpretivist**
Laboratory experiments	Subjective/argumentative
Field experiments	Reviews
Surveys	Action research
Case studies	Descriptive/interpretive
Theorem proof	
Forecasting	Futures research
Simulation	Role/game playing

Figure 3.1. IS research approaches, (Galliers, 1992, p149).

A useful discussion is also offered by Galliers into the relative strengths and weaknesses of the various approaches and these are quoted below for surveys, case studies and action research respectively.

Approach	Strengths	Weaknesses
Surveys	Greater number of variables may be studied than in the case of experimental approaches. Description of real world situations. More easy/ appropriate generalizations.	Likely that little insight obtained re. the causes/processes behind the phenomena being studied. Possible bias in respondents (cf. self-selecting nature of questionnaire respondents); the researcher, and the moment in time which the research is undertaken.
Case Studies	Capturing "reality" in greater detail and analysing more variables than is possible using any of the above approaches.	Restriction to a single event/ organization. Difficulty in generalizing, given problems of acquiring similar data from a statistically meaningful number of cases. Lack of control of variables. Different interpretations of events by individual researchers/ stakeholders.
Action Research	Practical as well as theoretical outcomes most often aimed at emancipatory outcomes. Biases of researcher made known.	Similar to case study research, but additionally places a considerable responsibility on the researcher when objectives are at odds with other groupings. The ethics of the particular research are a key issue.

Figure 3.2. Approaches, Strengths and Weaknesses, (Galliers, 1992, p149, Table 8.2.).

In view of the discussion reported above it is perhaps surprising that Galliers considers case studies to be in the scientific tradition of research. However, this undoubtedly stems from the basic point of view that factual knowledge can be obtained about particular organisations and cases. However, as noted under the weaknesses of case studies, it can be difficult not to contaminate facts with interpretation. All this leads to the suspicion that different commentators have different views about what a case study consists of. In the article entitled *The case study: a useful research method for information management* (Smith, 1990), the author emphasises that the use of case studies is an interpretivist approach in contrast to more positivist approaches. Because information management and information systems interact so intimately with organisational and human factors, more interpretivist (sociologically aware) methods are to be welcomed.

3.1.3. Summary of Approaches

This brief discussion of research methodology has discerned three main rationales. Firstly there is a scientific/positivist rationale which seeks to obtain generalisable knowledge though repeatable and reliable observation or experiments aimed at proving (or, if preferred, successively failing to disprove) clear hypotheses.

Secondly, there is a broadly interpretivist rationale which attempts to maintain a degree of distance between the researcher and the subject of enquiry. In this rationale, data can be gathered in a way that, as nearly as possible, renders the effect of the researcher neutral to the behaviours of the situations or systems under consideration. Interpretation of the data in terms of theory building and subsequent knowledge construction is acknowledged to be influenced by the experiences and proclivities of the individual researcher but checks and balances can be built in to reduce the possibilities for dubious conclusions. A common approach is to use some form of interpretative rationale to generate theories which can then be tested using something approaching a scientific rationale, for example a survey.

Finally, and in many ways most interestingly, there is the action research rationale in which no attempt is made to separate the researcher from the subject of the research; indeed, active involvement by the researcher is seen as being appropriate and necessary. Theories, knowledge and insights gained in action research can only have validity through being analysed and presented via the process of an appropriate framework, the most well known of which in the information systems sphere is Soft Systems Methodology. Using this approach the framework adopted is, in some ways, merely a narrative device, intended to make sense out of the researchers experiences and allow the learning generated to be easily communicated to a wider community.

3.1.4. The Present Research

The present research has proceeded based upon three main activities, two of which have been run in parallel to generate a research instrument which has then been applied to a longitudinal study within a single organisation as the third activity.

The first activity (Activity 1) has been to include a literature search including published case studies, together with some insights from consultancy and action research opportunities within a broad learning theme with the aim of developing theoretical insights and supports for the second activity. The organising principle for this activity has been based upon the literature review, thus case study material has been interpreted in the light of previous commentators together with the researchers own developing ideas and frames, rather than attempting any *grounded* theory building.

The second activity (Activity 2) has been to construct a coherent method which may be employed to measure the effect of co-operative information systems across an organisation at various stages of its development. The aim is that this model can be made computable so that meaningful comparisons can be made within and between different organisations. The approach has been to develop an understanding of co-operative information systems effect based upon published materials, case studies and theoretical perspectives, leading to development of data collection using a questionnaire, together with associated formulae and analysis methods.

The final activity (Activity 3) consists of a series of three surveys conducted using the research instrument in a single organisation, Northamptonshire County Council, between the last quarter of 1996 and the last quarter of 1998. This longitudinal study has permitted refinement of the instrument at the same time as allowing various inter-departmental, intra-organisational and temporal comparisons.

The research thus contains elements of a researcher centered (rather than grounded) interpretative rationale with reference to the literature and published case study reviews, an action research rationale relating to the unpublished case discussed already in Chapter 2 and a scientific rationale in attempting to develop and apply a model to the evaluation of co-operative information systems effect. Such a multiple approach seems to reflect the nature of the information systems and management field with its strong technical elements together with the often referred to socio-technical practicalities.

3.2. INFORMATION SYSTEMS EVALUATION

3.2.1. Evaluation Introduction

Evaluating the applications of information technology (IT) to the automation of business tasks may involve one of two main approaches characterised as *before the event* and *after the event*. Thus, before selecting and implementing the technology it is possible to evaluate its functions and features against what is required by the business and after implementation it is possible to review the performance benefits gained from the investment. A lot of published material discusses methods of IT evaluation both before and after implementation and, in the context of the present work *Measuring the Value of Information Technology* (Hares and Royle, 1994) is a good departure point. Hares and Royle discuss a number of methods and frameworks based upon mainstream practice for evaluating the cost-benefits of IT investments as well as matching them to requirements. Both tangible and intangible aspects of evaluation are extensively dealt with. Implicitly in the approach to less tangible aspects of evaluation the authors identify the use of scoring models for both system selection and evaluation. The scoring is against criteria to be established when the purpose of the evaluation has been determined and (implicitly) this is assumed to be a largely objective process.

A measurement or criteria based approach to evaluation of information systems presents some problems so that a number of commentators consider that broader views need to be taken. Evaluation is also discussed in some detail by Walsham, already cited, where he is mainly concerned to advocate an interpretative approach to evaluation (Walsham 1993). In discussing the practice of evaluation Walsham focuses upon three main areas, purpose, context and process. He makes the contrast between *technical/quantitative* data which are normally linked to what he calls *criteria* and important interpretative perspectives where the vocabulary shifts away from criteria to *concerns*, *issues* and *values* (Walsham, 1993, pp180-182).

It is however difficult to escape the importance of quantitative concerns where evaluation is concerned and the type of difficulties which need to be overcome in attempting to move away from a criteria/quantification model is well illustrated by the text *Achieving maximum value from information systems* (Remenyi, Sherwood-Smith and White, 1997). In this text the authors develop what is termed a *process approach* to evaluation which is, in its essentials, an iterative scheme of activities carried out by the active participation of various groups of stakeholders. The departure point for the evolution of a *"continuous participative evaluation process"* or, *"active benefits realisation"* is the perceived need for a *"post-modern approach"* to information systems and IT.

"the post-modernist concept as it is applied to information systems development concentrates on a number of issues, one of the most important being what is described later in this book as the contingent mind-set to systems development. In simple terms this means that information systems goal-posts may change and developers need to be prepared for this. A programme of continuous participative evaluation is introduced to manage the changes and to ensure that goal-post changes are recognised as early as possible and that disruption resulting from changes is minimised. This results in a strong preference for phased delivery of information systems. (Remenyi, Sherwood-Smith and White, 1997, p5).

The themes that emerge from this are those of participation, iteration and contingency. With these concerns the process approach developed seems sensible in that moving continually around the cycle of evaluation is, indeed, likely to make it easier to sense changes in the positions of the goal-posts. However, it is not easy to see how this can be characterised as a "post-modern" approach to evaluation, although it could be regarded as post-positivist, or possibly, pluralist. Remenyi, Sherwood-Smith and White set out to address shortcomings in conventional criteria based evaluation schemes but the later chapters of their text are replete with references to objective quantifiable factors. For example, the production of *"project pictures"* (Remenyi et al, pp189-193), includes *"Project activities..", "Forthcoming bottlenecks identified..", "Percentage of job finished by time, cost and specification..".*

So, a view of evaluation is that it should be quantitative and related to some defined criteria (or factors). And, in terms of CIS, it is proposed that the criteria may be linked to co-operative task completion in appropriate contexts.

3.2.2. Use of Scoring Models

The principle of multi-attribute (or multi-factor) scoring models employed for evaluation and decision making in a variety of applications is well developed in the literature. Implemented approaches vary but with typical characteristics as described in for example Finlay (1994) and, notably in relation to the current research, Leung (1980), and Kahraman and Tolga (1996). In all such approaches certain generic features may be noted; various factors chosen to reflect required performance are defined against which options or implemented systems are scored, the factors being weighted according to their assumed importance to the decision or evaluation. When evaluating IT for organisational fit for example, the factors are weighted to reflect requirements relating to organisational characteristics as well as usefulness in matching business requirements.

When following specific examples of the general approach, the development of the factors, their justification and weighting and the measurements of competing projects and existing IT investments against them can become complex and reach far beyond any simple cost benefit analysis or audit (Hochstrasser, 1992). Moreover the main focus of evaluation will vary depending upon the particular interests of the evaluation which may take a variety of possible approaches depending upon which situational and user characteristics are deemed important (Galliers, Merali and Spearing, 1994), (Clegg, Carey, Dean, Hornby and Bolden, 1997). However, whatever the factors selected the fundamental model underlying any scoring approach commonly consists of a form such that the total performance of the system, option or investment being evaluated can be expressed across n factors (a) weighted (w) so as to reflect their relative importance. The performance of a particular system may therefore be expressed as a vector representing some relationship to the total fit to organisational requirements. In effect for system i scores s_i are assigned to yield a performance P_i as a vector of the form:

$$P_i = (a_1w_1s_{i1},\ a_2w_2s_{i2}, \ldots a_nw_ns_{in})$$

Having developed this form of representation it is possible to compare the performance vector against the desired level of performance, perhaps to some idealised implementation where the scores are all maximised (100% or 1.0); represented by the vector;

$$(a_1w_1,\ a_2w_2, \ldots a_nw_n)$$

And, assuming the factors (a's) are not differentiable, the result is that the weights (w) reflect the importance to the organisation of each element of the vector so that poor performance against one factor can be compensated for by higher performance against another. In this situation the target vector reduces further to;

$$T = (w_1,\ w_2, \ldots w_n)$$

Measures of fit to organisational requirements can be evaluated from these vectors using two strategies. Firstly, the overall fit can be evaluated as the sum of the differences between weighted scores (the P_i vector for option i) and the ideal maximum represented by the corresponding elements in the T vector. Thus; Measure of fit FD_i is evaluated;

$FD_i = \Sigma_{j=1,n}w_j(1-s_{ij})$.. where overall $FD_i = 0$ is perfect fit to organisational requirements.

Secondly, fit can be construed as a ratio of the total scores in P_i to the total in the target vector such that; Measure of fit FR_i is evaluated;

$FR_i = \Sigma_{(j=1,n)} s_{ij} w_j / (\Sigma_{(j=1,n)} w_j)$ where $FR_i = 1$ (100%) is perfect fit.

3.2.3. Some limitations of Multi-Factor Scoring

The approaches discussed in the previous section have considerable value when used for IT applications where benefits can be linked to a set of business requirements or functions which can, in turn, be unambiguously expressed. In such cases it can be sensible to score systems in terms of their ability to fulfil these requirements and functions (perhaps for example the ability to perform some processing task within certain time or resource constraints). However over the last few years, a variety of information technologies, including CIS, are being implemented by organisations where the business requirements (or objectives) are often expressed in aspirational language such as; group facilitation, decision support system, team and task management, informal communication and work-flow support (Goldberg, Safran and Shapiro, 1992) (Clegg, Waterson and Carey, 1994), (Finnegan and O'Mahony, 1996).

Certainly, it has been argued, emergent and aspirational targets are present in most CIS implementations where an important aim of such systems is to support group mediated processes within organisations. This statement seems both *soft* and aspirational; and it is not immediately clear how value might be ascribed to particular technologies (Bannon and Schmidt, 1992), (Rudy, 1996). More recently, the use of internet, intranet and related networking technologies has tended to move away from a model capable of linking discrete business processes to particular information technologies (Blackler, 1994), (Jones, 1991), (Borman, 1994).

A way of thinking about such systems may be to consider the extent to which use of the technology is, at the one extreme a necessary process and at the other extreme a more or less voluntary one, the two extremes being represented by;

> **A transaction based system such as a sales ledger or order processing system.** In this case the functions to be performed by the users are totally prescribed by organisational necessities. If the users of the system are not employing the system to do their jobs then their jobs are not being done.
>
> **A CIS such as perhaps policy formulation or planning**. In this case the choice of whether to employ a particular technological capability lies much more with the (potential) user. They could use Electronic Mail or some form of Video Conferencing system, they could equally exchange paper memoranda or work using a whiteboard in a meeting room.

Some of this could undoubtedly be reflected using a weighted factor model of evaluation similar to that described earlier, except that both the weighting process and the scoring will present some difficulty. In particular, because the use of the technology may be contingent upon all sorts of variables present within the organisational context, assigning precise weights to the selected factors may be misleading. It is therefore suggested that some allowance should be made for **fuzziness** in the definition of factors as well as the scoring in order to evaluate the organisational fit of the systems under discussion.

3.3. EVALUATION OF CIS - TASK MODEL

3.3.1. Basic Model and Approach

A developing rationale of the current research has been the thesis that the effect of co-operative information systems within organisations will exhibit both a **design** theme and an **emergent** theme in application. The conceptual map developed towards the end of chapter 2 may be referred to again in order to identify and discuss the elements of an appropriate model to underpin measurement of CIS effect upon an organisation.

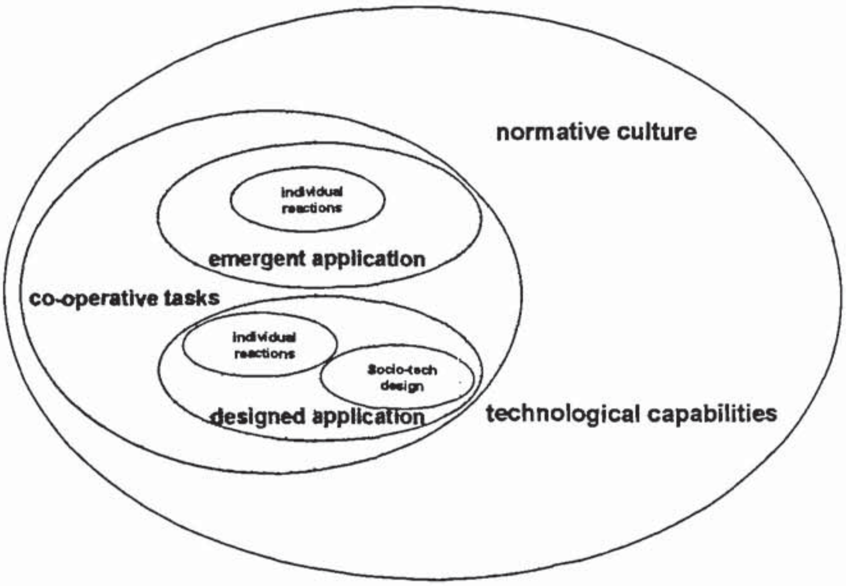


Figure 3.3. Conceptual Map of CIS Effect, (copy of Figure 2.14.).

The proposed measuring instrument will consist, firstly, of a series of appropriately defined co-operative business tasks which can be grouped into those where the technology offers a **designed application** solution and those where an **emergent application** solution is required. Secondly, a way of measuring the use of the technology to fulfil the defined co-operative business tasks will be required.

Definition of the business tasks will be dependent upon the organisational context and, as argued elsewhere (Hassall, 1998), the aspirations of the managers who seek to implement the technology. It will also depend upon the design features of the technology, which may offer support to particular business tasks.

Measurement of the impact of the co-operative information systems technology upon particular business tasks could potentially be addressed in a number of ways.

1. **Passive Observation:** Users employment of the CIS over a period of time could be observed with a view to developing reasonably accurate measurements of how they spent their time and whether the technology was being used to support particular business tasks.

2. **Active Recording by Users:** Users could be asked to record their actual use of the CIS including information on the co-operative business tasks that they were performing.

3. **Automatic Recording within the System:** The system might be set up to in some way automatically record the use made of it.

4. **Field Experiment:** A suitable experimental scenario could be developed for each or a number of co-operative tasks to test the use of the CIS to support these tasks.

5. **Survey:** A sample survey could be used to derive users judgements of the usefulness of the CIS for particular co-operative business tasks.

All of these methods have benefits and drawbacks.

Passive recording has the advantage that it offers the potential to gain qualitative insights into actual use of the technology on the ground which might otherwise not be available. A key disadvantage however is the possibility of the observer becoming intrusive within the work situation. Also, this method may be expected to be very labour intensive leading to limited coverage within the organisation.

Active recording is, in principle, good, but involves considerable commitment on behalf of the organisation if a large coverage is to be achieved. It is also intrusive into working practices and subject to distortions where different people adopt differing strategies for completing the record (for example, in the extreme, some people complete the record as they go along, others write it all down from memory at the end of the day).

Automatic recording within the system seems an ideal method offering the potential for 100% coverage but does not offer any easy way of gathering key information extrinsic to the technical tasks being performed. In other words, we know what functions of the system are being used but not (easily?) what they are being used for. This might be expected to be quite good for the design theme applications but very little use for monitoring the emergent theme applications. An ethical consideration is that monitoring of use of the system may be seen by users as a form of covert surveillance, and, by contrast, if users are made fully aware of the monitoring it may affect their use of the technology.

Field experiment is an intriguing possibility and offers the potential to determine the validity of various hypotheses. For example, we could test the use made by individuals for communicating certain information by ensuring that information was only available via the CIS; thus persons not aware of it within a certain period of time would clearly not be using the system for this purpose. The difficulty with this sort of approach is that it may be much more effective for studying passive use of the system (receiving information say..) than active use. Studying active use would mean monitoring the choices that people make when deciding to apply particular means to carry out a co-operative task which would mean generation of a scenario where it might be difficult to avoid alerting staff and influencing their behaviour. Field experiments in general also carry ethical/practical considerations with them; to what extent can it be justified to observe behaviours without informing those observed and gaining their permission.

Surveys offer the prospect of a wide coverage with relatively efficient application of resources. They are also free from the possible problems of users being requested to record actual activity as it happens. Because they are conducted in an overt manner they are free of the ethical difficulties of certain experiments and other types of observations. A difficulty is that the respondents to a survey may be self selecting, leading to the need to be sure that an appropriate sample size which is representative of the population has been achieved. Finally, they may be subject to distortions due to incorrect judgement by respondents, misunderstandings by respondents or (potentially) deliberately optimistic or pessimistic responses.

On balance, in attempting to derive meaningful measures of how CIS is affecting co-operative business tasks across an organisation, a survey instrument offers a variety of advantages including:

- Potential for wide coverage
- It is a overt data collection method
- It is likely to be efficient in resources
- If properly constructed it is unlikely to influence the behaviours being studied
- It offers the potential to gather further qualitative data alongside the quantitative results

The key factors in success of the survey approach therefore will be:

- Identification of appropriate co-operative business task and specification of a suitable measurement scale
- Obtaining a sufficient sample size

- Interpretation of the results within an appropriate framework
- Being sensitive to the possibilities for distortion due to misreporting

The use of survey instruments to examine various measures and perspectives of IST effectiveness is reported by a number of workers. In *Service quality and correspondence analysis in determining problems with the effective use of computer services (Remenyi and Money, 1993)* a study within one organisation on user perceptions of the *service gap* is reported. This research asked users of the organisations network systems to make two judgements, firstly their expectations of 25 aspects of services provision and secondly their opinion of the performance of the information systems department in delivering against these. The service gap was measured by consideration of the mean responses for the 25 attributes. Qualitative data was also collected in the form of comments and criticisms and analysed using content analysis to produce a frequency table of commonly mentioned issues and correspondence analysis to explore the relationships between these responses. Using this form of analysis, the researchers were able to identify groups of users with similar concerns and issues. After drawing a number of conclusions form the specific data, Remenyi and Money comment on the convenience of this method of data collection for measuring IT effectiveness, also that the combination of service quality gap measurements and correspondence analysis of qualitative returns offers complementary ways of measuring strengths and weaknesses in computer services and are relatively easy to use. A similar approach is adopted in the case of *Measuring the Effectiveness of Information Technology Management: a comparative study of six UK local authorities* (Worrall, Remenyi and Money, 1998). In this case inter-organisational as well as intra organisational data are gathered and the gap between the importance of factors in IT management and perceived performance within the respective organisation is measured across 38 factors for each of 6 local authorities. Both of these studies may be taken as prior examples of the use of a survey approach to measure effectiveness in relation to ICT based upon opinions/judgements of respondents. Moreover, in both cases, the reference levels for service/effectiveness are made explicit within the survey instrument.

Another example of a survey instrument designed to elicit *judgements* on information management and ICT issues at an organisational and cross organisational level is *Coping with information technology? How British executives perceive the key information systems management issue sin the mod- 90s* (Galliers, Merali and Spearing, 1994). This research is interpreted longitudinally with respect to an earlier survey in 1987 and asked respondents to judge the importance of a range of issues in 1992 (when the survey was carried out) and what they thought the importance of the same issues *would be* in 1997. The aim of the research was to try to understand how concerns and issues were developing over time.

The objective of the survey questionnaire for the current research then will be to ask respondents to judge, for a range of business tasks, how useful the CIS technology is. These judgements will be made on an ordinal scale, each point on which will be given a referent statement. The possibility of misreporting through over of under-optimism will be minimised by encouraging an honest appraisal of usefulness through focussing the questions on the technology rather than the individual. In other words, rather than asking a question that implies a measure of how the individual is performing we aim to ask one which clearly indicates that the technology is the focus of interest. In this way respondents are less likely to overstate their use of the CIS.

3.4. FUZZY ANALYSIS OF QUESTIONNAIRE RESPONSES

The desire to develop a computable model based upon judgements made by various individuals expressed within an ordinal/interval scale leads to the consideration of some principles developed in fuzzy set theory and fuzzy arithmetic.

3.4.1. Questionnaire Data

Ordinal or interval scales of various sorts are quite frequently employed to derive judgements from a sample population so that for example respondents may be asked to judge whether they agree with a particular statement such as..

"the information systems is ..."

1. Essential
2. Very useful
3. Of some use
4. Of little use
5. Of no use

The treatment of the results of such a survey must be dependent upon the meaning which is ascribed to the scale and the degree of statistical rigor which it is desired to apply. Pervan and Class in *The Use and Misuse of Statistical Methods in Information Systems Research* (Pervan and Class, 1992) address this important issue by means of a discussion of various applications of these types of scales. Pervan and Class discuss three sorts of scale, Nominal, Ordinal and Interval.

Nominal scales are simply lists of mutually exclusive categories. So, for example, if the answer to a question is a simple *yes* or *no* this is a nominal scale.

Ordinal scales imply a ranking of various alternatives, thus in the example above, *Very useful* implies a higher value than *Of some use*. The relative position in a ordinal scale is important but there is no implication that *Very useful* is in some precisely measurable degree greater than *Of some use*.

By contrast with an ordinal scale a true interval scale implies a definite interval between the various points on the scale. In this case, applying to the example, we would have to be able to assert that the "distance" between *Very useful* and *Of some use* was in some precise way equal to that between *Of some use* and *Of little use*, for example.

Pervan and Class point out that there is a frequent confusion of ordinal scales with true interval scales depending upon the use to which the scale is being put. In particular in certain uses of ordinal scales for example;

'the rating of a characteristic ; This use is the most controversial because it interprets ordinal measure with interval characteristics as well. Here the researcher assigns numbers to reflect relative ratings of a series of statements, then uses these numbers to interpret relative differences." (Pervan and Class, 1992, p212).

This is a very easy error to fall in to when numbers are derived from survey data. In fact the ability to apply meaningful statistical tests to survey results is dependent upon the nature of the scales used to derive the results. Strictly, as Pervan and Class illustrate, the valid use of (simple) statistical tests on an ordinal scale is limited to a Kolmogorov-Smirnov test that the distribution of results matches some expected value. Chi-square can be conducted on an nominal scale for the same purposes but use of t-test or other tests based upon the Normal distribution can only be used where an interval scale is being employed (implying an underlying continuous random variable).

So, in the case of the judgements of usage of co-operative information systems technologies discussed in the preceding section, we are (strictly) limited in terms of the statistical analysis of results if we proceed with what is essentially an ordinal scale.

3.4.2. Fuzzy analysis of Questionnaire Data

A different perspective and a way of analysing ordinal and interval scales produced from survey questionnaires may be developed through consideration of various principles of fuzzy logic, fuzzy set theory and fuzzy arithmetic linked to the idea of *linguistic variables*. An introduction to the topics of fuzzy set theory and fuzzy arithmetic is included in *Fuzzy Sets, Fuzzy Logic, Fuzzy Methods - with Applications* (Bademar and Gottwald, 1995) and much of the following discussion is derived from this text.

A *fuzzy* set is defined by comparison with a *crisp* set as one where the membership function for the set can return a fractional value rather than the more usual 0 (definitely not a member of the set) or 1 (definitely a member of the set). If, for example, the value of the membership function is considered to represent some measure of the *"grade of membership"* (Krause and Clark, 1993, p120) of a particular hypothesis, it may be treated as a way of looking at the world which reflects judgements, such as "High Temperature" which are imprecise or vague. Various persons may judge "High Temperature" , or (another frequently used example) "Middle Age" in different ways, so that any particular temperature or age may be assigned a degree of membership of the concept. Krause and Clark offer a definition for a fuzzy set (after Zadeh (1965), who developed much of the basic theory of fuzzy sets and fuzzy logic).

"Let Ω be a frame of discernment (set of all possible values x for an attribute). Then a fuzzy set A Ω is characterised by a membership function U_A: $\Omega \rightarrow [0,1]$. The value $U_A(x)$ for x ε: Ω represents the "grade of membership" of x in A. The characteristic function U_A can be thought of as a measure of the degree of compatibility of x with the concept A." (Krause and Clark, 1993, p120).

An important point to note at this stage is that in defining an ordinal scale we have implicitly established a set of imprecise (or vague) referents which may represent concepts to which varying degrees of membership may be assigned Thus, when a respondent makes a judgement that "the information systems is .... *Of little use*" they are doing something similar to judging that the "temperature is high". So we can take as a possible departure point that our scale can be said to represent a group of possible concepts (or indeed hypotheses) and that the particular instance under consideration may belong in varying degrees to any or all of them. In practice however, because the scale is linguistically *constructed* to be ordinal, a stronger degree of compatibility with for example the *Very useful* hypothesis than the with the *Of some use* hypothesis will, quite logically, imply an even lower degree of compatibility with the *Of little use* hypothesis.

The concept and definition of a fuzzy set leads on quite naturally to that of a fuzzy number which is spread-out, or vaguely defined version of an ordinary number. So, for example, we could consider a region around the number 3 as representing the fuzzy concept of *3 ness*. As we move away from 3 in the negative direction we will eventually reach a value which has no grade (or *degree*) of *3 ness* associated with it, similarly in the positive direction.

Where precisely the upper and lower bounds of *3 ness* lie, and what shape the membership function takes will depend upon the application being attempted but, in practice, we might wish to adopt a representation which will enable meaningful calculations to be made upon our numbers. Bademar and Gottwald discuss a range of possibilities including trapezoidal numbers, where the value of the membership function rises steadily from some minimum to reach a plateau of 1.0 then declines steadily to 0 again (Bademar and Gottwald, 1995, p56). Of more immediate potential use are so-called triangular fuzzy numbers which can be defined by three values; a minimum at which the membership function is 0, a kernel at which it is 1.0 and an maximum at which it returns to 0.

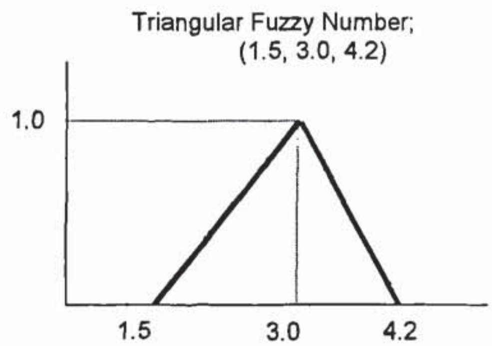


Figure 3.4. Triangular Fuzzy Number.

Arithmetic may be defined for such numbers as described below.

For triangular fuzzy number A (TFN A) having minimum value A1, kernel value A2 and maximum value A3 we write the number as (A1. A2, A3).

Let TFN A := (A1, A2, A3)

Let TFN B := (B1, B2, B3)

The sum of A and B is (A1+B1, A2+B2, A3+B3)

The difference of A and B is (A1-B3, A2-B2, A3-B1)

The sum and differences of TFNs are thus linear operations which yield other TFNs but products and quotients need not necessarily do so. Nonetheless, approximation of sums and quotients to TFNs is in practice desirable and Bademar and Gottwald report the following approximations for these operations which hold for positive TFNs.

The approximate product of A and B is (A1xB1, A2xB2, A3xB3)..... and the approximate quotient (A/B) is (A1/B3, A2/B2, A3/B1) for A1 and B1 greater than or equal to 0 (in which case A2, B2, A3 and B3 are, by definition greater than 0 and the whole fuzzy interval lies in the range >= 0 (Bademar and Gottwald, 1995, pp56).

In terms of evaluating a judgement, or a value that has a certain vagueness associated with it, fuzzy numbers have some attractiveness and the nature of computation with imprecise values is dealt with extensively in *Representing Uncertain Knowledge* (Krause and Clark, 1993). Krause and Clark characterise the fuzzy interval defined by a particular fuzzy number as a *possibility* space, with the point at which the membership function becomes 1.0, the kernel for example of a TFN, representing a value that *necessarily* matches the concept or hypothesis being evaluated. What is becoming clear is that there can be some mapping between a value on a scale and the linguistic conventions of an ordinal/interval scale. Thus, rather than making the intervals explicitly equal because based upon some underlying physical and continuous quantity, we set them as equal by definition and then seek to interpret the results in terms of the numbers that emerge. To put it another way, and referring back to the earlier example, we assign *Essential* the value 1 and *Of no use* the value of 5 by definition.

The next step is to develop a treatment of the results of the respondent scores of such a questionnaire which recognises the inherently imprecise nature of the judgements being made. Specifically, if the results *from* the respondent scores can be represented as triangular fuzzy numbers it should be possible to gain some intuitive understanding of the smeared out nature of such judgements, for example;

1. The closer together are the three numbers which define the score, the more consistent is the judgement being made by the respondents: this is rather like variance using traditional measures.
2. The shape of the triangular profile for a score could be used to distinguish judgements of minimum and maximum performance which may be indicative of relative optimism and pessimism.
3. Differences in the scores for particular groups of respondents might be presented in a way that indicates "overlap" in a useful way.
4. The scores might be used to develop a visualisation of the soft or judgemental aspects of evaluation.

Two formulations are now developed.

3.4.3. Formulation 1 - Triangular Fuzzy Numbers

Firstly we note that respondents have to choose between a series of statements on the ordinal/interval scale which one they judge most appropriate and it is argued that the choice of score is, in effect, a judgement between 3 indicator statements. Thus, as an example, respondents scores for whether a particular technology is employed may be recorded on the following scale.

1. Never employed
2. Seldom employed
3. Sometimes employed
4. Frequently employed
5. Almost always employed
6. Indispensable to task

In this interpretation, a respondent who judges 4 to be the appropriate score makes a constrained choice in the range where 3 is the minimum value and 5 the maximum. (To think of it another way, the respondent must consider which of the three hypotheses, *Sometimes employed*, *Frequently employed* and *Almost always employed* best represents their judgement of the situation.)

In the method of extracting fuzzy scores the score 4 corresponds to a triangular fuzzy number (3,4,5). Similarly, score 5 corresponds to (4,5,6), and so on. The full scoring correspondence is taken to be as follows.

1 = TFN (1,1,2)

2 = TFN (1,2,3)

3 = TFN (2,3,4)

4 = TFN (3,4,5)

5 = TFN (4,5,6)

6 = TFN (5,6,6)

The two extreme scores reflect the fact that the respondent is constrained within the range and cannot for example award a score of 7 or (say) 0.5.

With a results table of the following form

						Total respondents 45
Scores	**1**	**2**	**3**	**4**	**5**	**6**
Frequencies	7	5	11	12	7	3

Figure 3.5. Sample Frequency Table.

Taking the average weighted score for each TFN representing the appropriate score yields the TFN (2.51,3.36,4.29) when carried out with appropriate attention to arithmetic rules for TFNs thus;

((1,1,2)x7+(1,2,3)x5+(2,3,4)x11+(3,4,5)x12+(4,5,6)x7+(5,6,6)x3)/45 = (2.51,3.36,4.29)

It should be noted that, in this formulation, the kernel value is identical to the weighted average (or mean) score recorded.

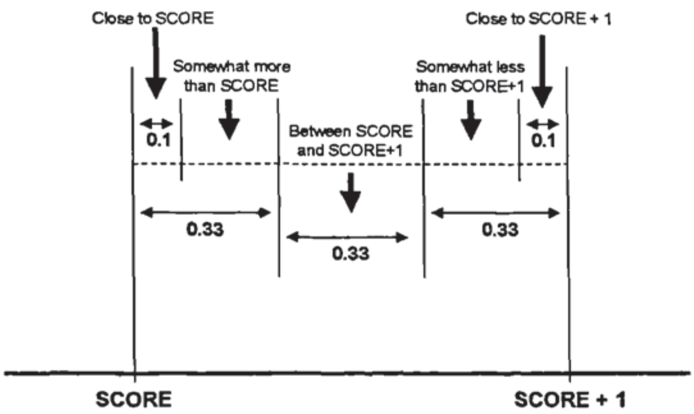
Using the average of weighted triangular scores in the way described means that, for scores which do not lie at the extremes of the scale (1,1,2 and 5,6,6), the "width" (distance between Min and Max) will always be 2. Thus the weighted averages for such scores will always be of width 2. Where scores of (1,2,2) and (5,6,6) do exist they will have the effect of *reducing* the width of the fuzzy interval represented in the overall average score derived and this in turn means that it is not possible to use this formulation for the purposes suggested in points 1 and 2 on (p110). That is, the shape of the triangular score can say nothing about the consistency of judgements or the relative optimisim or pessimism of respondents. However, triangular scores derived in this way can be employed to address purposes 3 and 4, evaluation of overlaps in judgements and helping to visualise the fuzzy judgemental space.

Having derived the TFN this can be interpreted with reference to the original ordinal/interval scale. For example it can be noted that the kernel value is "somewhat better than sometimes employed" and that this may be taken as the "most likely" value within the fuzzy interval.

In the formulation just discussed, understanding of the interpretation to be put upon the fuzzy triangular numbers derived is bound to be dependent upon prior experience and a degree of familiarity with the concepts. In some senses TFNs, because they present a rather clean model of a fuzzy interval, may not allow the person interpreting the results sufficient feel for the fuzziness of the linguistic space in which a judgement is being made. In these circumstances a variety of visual presentations may be preferable and a number of possibilities are offered.

3.4.4. Fuzzy Triangular Numbers Interpretation

Because of the underlying linguistic nature of the ordinal/interval scale we can potentially provide a direct interpretation of the triangular fuzzy score by mapping against the scale in a way that takes into account the linguistic values assigned to each point. The basic idea is illustrated in the diagram below.



Interpretation on linguistic scale based upon Fuzzy Score

Figure 3.6. Fuzzy Triangular Number Interpretation.

In the diagram (Figure 3.6.) the interval between SCORE and SCORE + 1 is divided into a total of 5 regions each of which is associated with an appropriate linguistic modifier. Thus, as the calculated score moved from SCORE to SCORE + 1 it travels through successive regions in which a particular linguistic modifier applies. Thus, initially it lies in the region *close to SCORE*, moving next to the region *somewhat more than SCORE*, then to a region *between SCORE and SCORE + 1*, then *somewhat less than SCORE + 1* and finally it lies *close to SCORE + 1*.

The implementation of this scheme means that a direct and automated read out is possible for any triangular fuzzy number in terms of its kernel, minimum and maximum values. In effect a linguistic interpretation of the possibilistic space of the score which is intended to convey a meaningful commentary on the score to a reader.

For the fuzzy triangular score 3.303, 4.277, 5.16 interpreted upon the scale,

1. Never employed
2. Seldom employed
3. Sometimes employed
4. Frequently employed
5. Almost always employed
6. Indispensable to task

For the business task "informal communications", the interpretation is.

'the score for informal communications is a Kernel value of 4.277 , with a Minimum of 3.303 and a Maximum of 5.16 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for informal communications."

This is taken from actual data in Chapter 4 and has been automatically interpreted by a simple software algorithm.

3.4.5. Formulation 1 - Discussion and Critique

The formulation developed above may be criticised from a number of perspectives. Firstly and obviously the translation of the ordinal scale linked to numerical values as if it were a representation of a continuum expressible as a real number, albeit a fuzzy one, is to treat the scale implicitly as being of interval nature. This has already been noted above but deserves further discussion.

Some of the original and frequently employed examples of fuzzy numbers and fuzzy set application are based upon a scale which clearly relates to a continuum that may validly be expressed as a meaningful number. The best known one is the discussion of set membership in relation to linguistic concepts such as *young*, *old*, *middle aged* etc. Bademar and Gottwald discuss this example in relation to linguistic variables (Bademar and Gottwald, 1995, Chapter 4). In the example, the judgement that someone is *middle* *aged* will vary over some range, perhaps from late 30s to early 60s but in any event is clearly linked to an underlying numerically valid continuum. Similarly, Lewis relates judgements about body temperature (*normal*, *slight fever*, *moderate fever*, *high fever*) to fuzzy triangular envelopes which are very similar in concept and application to the presently proposed formulation (Lewis, 1997, p75). But, again, the temperature continuum underlying the linguistic labels is real enough and continuous enough.

There seem two responses to this difficulty. Firstly, it may be possible to employ some statistical techniques to the frequency response tables which enable the ordinal scale to be converted into an interval scale with the characteristic linguistic points re-scaled to represent intervals closer to the internal distances implicit within the data. There are a variety of techniques which have been proposed for doing this based upon correspondence analysis. It is not intended to discuss correspondence analysis here except to note that it is essentially a geometrical way of analysing variables based upon understanding how they are distributed in a multi-dimensional space and how the weightings for particular values of variables are grouped. For example Carroll, Green and Schaffer discuss a technique for re-scaling the column intervals of a contingency table using correspondence analysis principles (Carroll, Green and Schaffer, 1986); however, their method was subsequently critiqued by Greenacre who questioned a number of the steps taken (Greenacre, 1989). More recently, Bendixen and Sandler have offered a further technique plus some specific examples based upon real survey data (Bendixen and Sandler, 1995). The motivation for these techniques in re-scaling is primarily to provide data which more accurately reflects an underlying interval scale so that various techniques of multivariate analysis (cluster analysis or discriminant analysis for example) can be reliably applied. However, it is important to determine whether this rationale can necessarily be carried over unquestioned into the sphere of fuzzy variables and linguistic scales.

A possible alternative view of the linguistic scale is that the numerical values associated with each point are definitional and represent a transformation of the linguistic space defined by the linguistic referents. In other words we could assume that some idealised linguistic concordance exists which would accurately reflect what someone means when they judge the use of IT facilities to be *frequently employed* as opposed to *sometimes employed* or *seldom employed*. This would enable the linguistic referents to be assigned to positions within a defined interval scale in some sensible fashion. However, we note that such a concordance is never likely to be found, but one thing that can be said for certain is that, if it is, the concordance assigning 4 as the value for frequently employed, 3 as the value for sometimes employed etc. may be obtained by a process of transformation (or re-scaling) from the true scale.

If we accept the scale established as linking our linguistic referents then the triangular fuzzy numbers derived from the analysis of the questionnaire responses must be acknowledged to be transformations themselves, perhaps a little like measures in some artificial linear space. In this case the characterising and parsing, including the automatic interpretation, is also purely based upon the transformed space or scale. We can imagine that, for example, we might transform the fuzzy triangular numbers back into the *true* scale. The form of the triangular numbers will be changed, perhaps the size of the interval between minimum and kernel and kernel and maximum altering, as well as the values of minimum, kernel and maximum. But, even when this is done, there will be important characteristics of the transformed scale which are retained within the true scale. For example, relative positions of the minimum, kernel and maximum between two scores will remain, indeed must remain if we are not suddenly to conclude that *sometimes employed* in fact represents a higher score than *frequently employed*.

3.4.6. Formulation 2 - Best Hypothesis Determination

Krause and Clark offer a discussion of the interpretation of imprecise or vague data based upon a set theoretic argument whereby evidence is weighted in terms of its contribution to the possibility of a particular hypothesis being true (Krause and Clark, 1993, pp 127-130). A way to think about this approach is to consider that responses to each of the possible judgements in the ordinal/interval scale;

1. Never employed
2. Seldom employed
3. Sometimes employed
4. Frequently employed
5. Almost always employed
6. Indispensable to task

represents a form of imprecise *sensor* and that the number of responses for each yields a weight distribution across these sensors.

To expand slightly, a score of 3 is a vote from the *3 sensor* in favour of the hypothesis *sometimes employed* but, because this sensor is assumed to be offering only an imprecise datum, it might also be expected to offer support for (at least) the adjoining hypotheses as well. In the Krause and Clark formulation the weightings therefore offer a range of supports for each of a number of hypotheses and the most likely hypothesis is the one which has the best support.

In interpreting the frequency table of responses then, it is proposed that the best supported hypothesis can be selected by taking the weighted sums of support for each hypothesis represented by each point on the ordinal/interval scale and adding them. This is conceptually similar to determining the modal value for the distribution but with the assumption that a vote for, e.g., *sometimes employed*, because of the imprecise nature of the data, also carries an equal level of support for the next lowest (*seldom employed*) and next highest (*frequently employed*) in the scale. So the total support for each hypothesis is the total weighted support where the scores for each hypothesis will also be assumed to contribute 100% of their weighted score to each adjacent hypothesis. Thus, from our frequency table of responses we can expect to get a single statement of the hypothesis that is best supported for the particular question being posed.

Conceptually, it is not difficult to come up with a common sense argument in favour of this strategy, which represents a form of approximation to where the centre of gravity of the frequency distribution is. Suppose, for example, 10 persons scored point 2 on such a scale but 6 persons each scored 4, 5 and 6 respectively. The modal value might suggest that 2 (*seldom employed*) was the most typical response, the mean value is 3.93 (close to *frequently employed*). but, the interpretation proposed will yield 5 (*almost always employed*) as the best hypothesis. This places the best hypothesis amongst the part of the distribution with the highest concentration (weight) of votes.

3.4.7. Discussion of Alternative Formulations

The two formulations discussed in the preceding sections are both based upon the idea that when respondents score the answer to a survey question on an ordinal or interval scale they are providing an imprecise judgement in relation to a range of hypothetical statements. Implicitly therefore, when a vote is received for a particular statement, this automatically entails a level of support for those hypotheses which, in judgement terms, lie immediately adjacent to the one being voted for. This principle is central to the idea of fuzziness in data derived in such a manner and the two formulations have been built upon this framework. However, the two formulations differ in the way in which this principle is exploited.

Firstly, considering Formulation 1. The use of fuzzy triangular numbers can be seen as a way of attempting to *retain* information from the frequency table of responses so that something of the shape (or envelope) of responses may be presented at output. If fact, as had been discussed on page 111, the formulation adopted cannot be employed to derive meaningful information about the shape of the distribution of responses, but can be employed as a means of expressing the fuzzy judgement ranges and, because it results in a number upon which appropriate arithmetical operations can be performed there is the possibility of various combinations and comparisons of data being produced. In terms of including support for adjacent hypotheses which are "fuzzily" implicit within a particular voted for hypothesis, the fuzzy triangular score has the effect of producing a least optimistic (TFN Min, being the *mean minima* for *all* hypotheses), most likely (TFN Kernel, being the *mean* for *all* hypotheses) and most optimistic (TFN Max, being the *mean maxima* for *all* hypotheses). Thus, in retaining fuzzy minima and maxima for all hypotheses in the final score, the formulation incorporates the extremes of the fuzzy judgement ranges implied by the responses.

By contrast, Formulation 2, best hypothesis, is a way of *reducing* information available within the frequency table responses. In this case each hypothesis may be supported by votes for immediately adjacent hypotheses but not other hypotheses. This has the effect of producing a *forced* best hypothesis which tends to exclude support from extremes of the fuzzy judgement ranges of the responses.

At this stage in the development of the approach it is not possible to say which formulation may offer the most useful output for evaluation purposes, although it seems likely that this may vary with application. However, it does seem likely that the best hypothesis formulation may be useful for applications involving decisions about outcomes from survey research and that fuzzy triangular score may, in contrast, be more useful as an input to qualitative interpretation.

3.5. AN EXAMPLE OF FUZZY ANALYSIS OF QUESTIONNAIRE RESPONSES

The approach to the analysis of questionnaire responses using fuzzy arithmetical techniques has been tested in a variety of contexts. This section, which is intended to demonstrate one early use of the method, is drawn from *Developing a fuzzy approach to the measurement of organisational effectiveness: a local government perspective* (Hassall and Worrall, 1997).

3.5.1. Description of Research

The research reported in the paper is aimed a developing a soft information system which is capable of contributing to the measurement of how effectively strategy formulation is translated into results. Hassall and Worrall firstly note that;

"Local authorities are very complex organisations which exist in a highly turbulent environment. They are expected to identify needs, identify and react to complex social, demographic, economic and environmental problems, respond to changing customer expectations, respond to the wishes of citizens and deploy increasingly scarce resources under the gaze of an increasingly attentive and critical citizenry. Unlike private sector organisations, local authorities do not have a "bottom line" and several public sector management thinkers (Ranson and Stewart, 1994) have expressed concerns about the attempt of many local authorities in the 1980s and early 1990s to uncritically import private sector methods and concepts into the domain of public sector management. Managing a local authority strategically is not easy and our research with a set of local authority chief executives (Worrall, 1996a) has identified the need for local authorities to develop effective "judgement support systems" given the nature of managing a local authority. " (Hassall and Worrall, 1997, p8).

These *judgement support systems* must possess the flexibility to enable a variety of types of measure to be made, often in relation to imprecisely defined targets. Thus, it is argued, while in many businesses and organisations pure *denominator* measures for effectiveness may be acceptable, this is unlikely always to be the case in local government. Measurements of achievement against a range of strategic goals will be based upon judgements made by individuals and groups and strategic management must reflect this. Continuing from this theme it is argued that what may prove more useful than hard statistical analyses is a softer approach recognising the qualitative and particularly the *possibilistic* nature of inputs to the process. In effect, this approach seeks to capture the richness of judgements of effectiveness over a measurement interval and allow the differences in judgements between different stakeholders to be exposed. An information system which can capture judgements of performance in their raw and imprecise form is proposed; and the incorporation of ideas from fuzzy mathematics and fuzzy set theory into such a system seems a sensible approach to take and to apply to a local authority. Imprecision and vagueness can be tackled with reference to appropriate elements of fuzzy set theory (Krause and Clark,1993, Chapter 5) and the development of soft information systems which incorporate these and related ideas (Jackson and Hosking, 1990).

In the case of the system described by Jackson and Hosking, vagueness is incorporated by a soft information interface where users are asked to feed impressionistic information into a forecasting model. These inputs are then encoded and a variety of fuzzy arithmetic and set operations are applied to produce the required predictions. The ideas inherent within fuzzy mathematics and fuzzy set theory are of interest in decision support and decision making generally since they intuitively hold out the prospect of incorporating varied, soft and opinion based information into a rationally defined and consistent process. Applications which have been proposed and attempted include small group decision making (Spillman, Spillman and Bezdek, 1980), project selection (Leung, 1980) and cost benefit analysis (Neitzel and Hoffman, 1980).

Hassall and Worrall propose the use of a soft information system to provide information which can guide a local authority on how effective its policy development is. For example the achievement of policy might be judged as follows;

1 = "BEING COMPLETELY SUCCESSFUL",

2 = "HAVING A MAJOR IMPACT",

3 = "HAVING A SIGNIFICANT, NOTICEABLE IMPACT",

4 = "HAVING SOME IMPACT",

5 = "HAVING A SMALL IMPACT",

6 = "HAVING NO DISCERNIBLE IMPACT".

Using a regime such as this, it may not be very useful to learn that the mean response was 3.5 or the modal response 4. The frequency of particular responses over the range between lowest possible and highest possible is useful and in practical cases it may well be reported in just this final form.

The research reported then goes on to describe the following steps.

1.	the development of a number of performance indicators representing elements of strategy against which the effectiveness of the organisation is to be judged;
2.	the elicitation of judgements of effectiveness for each performance indicator from a suitable sample of respondents using an interval scale;
3.	the analysis of the responses to give frequency breakdowns for each performance indicator.
4.	the representation of the frequency breakdowns for each performance indicator as a triangular fuzzy number expressed on a suitable scale;
5.	the present of the results in an appropriate form by means of the selection of an appropriate visualisation technique; and,
6.	(optionally) performing a number of analyses on the outcome of 4 which compare both the relative and absolute differences in judgements of effectiveness for different subset of respondents.
7.	The triangular fuzzy numbers representing the measures of effectiveness are derived from the frequency breakdowns as follows.

Figure 3.7. Research into strategy implementation, (Hassall and Worrall,1997, p11).

A questionnaire was developed which asked respondents to score particular policy areas against a scale as shown in the following table.

The Council's strategies and activities have been COMPLETELY SUCCESSFUL	1
The Council's strategies and activities have had A MAJOR IMPACT	2
The Council's strategies and activities have had A SIGNIFICANT, NOTICEABLE IMPACT	3
The Council's strategies and activities have had SOME IMPACT	4
The Council's strategies and activities have had A SMALL IMPACT	5
The Council's strategies and activities have had NO DISCERNIBLE IMPACT	6

Figure 3.8. Strategy implementation - scale, (Hassall and Worrall, 1997. p12).

3.5.2. Results of Research

Hassall and Worrall describe the results of a study based upon the foregoing method at Wrekin Council. At the time of the research the council was about to become a unitary authority and so issues of policy and strategic implementation were particularly relevant.

A questionnaire was designed in conjunction with senior officers at Wrekin Council to seek to gather impressionistic information on how well officers and members in the Council perceived that the Council had achieved its strategic objectives against a number of indicators. Nine strategic areas were identified and these are described in the results discussed below. In addition to the respondent's views on how well the Council had achieved its strategic objectives across the nine policy areas, each respondent was asked to signify their role in the organisation. The options were; elected representative; chief executive/director; second tier officer and business unit manager. The exercise presented here formed part of a broader research project to identify perceptions of the Council's effectiveness.

Results

The table below summarises the results in terms of overall fuzzy scores for each strategic indicator based upon the frequency data from the survey. In this table the mean value is taken as a kernel and is initially intended to represent something about the overall judgements made by the respondents.

		Min	Kernel	Max
1	Promoting the successful growth of the District	2	3.564	5
2	Reducing poverty	1	2.667	4
3	Tackling special needs and disadvantage	2	3.103	4
4	Improving customer satisfaction with services	2	3.615	5
5	Improving community and citizen involvement	1	3.333	5
6	Fostering economic development	1	3.615	6
7	Protecting the environment	2	3.59	5
8	Facilitating the provision of affordable housing	1	3.59	6
9	Tacking public concern about community safety	2	3.333	5
	Average Fuzzy Score (all indicators, mean kernel)	**1.556**	**3.379**	**5**

Figure 3.9. Strategy implementation - scores, (Hassall and Worrall, 1997, p13).

	Variance from average Fuzzy score (all indicators)	Min	Kernel	Max
1	Promoting the successful growth of the District	0.444	0.185	0
2	Reducing poverty	-0.56	-0.71	-1
3	Tackling special needs and disadvantage	0.444	-0.28	-1
4	Improving customer satisfaction with services	0.444	0.236	0
5	Improving community and citizen involvement	-0.56	-0.05	0
6	Fostering economic development	-0.56	0.236	1
7	Protecting the environment	0.444	0.211	0
8	Facilitating the provision of affordable housing	-0.56	0.211	1
9	Tacking public concern about community safety	0.444	-0.05	0

Figure 3.10. Departures from "average" scores, (Hassall and Worrall, 1997, p13).

It should be noted that in the formulation used in the reported research, an early version of the fuzzy triangular score was the only method used to evaluate responses. In this early version the minimum and maximum for the score for each question were taken as the actual minimum and maximum scored by the respondents, as can be seen in results Figure 3.9. above. Following initial work with this formulation, the full triangular fuzzy number formulation was developed as described in Hassall (1998).

Hassall and Worrall attempted to draw conclusions based upon a comparison of the fuzzy scores for each indicator with the overall average score and in this respect the scores are not dissimilar to ordinary numbers. However, it was the intention to encourage the users of this sort of information to gain some intuitive understanding of the smeared out nature of such possibilistic judgements.

In this context two visualisations were prepared with the intention of illustrating some simple possibilities.

The first chart (Figure 3.11.) shows a polar plot of the fuzzy scores for each indicator in the policy space of Wrekin Council, compared to the overall average (the labels 1 through 9 can be read from the results table presented above). The dark grey shaded areas are used to show where an indicator falls **below** the average for all indicators. In other words, the aim was to seek to draw attention to those areas of strategy where relatively less beneficial effect is judged to be felt as a result of programmes and activities.

This visualisation technique draws attention to those areas - or policy dimensions - where the Council is perceived to be under-performing. This is potentially a powerful technique for building consensus about areas where a review of policy and strategy may be beneficial or for identifying policy areas to which additional resources could be focused.

The concentration of dark grey in the policy effectiveness indicator 2 (reducing poverty) and 3 (meeting special needs) segments illustrates where the problems of policy under-performance are judged to lie.

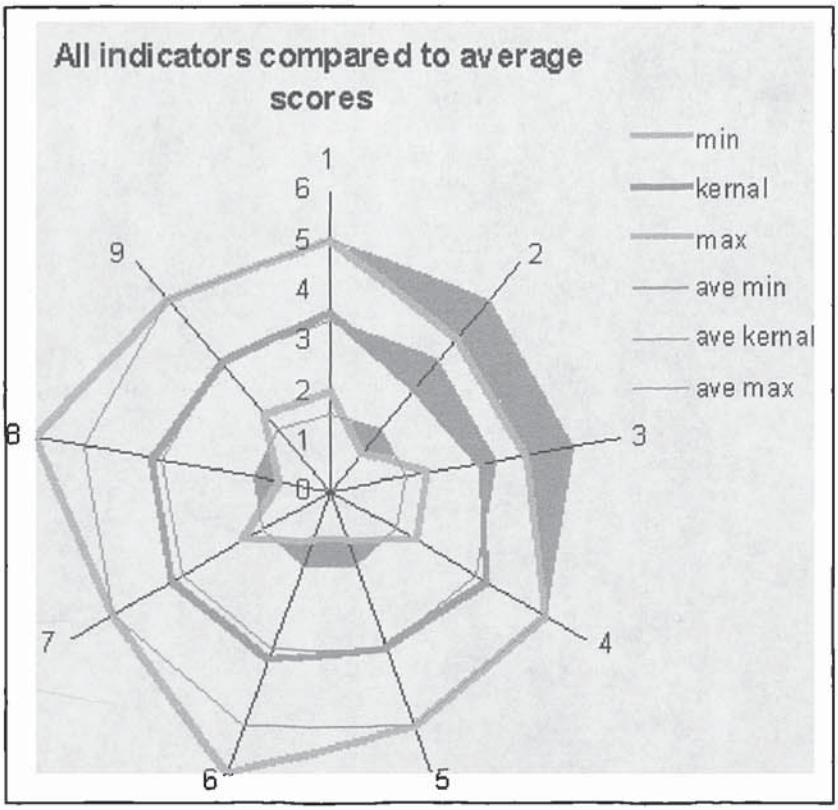


Figure 3.11. Scores gaps - polar plot, (Hassall and Worrall, 1997. p15).

The second chart (Figure 3.12.) compares the judgements of second tier management and business unit managers with those judgements made by elected members and directors. In advance of inspecting this chart it may be noted that the numbers already presented indicated a somewhat more optimistic judgement of effectiveness by elected members and chief officers than officers lower down the organisation (i.e. the planners and developers of policy and strategy seem to have made different judgements than those officers involved with the delivery of policy and strategy). The grey shading is in this case is used to illustrate where judgements of more operational level managers fall below those of elected members and directors.

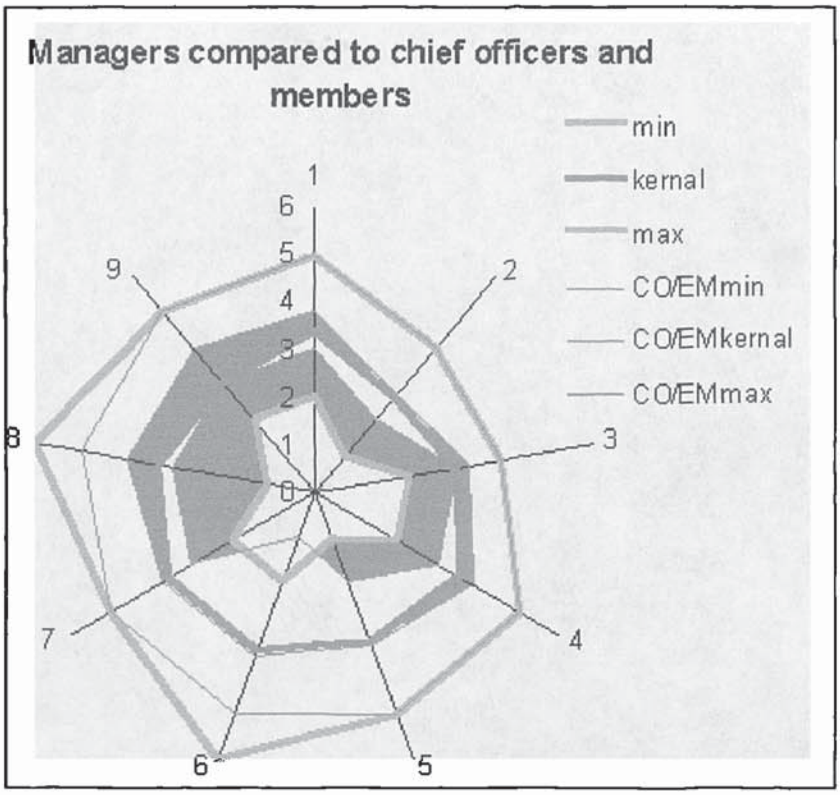


Figure 3.12. Managers and Chief Officers - polar plot, (Hassall and Worrall, 1997, P16).

A comparison of the two charts is instructive since it can be seen that there is considerable congruence between the two groups of respondents on indicators 2 and 3. Moreover, this is the area in the first chart which indicates a lower than average score for effectiveness. The visualisations thus simultaneously highlight both an area for concern and a degree of consensus about this judgement.

4. RESULTS OF LONGITUDINAL STUDY OF CIS

"The purpose of a system is what it does."

Stafford Beer.

4.1. DESCRIPTION OF STUDY

The study was carried out over the period Autumn 1996 to Autumn 1998 during which Northampton County Council were extending the implementation of GroupWise from an initial headquarters group to a number of the larger departments.

4.1.1. The Organisation - *Mission and Activities*

The County Council, characteristically of such local government units, is responsible for a range of service provision throughout the area of Northamptonshire. The various departments within the County Council perform quite different missions and consequently activities are very diverse (Northamptonshire County Council, Annual Report, 1997 - 1998). For example, the Education Department is responsible for administration, budget allocation and management of all state schools within the county, including employment of all staff within these schools. The Social Services (Social Services and Health) department is responsible for administration, budget allocation and management of a variety of social service provision across the County, including commissioning of services from private sector suppliers of services and subsequent management of contracts, as well as the maintenance of extensive contacts with voluntary sector organisations.

Indeed, the Social Services Department represents an interesting microcosm of the changes which have occurred in local government over the last 10 to 15 years and which are reflected throughout Northampton County Council today. In recent years, Local Authorities have been charged by Central Government with responsibility for providing a range of statutory services and meeting service level provision targets in addition to the implementation of strategies to meet specific local requirements. Local Government, which has traditionally established directly owned and managed services to perform its designated tasks, has moved increasingly via competitive tendering and contracting with outside providers, to shift the emphasis away from direct provision of services to management, monitoring and control of services provided by other bodies.

In this changing environment, staff within Local Authorities have seen the content and demands of their jobs shift increasingly towards becoming less bureaucratic (in the sense of being based upon fixed procedures), more flexible and more information intensive.

The move towards implementing technologies such as GroupWise in part reflects a recognition of the changing content of staff jobs and in part a simple technological succession in line with the way in which infrastructure is known to be changing in the private sector. The actual impact of such technologies on staff roles, job content and the way in which they carry out their tasks is of great interest to managers within the County Council and hence their enthusiasm for research into the effectiveness of GroupWise.

Research Activities

The research activities were planned with the aim of gaining some longitudinal data that would allow comparisons to be made as implementation and coverage of GroupWise within the County Council proceeded. The following flowchart illustrates the timing and content of the main stages of the data gathering exercise.

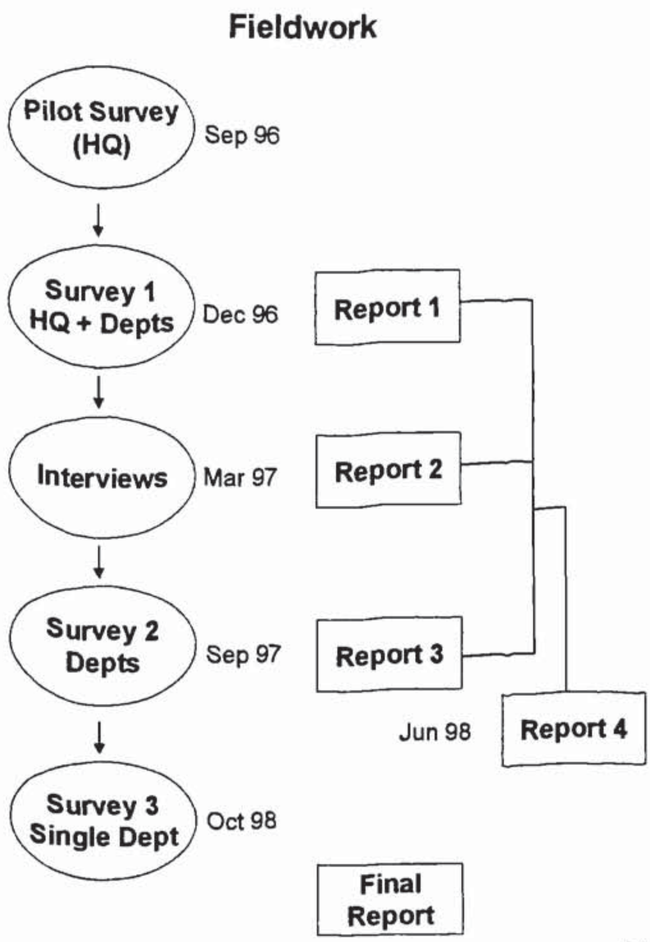


Figure 4.1. Fieldwork Activities.

4.1.2. The Technology - GroupWise

GroupWise from Novell Corporation is a general purpose group support technology incorporating electronic mail, diary and calendar management, tasks scheduling and management, filing support and limited forms-flow capabilities (*GroupWise 5*, Rogers and McTague, 1996). The software incorporates a filing cabinet and folder metaphor linked to the notion of task and to-do lists, work in progress and staff and resource calendars. The software is client-server based.

Historically, Novell have specialised in networking solutions for organisations. Accordingly, as might be expected, GroupWise mail and messaging capabilities are very good indeed. This includes automatic creation of messages to advise users of tasks allocated and meetings made as well as good capability for handling documents within messages.

A strength of GroupWise is its comprehensive and effective individual and group calendar capabilities which are aimed a making task, resource and person scheduling within an organisation as easy and efficient as possible.

Document management facilities are also included and are a focus for development in recent revisions of the product. Support for shared workspace and document sharing is by no means as developed as in rival groupware products such as Lotus Notes (*Mastering Lotus Notes 4, Brown, Brown, Koutchouk and Brown*, 1996).

In terms of the effectiveness of GroupWise within an organisational setting, it might be expected that for usage involving messaging, task management and scheduling and diary and calendar management it would be good. In relation to shared task completion and co-ordination, effectiveness might be expected to depend upon individual use and practice.

4.2. RESEARCH INSTRUMENT AND PILOT SURVEY

4.2.1. Development of Survey Questionnaire

The model of CIS effect developed in the earlier chapters requires a number of co-operative tasks to be identified so that the effect of the technology on the performance of these tasks can be evaluated. In the case of Northamptonshire County Council the intention was that these tasks should be determined by agreement between senior managers who were jointly responsible for the decisions to implement GroupWise within the various departments. These managers were all members of the Information Systems and Computer Management Group (ISCMG), a user oriented steering committee tasked with guiding user participation in information systems and computing decisions and implementation. Measurement would then consist of comparing user judgements of their use of the GroupWise system to meet the various task needs using a nominal/ordinal scale which would be analysed to provide a variety of absolute and relative measures of use.

Initially the tasks identified were as follows.

Task description for Questionnaire	Task Name (Used in Analyses)
Informal communications, keeping people informed	**Informal communications**
Co-ordination & communication within teams in relation to shared tasks	**Co-ordination within teams**
Distribution of formal communications such as memos	**Formal communications**
Editing and processing documents using mail attachments	**Processing documents using mail attachments**
Confirming that communications (memos, messages etc.) have been delivered to recipients	**Confirming delivery of communications**
Taking and recording telephone messages	**Recording telephone messages**
Taking and recording messages other than telephone messages	**Recording non telephone messages**
Recording and managing a personal task list	**Managing a personal task list**
Recording and managing tasks to be performed by other individuals or teams	**Managing a team task list**
Maintaining a personal diary	**Maintaining a personal diary**
Scheduling of meetings	**Scheduling meetings**
As a telephone directory	**As a telephone directory**

Figure 4.2. Co-operative Tasks for Longitudinal Study.

Respondents were asked to judge their use of the GroupWise system in the following way.

For each described business task I judge that,

GroupWise is..

1. Indispensable to task (No other acceptable method of performing task)
2. Almost always employed (Normal method for task, other methods occasionally used)
3. Frequently employed...(A variety of methods for task of which GroupWise is one)
4. Sometimes employed...(GroupWise is useful and is employed on some occasions)
5. Seldom employed (May have been tried once or twice but not normally used)
6. Never employed...(Has never been used and in all likelihood will never be used)

For purposes of analysis the ordinals 1 through 6 would be reversed so that a higher score signified a higher judgement of use. Respondents identified as managers were to be asked to give 2 scores. One would be their judgement of their own use of the system, the second would be their expectation of what their staffs use of the system should be based upon their own understanding of the staff's job roles and responsibilities.

Additionally to the 12 specified business tasks it was proposed that respondents have the opportunity to add their own business tasks and score them on the same basis as the predefined ones. Also, respondents were offered the opportunity for free-format responses to any ideas, issues or concerns which they wished to express.

A pilot study was conducted to test the acceptability of the questionnaire and iron out any difficulties that might arise.

4.2.2. Pilot Survey Outcomes

The pilot survey was carried out with 40 returns from selected staff in various headquarters functions. These staff were an untypical selection in that they included a high proportion of first line managers and staff who had expressed an interest in the survey process which they knew was proceeding. Accordingly they were asked to feed back their opinions on the questionnaire, its likely acceptability and any other comments as well as completing the questionnaire on a pilot basis.

The outcome of this pilot was that respondents found the questionnaire easy and convenient to complete so that it would be useful for broad use across the Council.

The main issues arising from the pilot are detailed below together with any response and adaptation in the main instrument.

1. Various persons expressed surprise that the survey had not been carried out via GroupWise.

   It had already been agreed by ISCMG that use of GroupWise for the initial survey might be construed as a "test" by some staff. Also it complicated the process of analysis in terms of communicating the results to the researcher.

2. One respondent completely re-designed the questionnaire to *"reduce the use of paper"* and made a variety of suggestions about re-phrasing the questions.

   It was felt more important to lay out the questions in an easy to read fashion than to pack them all into a single sheet of paper. The suggested re-phrasing would have changed the intention of the survey (and hence the research design) and so these proposals were (with suitable courtesies) ignored.

3. Several respondents felt that the inclusion of "telephone" and "other" messages as separate tasks was a bit confusing and in any event redundant.

   The two tasks were replaced by a single task of "Recording Messages".

4. Some concern was expressed about whether managers "expectations" of staff were what they would "expect" or what they judged their staff to be doing.

   Guidelines were included within questionnaires for managers phrased as follows.

   "As a manager you are asked to provide TWO scores for each task. The first is your own score and refers to your own use of GroupWise. The second is your EXPECTATION of how your staff should currently be using GroupWise; in other words you are being asked to provide a judgement of how useful the system should be, based upon your knowledge of the business tasks performed within your department."

Once these issues had been addressed the ISCMG were happy to proceed with the first survey using the modified questionnaire.

4.3. RESULTS OF SURVEY 1

Survey 1 was carried out with a target of 200 staff employed in mainly headquarters functions within the County Council during December 1996. There were 114 responses recorded across 5 departments.

4.3.1. Questionnaire - Qualitative Results

Respondents in the first survey were invited to give any comments upon GroupWise and their use of it in a free format. Additionally they were asked to supply brief details of business tasks which they did not feel fitted within those specified on the survey questionnaire and to score these self specified tasks in the same manner as for the specified ones.

This section contains details and analyses of the comments received and of the user specified tasks.

Table 4.1. Respondent Comments from Survey 1.

Respondent	Comments
2	*System would be more useful if more departments were connected.*
4	*How did we manage before?*
7	*I have had no training so am not familiar with many of the options available. I don't find it particularly easy to pick up as I go along i.e. it is not particularly intuitive. Much of my communication is with people who do not have the system yet.*
9	*Without a computer I am unable to use GroupWise as it should be used. Only able to update my diary and open messages when my colleague is about.*

12	*GroupWise is very good for office based people but for people who spend a lot of time offsite it is impossible to keep up to date and makes features like the diary pretty useless.*
16	*When scheduling meetings, it would be useful if you could send a busy? Message for several meetings in one go.*
18	*Far too slow. Assumes PC per desk logged on. Quicker to write phone messages down even when logged on. Useful for recording and maintaining message flows. Not as useful as Higgins (keywords). Cumbersome to use and an overhead! (time)*
19	*Credibility will be increased by further expansion across the authority.*
21	*Excellent business tool. One annoying feature, no sort facility on trash. I.e. It would be better to have the latest deleted Email at the top not the bottom.*
22	*GroupWise can only be used effectively as a telephone directory if it is kept up to date and all changes are made effective immediately. Some existing numbers are wrong.*
23	*I have only had GroupWise a short time. Some of the scores anticipate the extent to which I am likely to use it. Based on existing features in windows, I expect to find the diary and phone directory features useless.*
24	*Pity it runs in windows. Difficult to use, illogical and very very slow. Also much of the screen is taken up with windows garbage leaving only a tiny portion left for actual business. Like many of these systems the priority appears to be, run the system, with getting any value out of it very much second place. i.e, the cart is before the horse again.*
25	*GroupWise is not as quick to use as Higgins and therefore I have had to start using a desk diary so that if people ring me to make and appointment and I am not on GroupWise I can do so quickly.*
27	*On Higgins I used the "message delivered/read" function quite often. I do not, however, remember being shown this at the GroupWise training session; nor is it in the guide book we were given, nor have I yet found out how to do it - hence my response (5).*
28	*We have received no direction on how the system should be used in our dept. i.e. when should we use it instead of sending memos and using the helpline. Is a policy to be developed or is each dept to provide staff guidelines.*
29	*There is no scrolling mechanism when using the daily diary - only 3 months show, and to access beyond that is time consuming and frustrating. One area where Higgins was easier to use. Basic training was just that - only gave the briefest information. Does not give enough information on what other uses you can put the system to.*
34	*Excellent system. Not being computer literate this system is "user" friendly, easier to understand. It has impacted significantly on my working style/method. , cutdown on paper work. Communication is much speedier, able to respond to queries much quicker. I am actually using the system !!*
36	*System is quite easy to use although some initial teething problems. Training adequate. Able to communicate more quickly with my various colleagues.*
37	*GroupWise is a very useful tool, easy to use.*

40	*Would be useful if we could have Email addresses so external people can send mail to us.*
41	*Very good so far; but looking forward to the internetworking version that will connect with internet/intranet. Should be part of an integrated groupware/browser.*
42	*Diary maintained "for the boss" (10)*
44	*GroupWise is "ALL OR NOTHING". It has not yet been used very much because most of the people we need to contact regularly are either within shouting distance or not on the system yet.*
45	*GroupWise should be the ideal medium for DOCUMENT FLOW, however it is not possible to edit another users documents or mail. If this were possible , THIS DOCUMENT could have been mailed! (4)*
46	*Use friendly once you are acquainted! Needs expert understanding if you overstep the basic - if you still are (!!). Otherwise seems logical.*
53	*Very useful in many ways. Made my job a lot easier and made me more efficient and fast. I would say the "address" facility needs a lot more options e.g. personal address books that you can browse through*
55	*Excellent tool but I am not fully utilising it.*
57	*Would use more if all people were connected to GroupWise.*
61	*The GroupWise system is useful, but I find it very disappointing that the system will not be employed across the whole of the County Council due to resource implications. We are still in the position of depts using different communications systems.which does not paint a good picture for the County Council as a whole and does not enable GroupWise to be used to its full potential.*
62	*Would be more useful if educ", social services were on.*
65	*I would be able to make much better use of the facilities offered by GroupWise if it was extended to more departments as many of my communcation needs are outside CHQ, P&T & land and Buildings. My telephone is still the most vital thing in terms of informal communications & I still have to use paper memos etc for formal communications with most departments.*
69	*I am using GroupWise more fully now as I become familiar with the facilities it can offer. It is certainly improving communication within the department and inter-departmentally. I wonder how we managed without it before!*
70	*A very useful tool that makes communication with those absent/engaged much easier. It also helps if i need to receive/forward correspondence that are long and complicated and would be difficult to do over the phone.*
71	*I need training in how to schedule a meeting*
72	*I am very annoyed that I have not yet had a reply (10.12.96) from the administrator to an urgent query I had on 2nd December. It is holding my work up. I think we need more comprehensive manuals to make the most of the system because what we need isn't covered in the Paradise book. Is there any way of notifying all users at once?*

73	*I would say that GroupWise is a vast improvement to the Higgins system. It provides greater scope for management of personal diary and arranging meetings. The transfer of spreadsheets (as attachments) enables a quicker response time to that of hard copies via the internal mail. The system is useful for prioritising tasks and general reminders to myself. I would probably use the system more , but for the nature of my job, which is often working independently instead of in teams. Overall good sys"*
74	*I would find it easier to use if more County Council departments were GroupWise users. In the main, those with which I have most to do are not.*
75	*Overall I find GroupWise extremely useful - it would be even more use if I could commnucate to colleagues in Education and Social Services.*
83	*The PC which is used is used in total by four people. So I may only look at the PC once a day.*
84	*Too early in usage to make any worthwhile comments.*
85	*Save attachments to wordperfect to work on them so (4.) difficult to answer. Not everyone is on GroupWise yet which obviously reflects the amount of use. I feel once everyone is on it will be extremely useful.*
86	*GroupWise scores over previous non-windows products in many respects e.g. Speed and ease of operation, but lacks some useful functionality. Some functions are not transparently obvious to use e.g. "my calendar", proxy to view someone elses diary.retaining a proxy list etc.*
87	*The address book is too long and needs the ability to sub divide into departments etc.. Do not like the fact that when something is deleted it goes into the trash can and you have to delete it again from the trash can to get rid of it.*
89	*I have encountered a considerable amount of teething problems with the software - numerous "general protection fault" errors, which are both infuriating and time consuming.*
90	*As the project does not include all employees it falls flat, particularly on scheduling meetings etc. and as such make the project fail badly. It would be useful if a system administrator could book bank holidays etc for all users even weekends. Could the telephone pick list be reduced to people in your post box/section? Could it be possible to print a sections meetings for the week in a readable format.*
91	*The training we received was most basic and most people agreed we could have picked it up from the on-line tutor and there is no manual to show the finer points (surely there are some!?). There's things we don't know still and no-one to help. We all need to change the way we do things - i.e memos etc. - but I don't think everyone is on GroupWise yet are they? It should save a lot of paperwork and running round. Also I find peoples GroupWise diaries are not up to date.*
93	*Inter- departmental uses would make life really good. The ability to use it as a notice board is fun too.*
94	*I had a verbal presentation on the use of GroupWise and found a good deal I needed to absorb. It would be helpful to have a brief guide/manual.*

95	*Until this week I have been the only person in my department with access to GW. Even so, it has become valuable in personal time and activity management and in working closely with colleagues in other Depts (with access to GW). When colleagues and my staff are added to GW. It will become indispensable.*
96	*Will be great when everyone in NCC is on GroupWise.*
98	*(re .12), "internal only - major defect."* [referring to use as a telephone directory]
100	*GroupWise is being misused. 1. It is not the vehicle to advertise the carol concert, charity party or retirement "drinky do". 2. This questionnaire is an ideal application for GroupWise - why didn't you use it.*
101	*I am not convinced of its benefits. Lack of written records could be a future problem. I also find it slow and basically would rather use the telephone or W.P. hard copy. As for the diary - You cannot carry it around!!!*
105	*Suggest addresses are listed both alphabetically and as Branches. Often we know the christian name of someone and their branch, but without a surname we do not find it easy to find them in such a long alphabetical list. Within a branch, browsing for a Name would not take long.*
106	*Sharing of PC inhibits use of the system to some extent. The PC allocated for my use is not suitable for GroupWise (v slow).*
108	*My scoring disappoints me but is honest. I see an increasing use of the system for me personally. I WANT to use GroupWise as much as possible. There are however "horses for courses" and I use whatever is the most appropriate method for a task at the time it occurs.*
112	*(3.) Do not use GroupWise for memos and letters while I feel that a signed document is important. Use of GroupWise to distribute documents and schedule meetings limited to those who are on GroupWise - as the users of GroupWise incease, so my use of GroupWise will increase. While there are other methods which can be used to perform the above tasks, on the whole it is quicker to use GroupWise so I would be reluctant to loose it as a tool.*
113	*It would be helpful if more people were to be on the system. It is a huge improvement on Higgins.*
114	*I recently had to print information from my mail box that was typed in columns. I had to ask how to tun this into W/perfect. This was not covered by the training course.*

Analysis and Findings

Comments were recorded for 54 respondents. These have been recorded exactly as submitted and subjected to a review, each being placed into one of 5 categories as follows.

Positive endorsement - often expressed in quite enthusiastic language.

More people should be on GroupWise - a significant number of people recognised the fact that GroupWise effectiveness could be improved by having more people with access to it.

More/better training needed - there was some concern expressed about both the quality and quantity of training. Some of the comments were obviously valid, as they seemed to betray naiveté about the system and its capabilities.

Technical limitations - these comments were largely well thought through criticisms (in the positive sense of the word) of the system. It is possible that some of these were not valid because the respondent did not understand how to perform certain functions. Mostly though, these appeared to be from users with greater IT awareness and familiarity with other systems.

Negative reactions - a few respondents who have particular views to express. Some of the comments are probably valid criticisms.

Categorisation of comments with percentage of total respondents and percentage of respondents with comments are shown below.

	Number	%	% who commented
Positive endorsement	11	9.6%	20.3%
More people should be on GroupWise	18	15.8%	33.33%
More/better training needed	7	6.1%	12.9%
Technical limitations	15	13.1%	27.7%
Negative reactions	3	2.6%	5.6%

Figure 4.3. Summary of Respondent Comments, Survey 1.

Looking at the respondents comments it is clear that we are seeing differing reactions from different groups and individuals depending upon their prior experience, work circumstances and individual proclivities. In particular, it is notable that a number of respondents make unfavourable comparisons with Higgins, a co-operative work support tool which had been implemented previously amongst certain headquarters groups (see for example Wilson, 1991 for a description of Higgins). This suggests an attachment to familiar technologies which can influence users reactions to new ones.

Thus, users are influenced by their existing technological frame and this is illustrated by contrasting views of GroupWise as a "Windows" based technology. Some respondents clearly find the Windows GUI metaphor a problem, some find it intuitive.

On training, opinions were mixed, a number of respondents considering that training had been inadequate.

Respondent Specified Business Tasks

Respondents were invited to describe business tasks and these were analysed using the following method.

Each questionnaire returned was inspected to see if it contained any respondent specified business tasks. A total of 27 out of 114 recorded did so. The questionnaires with respondent specified tasks were then examined and each task which was judged to be distinctive identified separately. A total of 37 tasks were identified on the 27 questionnaires with "saturation" being achieved with 10 distinctive tasks as described in the table below.

Task description	**Number of respondents specifying**	**% specifying**
To inspect others diaries	11	41%
Automatic filing of messages	3	11%
Sending documents as attachments	7	26%
Sharing documents for manipulation	1	4%
Accessing or sending broadcast information (e.g. press releases)	3	11%
Scheduling meetings	3	11%
Confirming communications sent	2	7%
Informal communications	2	7%
Own diary management	2	7%
Managing a personal task list	3	11%

Figure 4.4. Respondent Specified Business Tasks, Survey 1.

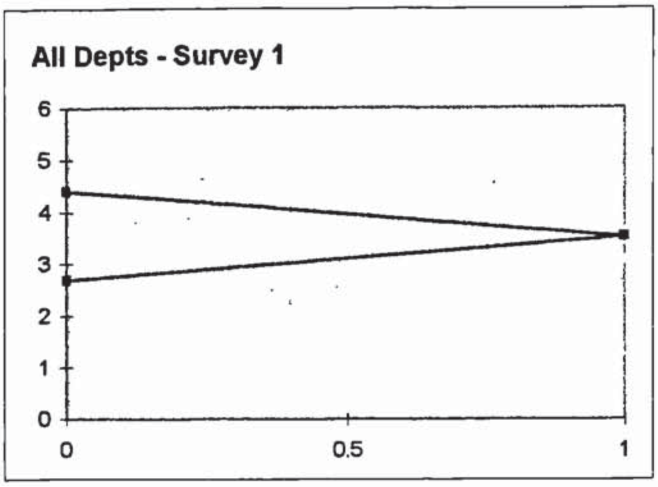
4.3.2. Questionnaire - Sample Task/Component Scores And Interpretation

ALL DEPARTMENTS

Visualisation and interpretations are included here for "All Departments" scores for survey 1 and "Managers Expectations of Staff". Details for individual departments are included within Appendix 3.

all business tasks

Min Kernel Max
2.694 3.528 4.404

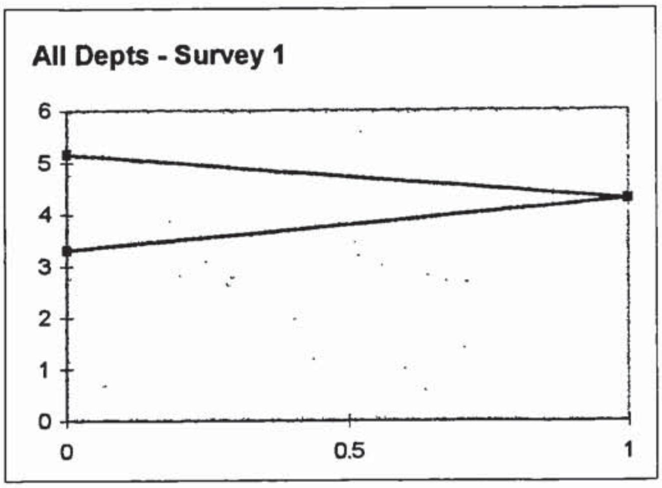


The score for all business tasks is a Kernel value of 3.528 , with a Minimum of 2.694 and a Maximum of 4.404 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for all business tasks.

informal communications

Emergent

Min Kernel Max **Best supported hypothesis**
3.303 4.277 5.16 .... frequently employed for informal communications

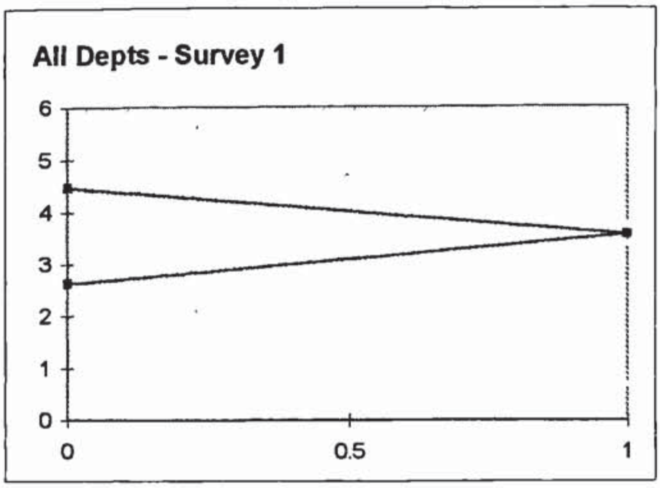


The score for informal communications is a Kernel value of 4.277 , with a Minimum of 3.303 and a Maximum of 5.16 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for informal communications.

co-ordination within teams

Emergent

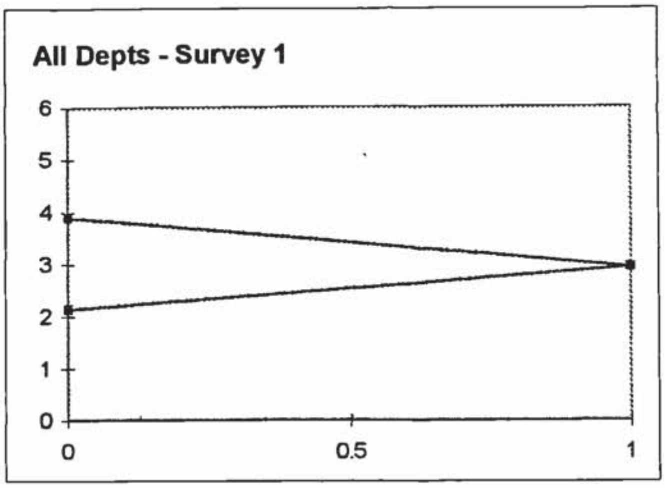
Min	Kernel	Max	Best supported hypothesis
2.627	3.559	4.483	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.559 , with a Minimum of 2.627 and a Maximum of 4.483 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for co-ordination within teams .

processing documents using mail attachments

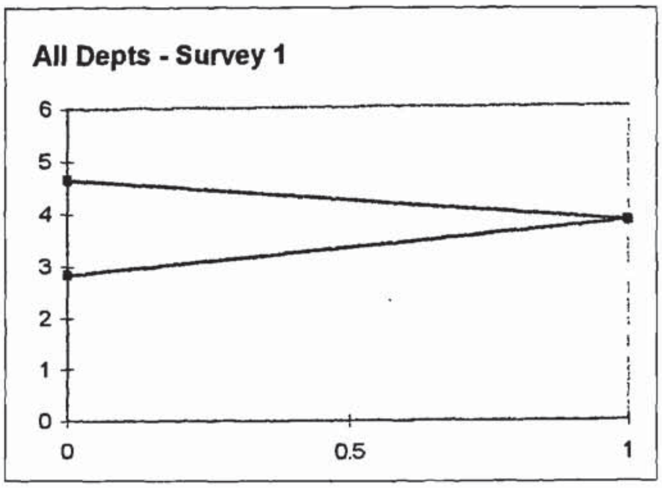
Min	Kernel	Max	Best supported hypothesis
2.136	2.932	3.898	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 2.932 , with a Minimum of 2.136 and a Maximum of 3.898 . The Kernel (most likely) value may be interpreted as close to sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for processing documents using mail attachments.

confirming delivery of communications **Emergent**

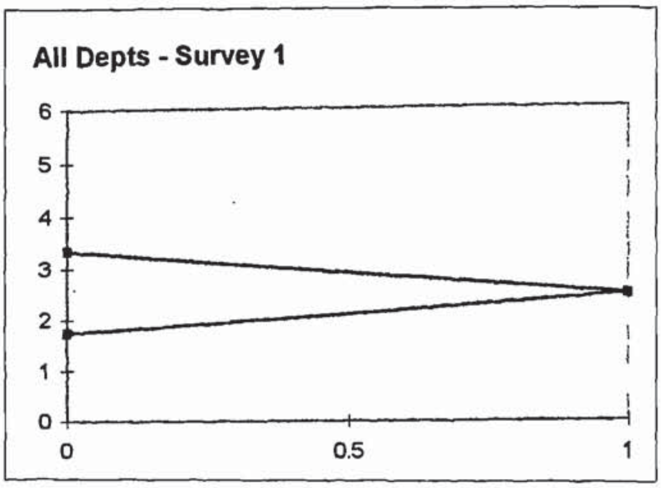
Min	Kernel	Max	Best supported hypothesis
2.829	3.769	4.65	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.769 , with a Minimum of 2.829 and a Maximum of 4.65 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for confirming delivery of communications.

managing a team task list **Emergent**

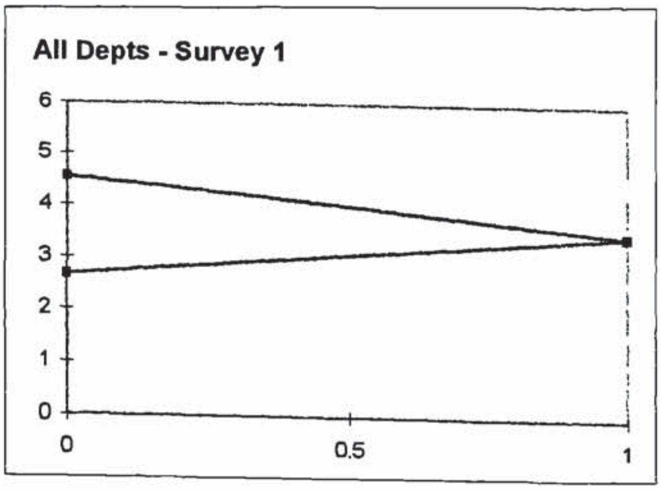
Min	Kernel	Max	Best supported hypothesis
1.746	2.36	3.333	.... never employed for managing a team task list



formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.664	3.58	4.538	.... frequently employed for formal communications

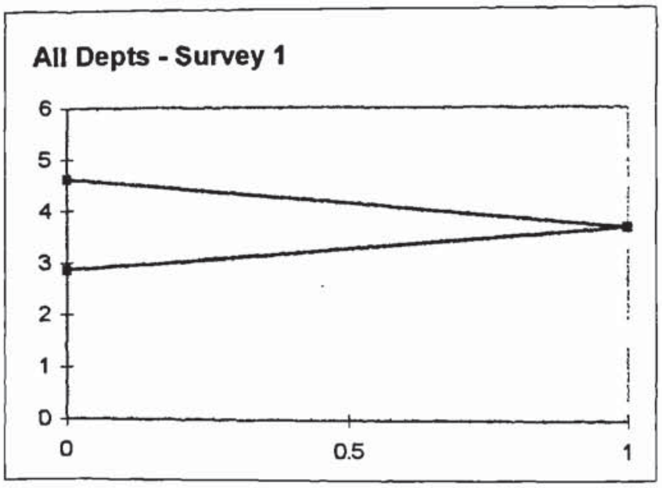


The score for formal communications is a Kernel value of 3.58 , with a Minimum of 2.664 and a Maximum of 4.538 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.856	3.729	4.61	.... frequently employed for recording messages

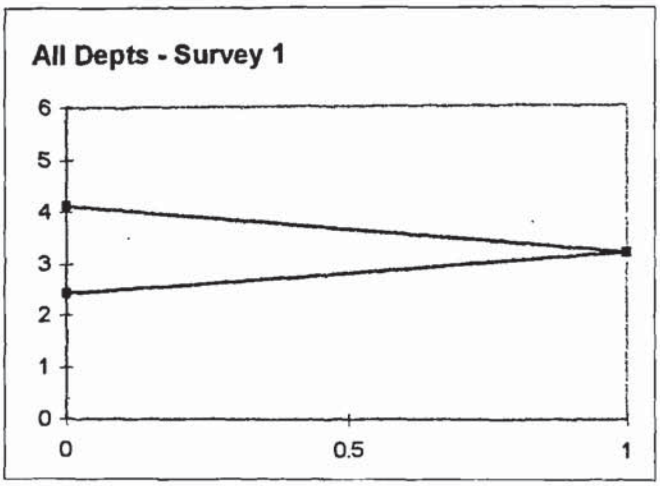


The score for recording messages is a Kernel value of 3.729 , with a Minimum of 2.856 and a Maximum of 4.61 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for recording

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.419	3.197	4.111	.... never employed for managing a personal task list

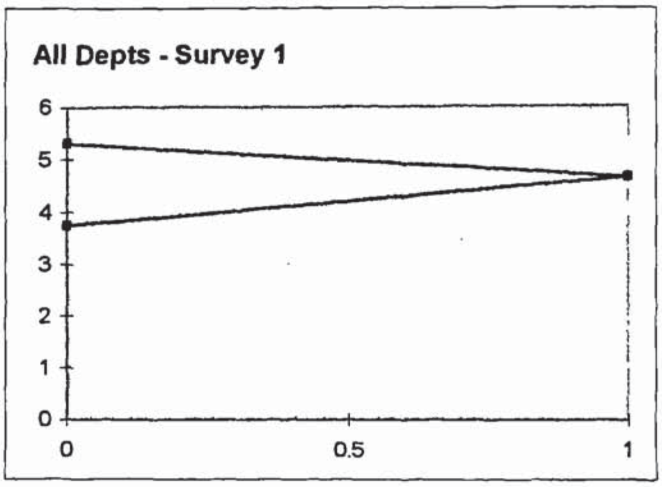


The score for managing a personal task list is a Kernel value of 3.197 , with a Minimum of 2.419 and a Maximum of 4.111 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.744	4.65	5.308	.... indispensible to task for maintaining a personal diary

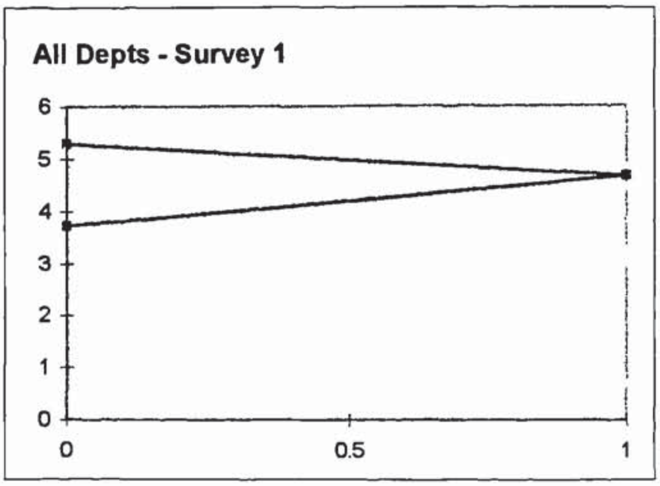


The score for maintaining a personal diary is a Kernel value of 4.65 , with a Minimum of 3.744 and a Maximum of 5.308 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
3.718	**4.658**	**5.299**	.... indispensible to task for scheduling meetings

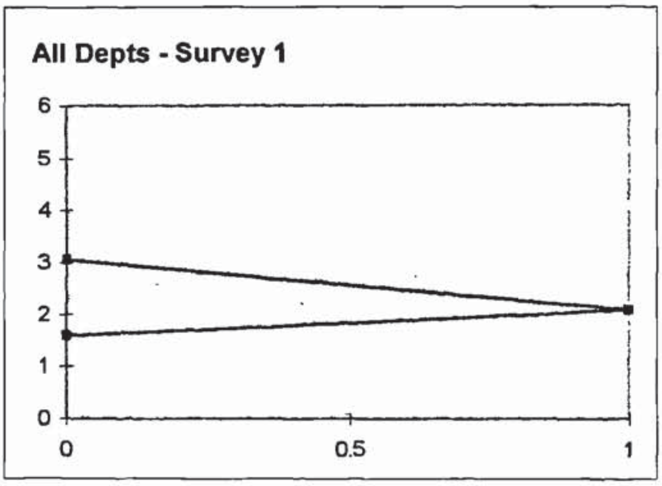


The score for scheduling meetings is a Kernel value of 4.658 , with a Minimum of 3.718 and a Maximum of 5.299 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
1.598	**2.094**	**3.051**	.... never employed for as a telephone directory

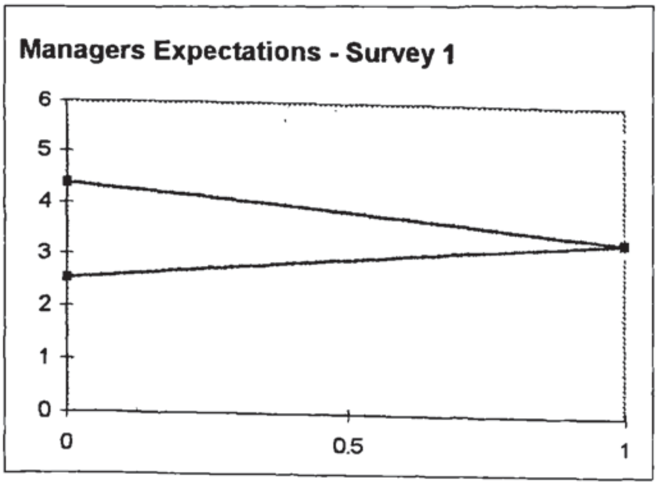


The score for as a telephone directory is a Kernel value of 2.094 , with a Minimum of 1.598 and a Maximum of 3.051 . The Kernel (most likely) value may be interpreted as close to seldom employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to sometimes employed for as a telephone directory.

MANAGERS EXPECTATIONS OF STAFF

all business tasks

Min Kernel Max
2.522 3.432 4.386

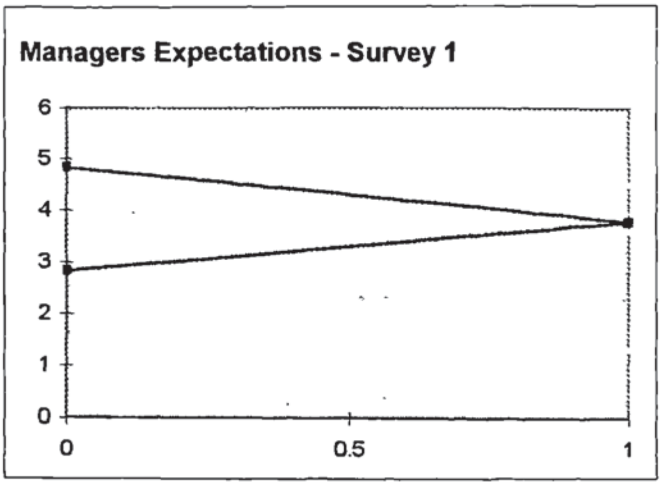


The score for all business tasks is a Kernel value of 3.432 , with a Minimum of 2.522 and a Maximum of 4.386 . The Kernel (most likely) value may be interpreted as *somewhere between sometimes employed and frequently employed for all business* tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for all business tasks.

informal communications

Emergent

Min Kernel Max **Best supported hypothesis**
2.833 3.833 4.833 .... frequently employed for informal communications

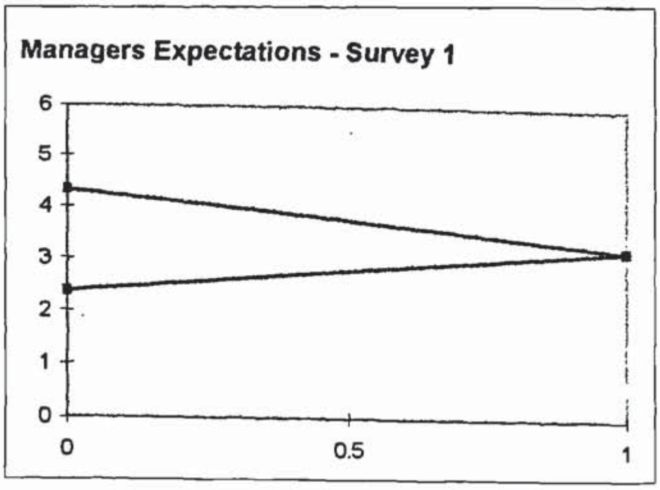


The score for informal communications is a Kernel value of 3.833 , with a Minimum of 2.833 and a Maximum of 4.833 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

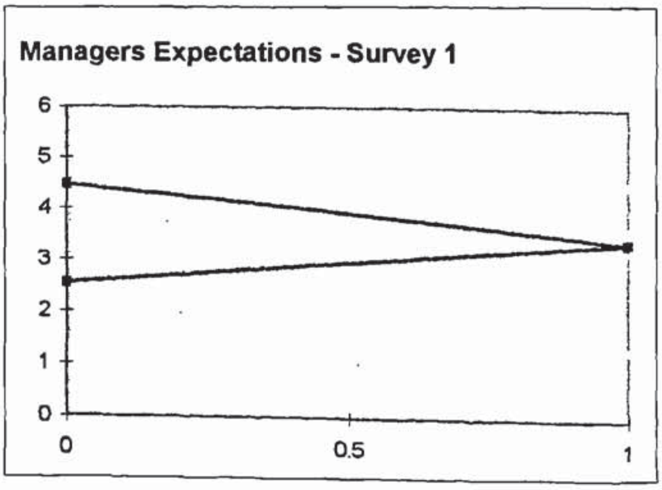
Min	Kernel	Max	Best supported hypothesis
2.357	3.321	4.321	.... sometimes employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.321 , with a Minimum of 2.357 and a Maximum of 4.321 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for co-ordination within teams .

processing documents using mail attachments

Min	Kernel	Max	Best supported hypothesis
2.536	3.464	4.464	.... frequently employed for processing documents using mail attachments

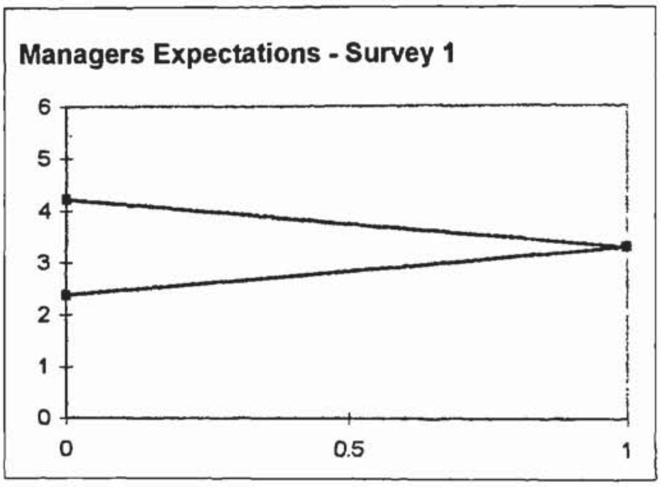


The score for processing documents using mail attachments is a Kernel value of 3.464 , with a Minimum of 2.536 and a Maximum of 4.464 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for processing documents using mail

confirming delivery of communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.37	**3.296**	**4.222**	.... sometimes employed for confirming delivery of communications

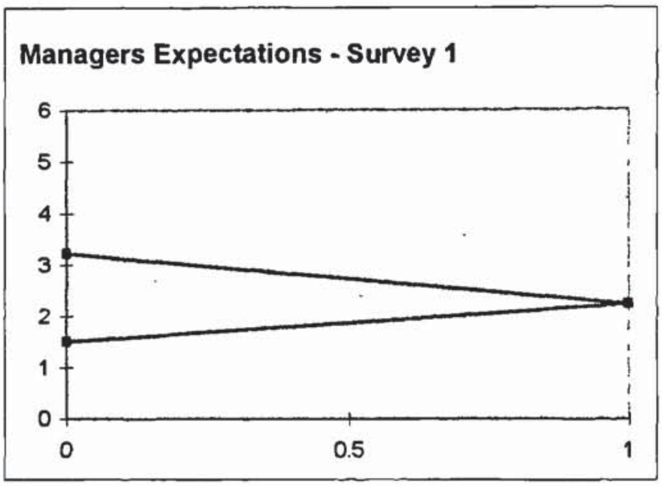


The score for confirming delivery of communications is a Kernel value of 3.296 , with a Minimum of 2.37 and a Maximum of 4.222 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for confirming delivery of communications.

managing a team task list

Emergent

Min	Kernel	Max	Best supported hypothesis
1.5	**2.231**	**3.231**	.... seldom employed for managing a team task list

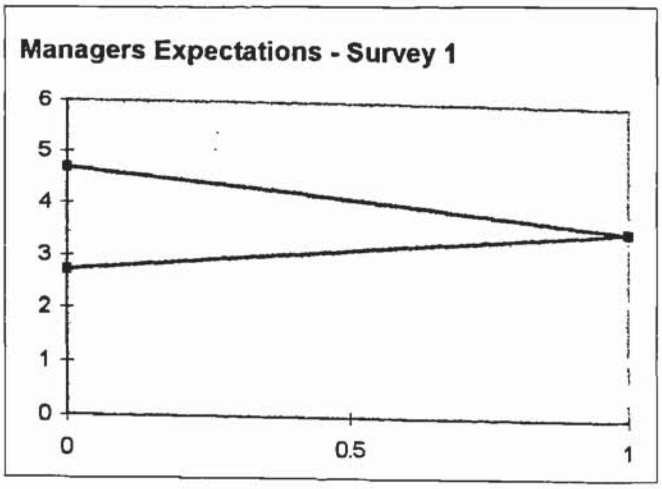


The score for managing a team task list is a Kernel value of 2.231 , with a Minimum of 1.5 and a Maximum of 3.231 . The Kernel (most likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for managing a

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.714	3.679	4.679	.... frequently employed for formal communications

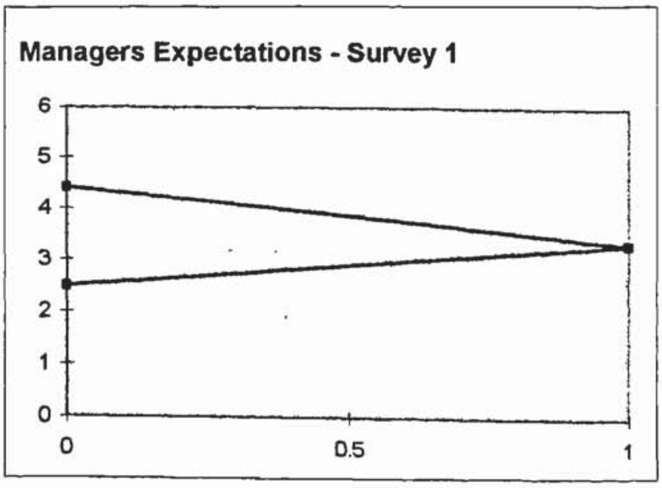


The score for formal communications is a Kernel value of 3.679 , with a Minimum of 2.714 and a Maximum of 4.679 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.481	3.407	4.407	.... frequently employed for recording messages

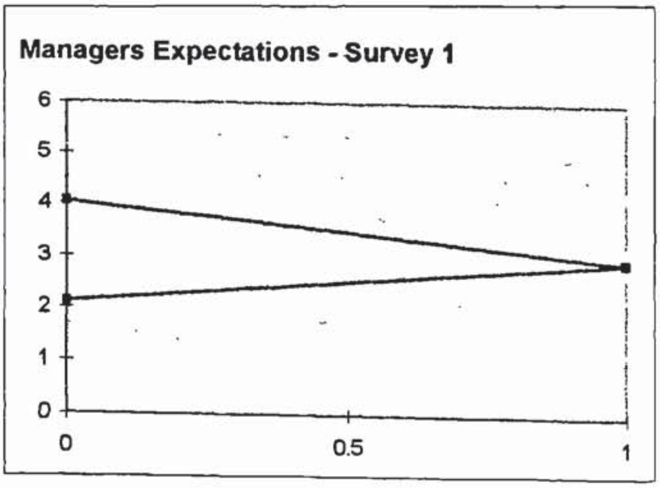


The score for recording messages is a Kernel value of 3.407 , with a Minimum of 2.481 and a Maximum of 4.407 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.111	3.037	4.037	.... sometimes employed for managing a personal task list

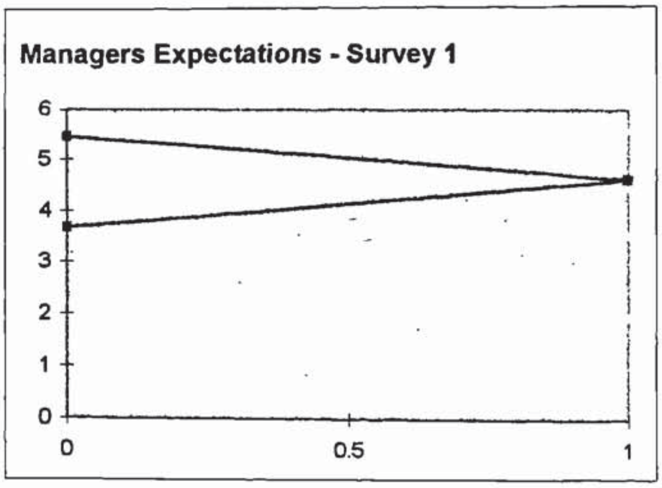


The score for managing a personal task list is a Kernel value of 3.037 , with a Minimum of 2.111 and a Maximum of 4.037 . The Kernel (most likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.667	4.667	5.444	.... indispensible to task for maintaining a personal diary



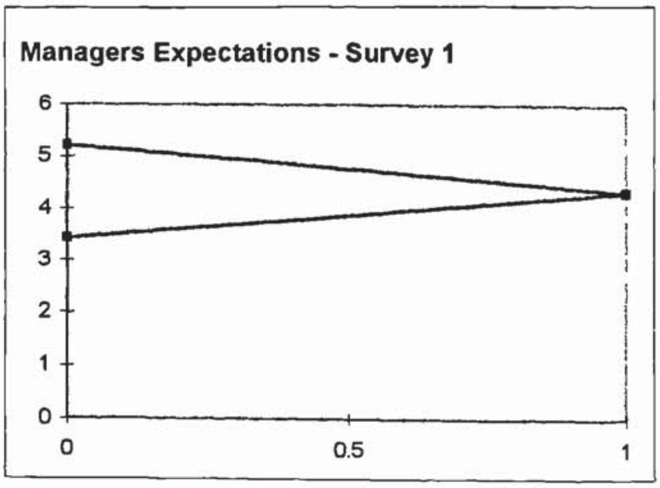
The score for maintaining a personal diary is a Kernel value of 4.667 , with a Minimum of 3.667 and a Maximum of 5.444 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for maintaining a personal diary.

scheduling meetings

Design

Min Kernel Max **Best supported hypothesis**

3.414 4.379 5.207 .... almost always employed for scheduling meetings



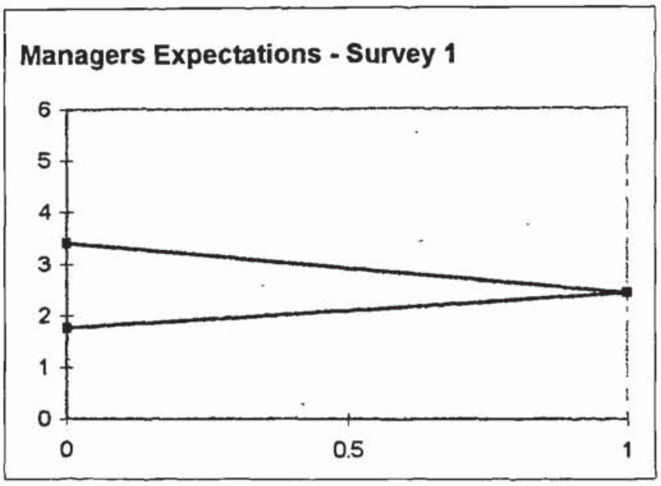
The score for scheduling meetings is a Kernel value of 4.379 , with a Minimum of 3.414 and a Maximum of 5.207 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for scheduling meetings.

as a telephone directory

Design

Min Kernel Max **Best supported hypothesis**

1.76 2.44 3.4 .... never employed for as a telephone directory



The score for as a telephone directory is a Kernel value of 2.44 , with a Minimum of 1.76 and a Maximum of 3.4 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently

4.4. STRUCTURED INTERVIEWS

4.4.1. Results

A series of short structured interviews was carried out following the administration of the first survey. These were conducted during March 1997 and covered a total of 22 staff using GroupWise, 13 of who were managers.

The method of carrying out the interviews and the structure of these interviews was as follows.

In order to gain approval for the use of the interview instrument across a range of individuals and departments it was not deemed appropriate to record interviews for later transcription and analysis. Accordingly it was decided to structure the interviews in a way that facilitated collection of summary responses from interviewees and subsequent analysis. An interview structure was constructed with a short series of questions which related to the same sorts of business tasks as had been included within the survey questionnaire. The structure consisted of a series of main questions (QL1) which were supported by supplemental questions (QL2, QL3). The level 1 questions were;

1. Give a brief description of your job role
2. What do you most use GroupWise for?
3. For what is GroupWise most useful for you?
4. Do you find GroupWise helpful for working in teams?
5. Do you find GroupWise helpful for preparing documents (reports etc.)?
6. Do you find GroupWise helpful for formal communications?
7. What are the best and worst things about GroupWise?
8. (How) do you judge your training on GroupWise to have been (Good, Adequate, Could have been better)?
9. (What is) your IT experience prior to using GroupWise?

These questions and the related underlying structure is more fully shown in the data collection format which is reproduced in Appendix 2.

The results of these interviews were collated in the table (Table 4.2) included in the following pages.

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Table 4.2. Analysis of structured interview responses.

	Most Use	Most Useful	T Work	Documents	F Comms	Best	Worst	Training
S1	*Responses to queries*	*Communication directly to people*	*Sharing Information*	*Saves time on photocopying*	*Minutes of meetings*	*Quick and getting responses*	*When system is down. Need for discipline in usage*	*Good*
S2	*Informal comms*	*Email*		*Receiving documents*	*Memos*	*Full featured package*	*Not very intuitive*	*None*
S3	*Group diary*	*Task scheduling and "alarm" function*	*Diary useful*		*Memos*	*Arranging meetings*	*Interruptions by messages can be intrusive*	*None*
S4	*Mail*	*Calendar and diary*		*Using attachments*	*Mail with attachments (?)*	*It is integrated, things work well together*	*Slow response*	*Adequate*
S5	*Scheduling meetings*	*Immediate communications in "writing"*	*Sub committee reports, reminders and messages*			*Easy to use, user friendly*	*People resist using it*	*Could have been better*
S6	*Reports*	*Diary and to-do lists*	*Committee reports and budget monitoring*	*Re-formulating documents prepared by others*	*Finance authorisations ?*	*Time saving in relation to reporting*	*Assumes expertise in the users*	*Adequate*
S7	*Diaries when responding to telephone calls*	*Organising meetings*	*Informal messages, quick to type on the screen*	*Minutes distribution*	*Messages instead of memos and faxes*	*Communications are easier, "instant"*	*Cuts down human contact, miss out on the personal touch*	*Adequate*
S8	*Diary, looking at others diaries*	*Diary*		*Occasionally use attachments*	*Sometimes messages but loath to use for confidential information*	*A good communications tool*	*Possible for people to "hide" away*	*Adequate*
S9	*Mail and messaging*	*Accurate diary*	*Diary , so that people can be covered for*	*Draft agendas*	*Committee reports*	*Diary*	*Sometime others diaries are "not available"*	*Good*
M1	*Formal and informal communications*	*Improving communications*	*Time management and diary within a small team*		*Communications with ITS e.g. orders*	*Helps improve communications*	*Reliability*	*Could have been better*

M2	*Communications*	*Communications and time and task management*		*"Bouncing" reports off others to get opinions*	*Could use but less happy about some uses*	*Easy and intuitive*	*Some product elements not present - "groupwork side not well developed*	*Good*
M3	*Messages, keeping people informed*	*Messages + communications "instantly"*	*Making sure people are not left out*		*Formalising wording of certain reports and memos*	*Easy to use*	*Poor printing facilities*	*Could have been better*
M4	*Messages*	*To assure delivery internally of messages*	*Sending mail to everyone within a team (within division and across divisions)*			*Enable fast decisions and feedback*	*Can interrupt what you are doing*	*Adequate*
M5	*Communicating with staff at JDH (intersite)*	*Quick and easy communications with a permanent track*			*Quicker than a memo to circulate to all members of staff*	*Easy to operate*	*Telephone messages are time consuming to handle. Difficult to delete or re-arrange meetings*	*Adequate*
M6	*Communications*	*Diary and task lists*	*Task management for teams*		*Task scheduling (20 to 25 per day)*	*Exercise more control and be more productive*	*Can be intrusive when messages and tasks "arrive"*	*Irrelevant*
M7	*Diary*	*Integrated facilities and timeliness*	*Management team agendas*		*Memos and documents for approval*	*Simple to use*	*Time management,*	*Adequate*
M8	*Diary management and to-do lists*	*Messages and meeting scheduling*		*Using folder mgt to mirror word-perfect files*	*memos and notes, reports via attachments*	*Arranging meetings*	*Not everyone on it and diaries not up to date. Technically fiddly.*	*Adequate*
M9	*"Nen" sorts of communication*	*Document transmission. Managing networks with documents. Efficiency*	*Agendas, minutes and draft documents*	*Sharing documents*	*Reports*	*Diary and calendar management*	*Printing out of diary!*	*Adequate*
M10	*Diary and calendar*	*Reminders and ability to leave messages when people are not*	*Mail within a small group (6 people)*			*Relatively easy to use*	*Coverage is not complete*	*Good*

		there						
M11	*Diary and calendar management and meeting scheduling*	*Resource management. Knowing where people are*		*Forwarding features*		*Immediate access to diaries*	*Tends to reduce "human" contact*	*Adequate*
M12	*Diary management*	*Email for communication with others (in ITS)*	*Team communications within a small teams (6 people)*	*Circulating agendas, minutes and papers*	*Reports and minutes*	*De-synchronisation of conversations as when questions are asked*	*"Bombardment" rate*	*Adequate to could have been better*
M13	*Informal internal mail, knowing documents have been sent. Diary and calendar*	*Diary and being able to access colleagues diaries*	*Messaging within small teams*	*Using attachments to point to useful documents, forwarding*	*Documents attached*	*Prettier but windows complicated*	*Lack of scrolling calendars. Lots of windows open.*	*good*

4.4.2. Congruence with Model

As described above, the respondent specified business tasks were examined and a total of 10 discernible tasks identified. Additionally a similar exercise was carried out with the data from the interviews taking into account the responses from the "Most Use" and "Most Useful" categories.

The following table presents an attempt to map the correspondence between the two sets of un-constrained responses and the questionnaire model.

	Respondent Specified Business Tasks		Interviewee Identified Business Tasks		
Business Task in Model				**Most Used**	**Most Useful**
Informal communications	"Informal Communications"	✓✓	"Informal Communications"	✓✓✓✓✓✓✓✓ ✓	✓✓✓✓✓✓
Co-ordination within teams					
	"Inspection of Others Diaries"	✓✓✓✓✓✓✓ ✓✓✓✓	"Group Diary"	✓✓✓✓✓✓✓✓ ✓	✓✓✓✓✓✓✓
Formal communications					
	"Broadcast Communications"	✓✓✓	"Response to Queries"	✓	
Processing documents using mail **attachments**	"Document Transmission"	✓✓✓✓✓✓✓	"Document Transmission and Management		✓
			"Reporting"	✓	
	"Auto-Filing Messages"	✓✓✓			
Confirming delivery of communications	"Confirming Messages Sent"	✓✓	"Confirming delivery of messages"	✓	✓✓
Recording messages			"Messages"		✓
Managing a personal task list	"Personal Task Management"	✓✓✓	*'task Scheduling"*		✓✓✓✓✓
	"Diary Management"	✓✓			
Managing a team task list					
Maintaining a personal diary					
Scheduling meetings	"Meeting Scheduling"	✓✓✓	"Meeting Scheduling"	✓✓	✓✓
As a telephone directory					

Figure 4.5. Congruences with questionnaire task model, *Survey* 1 and structured interviews.

4.5. RESULTS OF SURVEY 2

Survey 2 was carried out with a target of 250 staff employed in headquarters functions and in the large departments of Education and Social Services during September 1997. This survey was carried out via Email which proved successful in general but did result in the total "loss" of approximately 60 responses from the Education department. The other departments were able to respond effectively and there were 120 responses recorded across 5 departments.

4.5.1. Questionnaire - Qualitative Results

As in the first survey respondents were invited to give any comments upon GroupWise and their use of it in a free format. Additionally they were asked to supply brief details of business tasks which they did not feel fitted within those specified on the survey questionnaire and to score these self specified tasks in the same manner as for the specified ones.

This section contains details and analyses of the comments received and of the user specified tasks. However, in this case, a detail listing of the comments are not included.

Analysis and Findings.

In the second survey comments have been recorded for 68 of the 120 respondents. These have been subjected to a brief review and analysis, each being placed into one or more of 6 categories as follows.

Positive endorsement - as survey 1.

More people should be on GroupWise - as survey 1.

More/better training needed - as survey 1.

Technical limitations - as survey 1.

Additional functionality requested - As use of the system is expanding a growing number of thoughtful users are actively considering ways in which the use of the system could be enhanced by additional functionality. For example "work-flow" is mentioned on several occasions.

Negative reactions - as survey 1.

Categorisation of comments with percentage of total respondents and percentage of respondents with comments are shown below.

	Number	%	% who commented
Positive endorsement	20	17%	29%
More people should be on GroupWise	28	23%	41%
More/better training needed	10	8%	15%
Technical limitations	15	13%	22%
Additional functionality requested	5	4%	7%
Negative reactions	7	6%	10%

Figure 4.6. Respondent Specified Business Tasks, Survey 2.

Survey 1 (for comparison)

	Number	%	% who commented
Positive endorsement	11	9.6%	20.3%
More people should be on GroupWise	18	15.8%	33.33%
More/better training needed	7	6.1%	12.9%
Technical limltations	15	13.1%	27.7%
Negative reactions	3	2.6%	5.6%

Figure 4.7. Summary of Respondent Comments, Survey 1, (copy of 4.3.).

Respondent Specified Business Tasks

Respondents were invited to describe business tasks as in survey 1 and these were analysed using the same method. Each questionnaire returned was inspected to see if it contained any respondent specified business tasks. A total of 34 out of 120 recorded did so. The questionnaires with respondent specified tasks were then examined and each task which was judged to be distinctive identified separately. A total of 53 tasks were identified on the 34 questionnaires with "saturation" being achieved with 13 distinctive tasks as described in the table below.

Task description	Number of respondents specifying	% specifying
To inspect others diaries	10	29%
Automatic filing of messages	1	3%
Sending documents as attachments	8	24%
Accessing or sending broadcast information.	5	15%
Scheduling meetings	1	3%
Informal communications	5	15%
Own diary management	6	18%
Task allocation	4	12%
Recording reminders	2	6%
Recording messages	4	12%
Project management	1	3%
Resource management	2	6%
Recording annual leave	4	12%

Figure 4.8. Respondent Specified Business Tasks, Survey 2.

Qualitative Findings in Surveys 1 and 2, Comparisons

In general the qualitative findings that were revealed by survey 2 did not add significantly to those of survey 1 over and above a general reiteration of support for the concerns that had already been expressed about coverage and training. The two surveys were taken around 10 months apart during a time when coverage by GroupWise within the County Council was being extended. In these circumstances it is perhaps understandable that the number of concerns about coverage has declined whilst the recognisable concerns about technical limitations has started to exhibit itself through requests for technical enhancements. This is as might be expected as use of a technology was gradually extending to more and more users with ever widening interests and experiences.

4.5.2. Questionnaire - Task/Component Scores and Interpretation

Details of visualisation and interpretations for survey 2 are included in Appendix 3.

4.6. RESULTS OF SURVEY 3

Survey 3 was carried out with a target of 137 non-managers and 47 managers employed in Social Services during October 1998. The survey covered a total of 5 sites distributed geographically. This survey was again carried out using a paper questionnaire. There were 67 non-manager and 21 manager respondents.

4.6.1. Questionnaire - Qualitative Results

As in the first and second surveys, respondents were invited to give any comments upon GroupWise and their use of it in a free format. However, instead of being requested merely to add user specified business tasks, in the third survey respondents were requested to describe those business tasks for which they found the system most useful; thus:

"You are asked to briefly describe the 3 business tasks for which you find the application of GroupWise most useful."

The questionnaire comments and business task details are reported below separated into those supplied by non management users and those supplied by managers.

Table 4.3. Non Managers Comments, Survey 3.

Respondent	Comments
2	*I recently had to go a day without using GroupWise and I felt that my right hand was missing.*
3	*Still awaiting local offices (U. managers) to be put on GroupWise. Will be more useful to me personally when more people are linked.*
5	*It is only as good as the individual chooses to make it. For instance, maintaining personal diary so that meetings can be arranged. I get frustrated that not everyone has GroupWise.* *It would be good if bank holidays were marked in diaries from central point. In formal communications should be allowed in some way. Why wasn't this survey done on GroupWise.*
7	*GroupWise is invaluable in communicating with Sally's management colleagues in County Hall and John Dryden House* (remote sites to user) *There is tremendous scope for increasing efficiency of communications with the "coal face" - Children's Centres, St Johns - where widespread sites & shifts can delay things for 2/3 days.*
9	*Spell check could be helpful.*
13	*Now, indispensable. I don't speak verbally to many people, find out by letting my fingers do the talking.*
15	*Would be helpful if other sites were connected as much as we are, i.e.. more users.*
16	*I'm still awaiting full training/familiarisation on using GroupWise + currently only use it to read messages sent by other people - so above* (question about most useful application of GroupWise) *not really relevant at present.*
17	*AS I mainly communicate with staff based in the community such as home -carers and I myself are* (sic) *out working in the community I do not find GroupWise useful.* *I spend a lot of time deleting messages that are of no use to me ie :*

	ford fiesta with lights left on in Northampton when I am based in W"Boro (Wellinborough) *. Is there no way people can send messages to only those appropriate staff.*
19	*Vastly over-rated.* *Not an effective diary when most meetings involve outsiders. Rather slow and cumbersome (those who use it most probably have secretaries to sort it for them).* *I am not impressed.* *The amount of rubbish messages is huge and a hindrance - and guidelines on use are ignored.*
21	*I think it is a useful system. However being based centrally where GW is available is V. frustrating as the majority of people/teams I wish to communicate with i.e. MH Teams are not on GW.* *The diary facility is of no use to me as I am not in the office 1st thing quite often, therefore unless I had my own LAP" TOP or equivalent I cannot use it in other locations to see if others have asked to set up meetings.*
22	*Use of GroupWise is limited until the network of users is extensively increased - there needs to be a link with managers at all outlying units.*
23	*Electronical* (sic) *diary is excellent until the system goes down, which it has done. This almost enforces the use of paper diary as a back up. Printing weekly sheets of diary has its drawbacks as plans do change, appointments are cancelled.* *Unsociable.* *Abrupt.* *Very useful.*
26	*Would be indispensable if all were given access.*
28	*I feel that GroupWise is still used inappropriately for Cafeteria Menus. Training needs to be provided to ensure that messages are only sent to those people who messages is meant for; e.g. "Has anyone got any jump leads to help lady in distress who's car will not start in County Hall car part, Northampton. Since we are all in Wellingborough, did they really require our help???*
32	*I find GroupWise a extremely useful tool, within my role as operational support for ops managers/ Ideally it would an advantage* (sic) *if units were also on GroupWise and I am sure this is on the cards already, and other local offices.*
35	*Unfortunately a lot of the people I communicate with (EPH's) are not on GroupWise, but I do use it whenever possible.*
36	*It would work more efficiently + effectively when all (all SS units) have access to GroupWise.*
39	*As I am only in training section approx 1 x weekly, it can be time consuming.*
40	*Would like all users to keep the diary.* *Messages behind appointments could be highlighted on the diary in same way.* *Would be useful to be able to cross out messages/appointments in diary without deleting the,* *Could be used to pass on press releases, relevant to directorates.*
41	*As manager of a team of independent workers my use of GroupWise is limited because most of my communication is with people outside the department.* *I am trying to develop the habit of using GroupWise for internal communications but old habits die hard!*
45	*The limiting factors are - that not all people you wish to communicate with are on GroupWise + therefore duplicate some tasks.* *Notices to everyone about menus/events can sometimes lead to*

	annoyance when in the middle of an important task.
51	*When use of GroupWise is extended to other offices, will be more useful.*
54	*I find the top-down installation of GroupWise extremely limiting. Our service managers and teams are the people we most need daily, reliable communications with an they are NOT on GroupWise. The therefore continue to rely upon couriers (hopeless!). faxes + t'phones and reams of paper (poor forests!). I find the rubbish put onto GroupWise infuriating - sales, car park damage, skiing holidays etc.*
59	*I think the more facilities which use E-mail/The net the better - paper/photocopying costs will be saved & time!!* *E-mail is a neat/efficient way of diarising* (sic) *& keeping records/messages etc.*
61	*Some of the messages received are utter nonsense and merely clog up the system and waste my time.* *Please add more users onto system as not everyone I need to contact is included.*
63	*A useful tool but limited in value due to :-* *Lack of machines - I share with 5 others.* *Lack of access by non managerial/administrative staff to system.*
67	*I have found the system most useful after being rather doubtful at start, particularly over keeping a control over diary entries. However, the system does allow me to decline meetings & explain why.* *Telephone numbers in address book - very useful.* *Easy to keep a record of what is happening on any particular issue.* *I do not find it replaces a paper diary which is quicker to use & more versatile.*
68	*As I am only in the office 1/2 days a week - difficult to keep up to date.* *Most incoming mail not relevant to me.*
69	*I am part-time and find the diary facility both useful and frustrating.* *I share a PC with 4 others so cannot access info as quickly as receiving hand-written messages.* *I have yet to be convinces of its value.*
70	*One computer between 5 of us means that you can wait hours for you turn - especially problematic for part-time staff like myself.* *Ploughing through lots of irrelevant messages also takes a lots of time and increases stress levels.* *I'm sure it (and I) will get better with practice!* *I'm interested that you haven't asked for this information via GroupWise.*
72	*It would be beneficial for all units to be on GroupWise, this would enable the system to be used much more efficiently and to its full potential.*
73	*It would be better if there was more of our units on the system.*
76	*Excellent system, flawed only by complete clutter circulated to all and sundry and the fact I have had inadequate time to use it's full potential.*
78	*- useful if GroupWise could "link in" to other packages - e.g. so that an item on bring forward in an Excel spreadsheet or Access database against "A. Manager" could be used to click directly into GroupWise to chase up by taking straight into a mail message to "A. Manger",*
79	*I'd like to be able to use to connect to full internet rather than just intranet use.* *I'd like to use as a full face node to wider internet.*
81	*As a clerk, do not like using diary - hard on the eyes - easy to make mistakes in it.* *Useful for sending messages but do not use it a great deal.*

84	*I would find GroupWise more beneficial to me when it has expanded to the units, e.g. residential as most of my dealings are with people working in units etc.*
87	*None of the unit managers who are responsible to me are on the system. I get messages from people so far away but cannot communicate with staff in local offices. If it was widely available I would use it more.*

Table 4.4. Managers Comments, Survey 3.

Respondent	Comments
4	*The notify doesn't always enable you to read. I often have to go back to the main menu.* *A development I would like to see is the ability to book a personal appointment, immediately followed by a task but with all the previous details filled in and the ability to edit. My use for this would be:- "Booked an appointment and would like immediately enter a task relating to the appointment 1/2 days before for example - prepare papers"* *P.S. Please note scoring still affected by lack of availability to all users.*
12	*There are about 150 users within SC&H. As such it is a tool available only to a limited few. Need to achieve critical mass.* *There is no evidence that making it available to managers has significantly changed their thinking to the extent that they are willing to invest in hardware & infrastructure to make it more widely available.* *Need for an "add-on" to improve document handling/work-flow.*
33	*Only recently gone one.* *Not enough of my staff or staff in Health Authority where I need to contact on the system.* *Irritated by excess of social stuff advertising coffee mornings etc.*
34	*Please note none of my staff is currently on GroupWise and this severely limits usefulness. I have not completed the staff score. At least 50% of my communications are with other agencies, especially the Health Service.*
42	*My wish list for improvements is:* *Calendar-* - *entries don't show whether there is a note behind them* - *no facility for crossing out, only deleting entries* - *no easy facility for copying or pasting meeting, e.g. ctrl C* - *I'd like to synchronize with my Psion 5, but need Windows 95 not 3.1.* *E-mail* - *Personal address groups awkward to use*
46	*Majority of people still do not put their diary on G.W. making it very difficult to successfully use busy search.* *People expect you to respond immediately to G.W. messages - cultural change.* *Still unsure about which USERS actually use GroupWise.*
52	*Our biggest problem is that not all colleagues are on GW.* *Another is the Word 97* difficulty (obviously a backwards compatibility problem). *A nice feature would be for a SEARCH facility on keyword in title.*

65	*Until GroupWise is made available to managers and service units throughout the department the system will continue to have extremely limited application for me. None of the managers of service units which I work with on a regular basis are linked to GroupWise. Thus this questionnaire has been completed on the basis of its present usefulness not its potential.*
66	*Due to the limitations on the other office(s) who have access to GroupWise it means that mail merge documents and other important information through the post or by telephone which can cause a delay in completing arrangements.* *Also messages relating to the canteen at JDH or County Hall are totally irrelevant to staff in Oxford House.*
80	*I find it difficult when so many people I contact are not able to receive G.W.*
83	*The blanketing of GroupWise users by certain correspondents with irrelevant* correspondents (is a problem) *Having a shared workstation* (in some cases) *can prohibit greater use of the functions available.* *It will assist communication when all NCC establishments are connected - providing there is enough hardware for staff to access.*
85	*Although invaluable for corresponding with colleagues in JDH & County Hall the inability to communicate with out posted units is a major drawback.* *It is very frustrating to see GroupWise not being employed to maximum potential.*
88	- *I have answered the questionnaire accurately from my perspective and in anticipating its method of use by my staff who have only just received the facility (2 weeks).* - *I would like the ability to log in at different sites and machines to read and sent messages. I'm not sure if this is possible without taking my laptop and having a docking station. Particularly as I am fully mobile.* - *I do sometimes fear the abuse of GroupWise i.e. people almost refusing to communicate verbally which can lead to many problems, particularly with relationships.* - *I also fear the "overload" aspects of GroupWise when one is bombarded with messages you can feel pressurised and out of control.* - *It is also potentially a very intimidating method of communication.* - *(As an aside, before I joined NCC I worked for another authority which had an internal e-mail system and will be interested to see if the pattern of use and some of the problems and benefits are replicated.*

Summary of Qualitative Responses

In the third survey comments have been recorded for 52 of the 88 respondents. These have been subjected to a brief review and analysis, each being placed into one or more of 7 categories as follows.

Positive endorsement - as survey 1.

More people should be on GroupWise - as survey 1 but with many respondents more precisely identifying why greater coverage was desirable.

More/better training needed - as survey 1.

Technical limitations - as survey 1.

Additional functionality requested - as survey 2

Negative reactions - as survey 1.

Concerns expressed about inappropriate use - respondents in the earlier surveys had also mentioned inappropriate use of the system by some users. However, in survey 3 there was a discernible flavour of increased irritation registered in the comments recorded.

Categorisation of comments with percentage of total respondents and percentage of respondents with comments are shown below.

	Number	%	% who commented
Positive endorsement	4	5%	8%
More people should be on GroupWise	19	22%	37%
More/better training needed	1	<2%	<2%
Technical limitations	5	6%	10%
Additional functionality requested	6	7%	12%
Negative reactions	3	3%	6%
Concern with inappropriate use	6	7%	12%

Figure 4.9. Summary of Respondent Comments, Survey 3.

Respondent Most Useful Business Tasks

Respondents were invited to briefly describe the 3 business tasks for which they found GroupWise most useful. These were examined in detail and responses grouped according to the description of the tasks provided and, wherever possible, that corresponded to those already recorded for the earlier surveys. In contrast with the first 2 surveys, the respondents in this survey all provided information on most useful business tasks. Responses for 67 non managers and 21 managers were recorded and the results are summarised below.

Task description	Non Managers		Managers	
	No.	%	No.	%
To inspect others diaries/own diary management	44	66%	11	52%
Message management	7	10%	1	5%
Sending documents as attachments	9	13%	6	29%
Accessing or sending broadcast information.	3	4%	1	5%
Scheduling meetings	34	51%	13	62%
Informal communications	39	58%	6	29%
Task List Management	20	30%	5	24%

Figure 4.10. Business Tasks for which GroupWise is Most Useful, Survey 3.

Qualitative Findings - Commentary

In general the issues and concerns expressed by respondents in survey 3 mirror those obtained from earlier surveys. Additionally, the selection of most useful application of GroupWise to business tasks seems to reflect the results from earlier requests for user specified business tasks.

The first major message that emerges from the comments in survey 3 is a concern with coverage, the number of people who are on the system and able to communicate using it. A careful reading of the comments reveals that those respondents who express the desire for further coverage seem in little doubt of how they would employ the system to communicate with a wider group of work colleagues. These comments are focused upon the possibilities of the system in a way that comments from earlier surveys are not. It seems that some form of critical point has been reached beyond which only an order of magnitude increase in the number of users able to access the system can fulfil the pent-up demand to communicate.

Despite the lack of coverage issue however, the most useful applications of GroupWise remain those associated with diary management, meeting scheduling and informal communications. (This is a useful triangulation with the fuzzy scores recorded.)

The suggestion that many staff are abusing the facilities provided by GroupWise emerges in a somewhat more pointed focused form than in the earlier surveys. This may be a reflection of an increase in the problem because of the increased coverage.

Finally, an interesting difference may be signalled within the comments by differences in the responses of managers and non managers. Whereas 58% of non managers list informal communications as a most useful task, only 29% of managers do so. Moreover, the situation is reversed in the case of the use of document attachments, 29% of managers listing this as a most useful task and only 13% of non managers. The latter result undoubtedly reflects, at least in part, differences in the nature of managers and non managers jobs. However, it is also possible that these two items taken together are suggestive of a different perspective as between the two groups. Possibly managers are more likely to articulate the use of GroupWise in a business connected and formal way. Non managers by contrast, are not thinking of the use of the technology in as focused a fashion, but articulate its use and function in relation to a more social rather than business context.

4.6.2. Questionnaire - Task/Component Scores and Analyses

Details of visualisation and interpretations for survey 3 are included in Appendix 3.

4.7. SUMMARIES, COMPARISONS AND PATTERNS

4.7.1. All Surveys - Summary Tables

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indisponsible to task

All departments surveyed

Survey 1

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	*Informal communications*	3	1	23	39	39	14	3.303	4.277	5.160	119	4.277	4	4	frequently employed
2	Co-ordination within teams	8	14	34	37	16	9	2.627	3.559	4.483	118	3.559	4	4	frequently employed
3	Formal communications	10	17	28	27	32	5	2.664	3.580	4.538	119	3.580	5	4	frequently employed
4	Processing documents using mail attachments	24	20	32	28	10	4	2.136	2.932	3.898	118	2.932	3	3	sometimes employed
5	Confirming delivery of communications	7	22	20	24	30	14	2.829	3.769	4.650	117	3.769	5	4	frequently employed
6	Recording messages	15	14	19	24	32	14	2.856	3.729	4.610	118	3.729	5	4	frequently employed
7	Managing a personal task list	26	21	19	16	25	10	2.419	3.197	4.111	117	3.197	1	1	never employed
8	Managing a team task list	44	27	16	15	9	3	1.746	2.360	3.333	114	2.360	1	1	never employed
9	Maintaining a personal diary	11	6	3	13	44	40	3.744	4.650	5.308	117	4.650	5	6	indispensible to task
10	Scheduling meetings	7	7	7	19	35	42	3.718	4.658	5.299	117	4.658	6	6	indispensible to task
11	As a telephone directory	59	22	15	13	3	5	1.598	2.094	3.051	117	2.094	1	1	never employed
12	All business tasks							2.694	3.528	4.404					

Survey 2

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	6	11	24	48	23	6	2.805	3.754	4.703	118	3.754	4	4	frequently employed
2	Co-ordination within teams	14	18	27	33	16	10	2.534	3.415	4.331	118	3.415	4	3	sometimes employed
3	Formal communications	11	13	38	33	16	6	2.504	3.410	4.359	117	3.410	3	4	frequently employed
4	Processing documents using mail attachments	11	22	38	22	19	5	2.359	3.265	4.222	117	3.265	3	3	sometimes employed
5	Confirming delivery of communications	14	27	32	19	13	13	2.364	3.246	4.136	118	3.246	3	3	sometimes employed
6	Recording messages	19	31	27	20	12	6	2.104	2.939	3.887	115	2.939	2	3	sometimes employed
7	Managing a personal task list	38	19	16	13	12	19	2.316	2.991	3.829	117	2.991	1	1	never employed
8	Managing a team task list	51	20	16	13	11	5	1.819	2.379	3.336	116	2.379	1	1	never employed
9	Maintaining a personal diary	10	9	8	17	34	37	3.539	4.452	5.130	115	4.452	6	6	indispensible to task
10	Scheduling meetings	16	8	14	16	35	26	3.217	4.078	4.852	115	4.078	5	6	indispensible to task
11	As a telephone directory	47	23	15	17	5	8	1.835	2.426	3.357	115	2.426	1	1	never employed
12	All business tasks							2.491	3.305	4.195					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

All and Expectations

Survey 1 All Departments

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	3	1	23	39	39	14	3.303	4.277	5.160	119	4.277	4	4	frequently employed
2	Co-ordination within teams	8	14	34	37	16	9	2.627	3.559	4.483	118	3.559	4	4	frequently employed
3	Formal communications	10	17	28	27	32	5	2.664	3.580	4.538	119	3.580	5	4	frequently employed
4	Processing documents using mail attachments	24	20	32	28	10	4	2.136	2.932	3.898	118	2.932	3	3	sometimes employed
5	Confirming delivery of communications	7	22	20	24	30	14	2.829	3.769	4.650	117	3.769	5	4	frequently employed
6	Recording messages	15	14	19	24	32	14	2.856	3.729	4.610	118	3.729	5	4	frequently employed
7	Managing a personal task list	26	21	19	16	25	10	2.419	3.197	4.111	117	3.197	1	1	never employed
8	Managing a team task list	44	27	16	15	9	3	1.746	2.360	3.333	114	2.360	1	1	never employed
9	Maintaining a personal diary	11	6	3	13	44	40	3.744	4.650	5.308	117	4.650	5	6	indispensible to task
10	Scheduling meetings	7	7	7	19	35	42	3.718	4.658	5.299	117	4.658	6	6	indispensible to task
11	As a telephone directory	59	22	15	13	3	5	1.598	2.094	3.051	117	2.094	1	1	never employed
12	All business tasks							2.694	3.528	4.404					

Survey 1 Expectations

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	2	6	17	5	0	2.833	3.833	4.833	30	3.833	4	4	frequently employed
2	Co-ordination within teams	1	3	12	10	2	0	2.357	3.321	4.321	28	3.321	3	3	sometimes employed
3	Formal communications	1	1	9	12	5	0	2.714	3.679	4.679	28	3.679	4	4	frequently employed
4	Processing documents using mail attachments	2	1	12	8	5	0	2.536	3.464	4.464	28	3.464	3	4	frequently employed
5	Confirming delivery of communications	2	4	10	8	1	2	2.370	3.296	4.222	27	3.296	3	3	sometimes employed
6	Recording messages	2	5	6	8	6	0	2.481	3.407	4.407	27	3.407	4	4	frequently employed
7	Managing a personal task list	2	6	10	7	2	0	2.111	3.037	4.037	27	3.037	3	3	sometimes employed
8	Managing a team task list	7	9	7	3	0	0	1.500	2.231	3.231	26	2.231	2	2	seldom employed
9	Maintaining a personal diary	0	3	1	4	13	6	3.667	4.667	5.444	27	4.667	5	6	indispensible to task
10	Scheduling meetings	1	2	3	7	11	5	3.414	4.379	5.207	29	4.379	5	5	almost always employed
11	As a telephone directory	8	6	6	3	1	1	1.760	2.440	3.400	25	2.440	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.522	3.432	4.386					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

All and ITS

Survey 1 All Departments

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	*Informal communications*	3	1	23	39	39	14	3.303	4.277	5.160	119	4.277	4	4	frequently employed
2	*Co-ordination within teams*	8	14	34	37	16	9	2.627	3.559	4.483	118	3.559	4	4	frequently employed
3	Formal communications	10	17	28	27	32	5	2.664	3.580	4.538	119	3.580	5	4	frequently employed
4	*Processing documents using mail attachments*	24	20	32	28	10	4	2.136	2.932	3.898	118	2.932	3	3	sometimes employed
5	Confirming delivery of communications	7	22	20	24	30	14	2.829	3.769	4.650	117	3.769	5	4	frequently employed
6	Recording messages	15	14	19	24	32	14	2.856	3.729	4.610	118	3.729	5	4	frequently employed
7	*Managing a personal task list*	26	21	19	16	25	10	2.419	3.197	4.111	117	3.197	1	1	never employed
8	Managing a team task list	44	27	16	15	9	3	1.746	2.360	3.333	114	2.360	1	1	never employed
9	Maintaining a personal diary	11	6	3	13	44	40	3.744	4.650	5.308	117	4.650	5	6	indispensible to task
10	Scheduling meetings	7	7	7	19	35	42	3.718	4.658	5.299	117	4.658	6	6	indispensible to task
11	As a telephone directory	59	22	15	13	3	5	1.598	2.094	3.051	117	2.094	1	1	never employed
12	All business tasks							2.694	3.528	4.404					

Survey 1 ITS

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	0	4	11	11	4	3.500	4.500	5.367	30	4.500	4	5	almost always employed
2	Co-ordination within teams	0	5	3	12	7	3	3.000	4.000	4.900	30	4.000	4	5	almost always employed
3	Formal communications	0	3	1	8	14	4	3.500	4.500	5.367	30	4.500	5	5	almost always employed
4	Processing documents using mail attachments	4	3	7	8	7	0	2.517	3.379	4.379	29	3.379	4	4	frequently employed
5	Confirming delivery of communications	1	5	4	3	9	6	3.179	4.143	4.929	28	4.143	5	6	indispensible to task
6	Recording messages	0	2	4	6	13	5	3.500	4.500	5.333	30	4.500	5	5	almost always employed
7	Managing a personal task list	3	5	3	2	12	3	2.964	3.857	4.750	28	3.857	5	6	indispensible to task
8	Managing a team task list	3	13	2	4	6	0	2.000	2.893	3.893	28	2.893	2	3	sometimes employed
9	Maintaining a personal diary	3	1	1	4	11	8	3.643	4.536	5.250	28	4.536	5	6	indispensible to task
10	Scheduling meetings	2	0	0	5	11	10	3.964	4.893	5.536	28	4.893	5	6	indispensible to task
11	As a telephone directory	6	7	5	8	1	1	2.000	2.786	3.750	28	2.786	4	3	sometimes employed
12	All business tasks	0	0	0	0	0	0	3.070	3.999	4.859					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Personnel and Land & Buildings

Personnel (Survey 1)

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	0	1	2	4	6	4.154	5.154	5.692	13	5.154	6	6	indispensible to task
2	Co-ordination within teams	0	1	4	3	4	1	3.000	4.000	4.923	13	4.000	3	4	*frequently employed*
3	Formal communications	0	4	2	3	4	0	2.538	3.538	4.538	13	3.538	2	4	frequently employed
4	Processing documents using mail attachments	3	5	1	3	1	0	1.769	2.538	3.538	13	2.538	2	1	never employed
5	Confirming delivery of communications	1	0	2	3	3	4	3.538	4.462	5.154	13	4.462	6	6	indispensible to task
6	Recording messages	0	0	0	5	4	4	3.923	4.923	5.615	13	4.923	4	5	almost always employed
7	Managing a personal task list	1	4	3	3	1	1	2.231	3.154	4.077	13	3.154	2	3	sometimes employed
8	Managing a team task list	5	4	1	3	0	0	1.538	2.154	3.154	13	2.154	1	1	never employed
9	*Maintaining a personal diary*	0	1	2	1	5	4	3.692	4.692	5.385	13	4.692	5	6	indispensible to task
10	Scheduling meetings	0	1	1	1	2	8	4.154	5.154	5.538	13	5.154	6	6	*indispensible to task*
11	As a telephone directory	4	3	2	1	0	3	2.231	2.923	3.692	13	2.923	1	1	*never employed*
12	All business tasks	0	0	0	0	0	0	2.979	3.881	4.664					

Land & Buildings (Survey 2)

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	2	1	3	4	2	0	2.417	3.250	4.250	12	3.250	4	4	frequently employed
2	Co-ordination within teams	0	2	7	2	1	0	2.167	3.167	4.167	12	3.167	3	3	sometimes employed
3	Formal communications	2	1	2	5	2	0	2.500	3.333	4.333	12	3.333	4	4	frequently employed
4	Processing documents using mail attachments	1	4	3	1	2	1	2.250	3.167	4.083	12	3.167	2	3	sometimes employed
5	Confirming delivery of communications	2	2	4	2	0	2	2.333	3.167	4.000	12	3.167	3	3	sometimes employed
6	Recording messages	3	2	4	2	1	0	1.917	2.667	3.667	12	2.667	3	2	seldom employed
7	Managing a personal task list	3	3	1	1	3	1	2.333	3.083	4.000	12	3.083	1	1	never employed
8	Managing a team task list	5	2	0	2	2	1	2.167	2.750	3.667	12	2.750	1	1	never employed
9	Maintaining a personal diary	1	2	1	2	4	1	2.909	3.818	4.727	11	3.818	5	5	almost always employed
10	Scheduling meetings	4	0	1	0	4	2	2.909	3.545	4.364	11	3.545	1	6	indispensible to task
11	As a telephone directory	3	4	2	1	0	1	1.727	2.455	3.364	11	2.455	2	1	never employed
12	All business tasks	0	0	0	0	0	0	2.330	3.127	4.056					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Finance and Admin

Survey 1

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	0	5	5	11	1	3.364	4.364	5.318	22	4.364	5	4	frequently employed
2	Co-ordination within teams	0	3	5	12	2	0	2.591	3.591	4.591	22	3.591	4	3	sometimes employed
3	Formal communications	2	2	6	5	7	0	2.682	3.591	4.591	22	3.591	5	4	frequently employed
4	Processing documents using mail attachments	2	4	11	4	1	0	2.000	2.909	3.909	22	2.909	3	3	sometimes employed
5	Confirming delivery of communications	1	3	4	7	6	1	2.818	3.773	4.727	22	3.773	4	4	frequently employed
6	Recording messages	1	2	4	6	6	3	3.091	4.045	4.909	22	4.045	4	4	frequently employed
7	Managing a personal task list	2	2	4	6	6	2	2.909	3.818	4.727	22	3.818	4	4	frequently employed
8	Managing a team task list	6	6	5	2	2	0	1.714	2.429	3.429	21	2.429	1	1	never employed
9	Maintaining a personal diary	0	0	0	2	10	10	4.364	5.364	5.909	22	5.364	5	6	indispensible to task
10	Scheduling meetings	0	0	1	5	11	5	3.909	4.909	5.682	22	4.909	5	6	indispensible to task
11	As a telephone directory	9	7	5	0	1	0	1.364	1.955	2.955	22	1.955	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.800	3.704	4.613					

Survey 2

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	0	2	4	7	0	3.385	4.385	5.385	13	4.385	5	4	frequently employed
2	Co-ordination within teams	0	2	1	8	2	0	2.769	3.769	4.769	13	3.769	4	4	frequently employed
3	Formal communications	0	2	1	5	3	2	3.154	4.154	5.000	13	4.154	4	5	almost always employed
4	Processing documents using mail attachments	0	2	2	4	5	0	2.923	3.923	4.923	13	3.923	5	4	frequently employed
5	Confirming delivery of communications	0	1	3	3	4	2	3.231	4.231	5.077	13	4.231	5	4	frequently employed
6	Recording messages	1	2	2	4	3	1	2.769	3.692	4.615	13	3.692	4	4	frequently employed
7	Managing a personal task list	3	1	1	2	3	3	3.000	3.769	4.538	13	3.769	1	6	indispensible to task
8	Managing a team task list	3	4	1	1	4	0	2.154	2.923	3.923	13	2.923	2	1	never employed
9	Maintaining a personal diary	0	1	0	2	3	7	4.154	5.154	5.615	13	5.154	6	6	indispensible to task
10	Scheduling meetings	0	1	0	3	4	5	3.923	4.923	5.538	13	4.923	6	6	indispensible to task
11	As a telephone directory	2	2	4	3	1	1	2.308	3.154	4.077	13	3.154	3	3	sometimes employed
12	All business tasks	0	0	0	0	0	0	3.070	4.007	4.860					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Survey 1

		Frequencies						Fuzzy Score						Policy	
Number	Business Task Details	1	2	3	4	5	6	Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	1	0	3	7	3	1	3.000	3.933	4.867	15	3.933	4	4	frequently employed
2	Co-ordination within teams	3	2	5	4	0	1	2.133	2.933	3.867	15	2.933	3	3	sometimes employed
3	Formal communications	4	5	2	2	2	0	1.800	2.533	3.533	15	2.533	2	1	never employed
4	Processing documents using mail attachments	5	3	5	2	0	0	1.600	2.267	3.267	15	2.267	1	2	seldom employed
5	Confirming delivery of communications	4	2	5	3	1	0	1.933	2.667	3.667	15	2.667	3	2	seldom employed
6	Recording messages	0	3	5	3	3	0	2.429	3.429	4.429	14	3.429	3	4	frequently employed
7	Managing a personal task list	7	1	4	1	1	1	1.867	2.400	3.333	15	2.400	1	1	never employed
8	Managing a team task list	10	1	2	2	0	0	1.400	1.733	2.733	15	1.733	1	1	never employed
9	Maintaining a personal diary	3	2	0	2	5	3	3.067	3.867	4.667	15	3.867	5	6	indispensible to task
10	Scheduling meetings	1	3	2	1	5	3	3.067	4.000	4.800	15	4.000	5	6	indispensible to task
11	As a telephone directory	14	0	1	0	0	0	1.067	1.133	2.133	15	1.133	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.124	2.809	3.754					

Survey 2

		Frequencies						Fuzzy Score							
Number	Business Task Details	1	2	3	4	5	6	Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	0	1	3	3	2	1	2.900	3.900	4.800	10	3.900	3	4	frequently employed
2	Co-ordination within teams	0	2	1	4	1	2	3.000	4.000	4.800	10	4.000	4	5	almost always employed
3	Formal communications	1	2	2	3	0	1	2.333	3.222	4.111	9	3.222	4	3	sometimes employed
4	Processing documents using mail attachments	1	1	4	2	2	0	2.400	3.300	4.300	10	3.300	3	4	frequently employed
5	Confirming delivery of communications	1	3	3	0	1	2	2.400	3.300	4.100	10	3.300	2	2	seldom employed
6	Recording messages	1	2	4	0	2	1	2.400	3.300	4.200	10	3.300	3	2	seldom employed
7	Managing a personal task list	3	1	2	1	0	3	2.600	3.300	4.000	10	3.300	1	1	never employed
8	Managing a team task list	2	1	3	2	1	1	2.400	3.200	4.100	10	3.200	3	4	frequently employed
9	Maintaining a personal diary	1	1	1	4	2	1	2.900	3.800	4.700	10	3.800	4	5	almost always employed
10	Scheduling meetings	1	1	3	1	2	2	2.900	3.800	4.600	10	3.800	3	6	indispensible to task
11	As a telephone directory	5	1	1	1	0	2	2.100	2.600	3.400	10	2.600	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.576	3.429	4.283					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Planning

Survey 1

Number	**Business Task Details**	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	1	0	5	9	5	1	3.000	3.952	4.905	21	3.952	4	4	frequently employed
2	Co-ordination within teams	4	0	9	4	1	2	2.400	3.200	4.100	20	3.200	3	4	frequently employed
3	Formal communications	3	2	11	3	2	0	2.095	2.952	3.952	21	2.952	3	4	frequently employed
4	Processing documents using mail attachments	6	2	3	7	1	2	2.333	3.048	3.952	21	3.048	4	1	never employed
5	Confirming delivery of communications	0	6	2	5	7	1	2.762	3.762	4.714	21	3.762	5	4	frequently employed
6	Recording messages	6	5	3	2	4	1	2.095	2.810	3.762	21	2.810	1	1	never employed
7	Managing a personal task list	5	7	3	2	2	2	2.000	2.762	3.667	21	2.762	2	1	never employed
8	Managing a team task list	10	2	3	3	1	1	1.800	2.300	3.250	20	2.300	1	1	never employed
9	Maintaining a personal diary	2	1	0	2	8	8	3.857	4.762	5.381	21	4.762	5	6	indispensible to task
10	Scheduling meetings	2	0	3	3	2	11	3.810	4.714	5.190	21	4.714	6	6	indispensible to task
11	As a telephone directory	16	4	0	1	0	0	1.095	1.333	2.333	21	1.333	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.477	3.236	4.110					

Survey 2

Number	**Business Task Details**	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	1	2	5	9	3	3	2.913	3.870	4.739	23	3.870	4	4	frequently employed
2	Co-ordination within teams	4	6	4	3	2	4	2.391	3.217	4.043	23	3.217	2	2	seldom employed
3	Formal communications	2	3	7	5	4	1	2.500	3.409	4.364	22	3.409	3	4	frequently employed
4	Processing documents using mail attachments	4	4	5	4	2	3	2.409	3.227	4.091	22	3.227	3	3	sometimes employed
5	Confirming delivery of communications	3	5	7	4	3	1	2.217	3.087	4.043	23	3.087	3	3	sometimes employed
6	Recording messages	5	7	3	4	1	2	2.000	2.773	3.682	22	2.773	2	1	never employed
7	Managing a personal task list	7	4	6	4	0	2	1.957	2.652	3.565	23	2.652	1	1	never employed
8	Managing a team task tist	11	2	5	2	1	2	1.870	2.391	3.304	23	2.391	1	1	never employed
9	Maintaining a personal diary	3	0	1	5	9	5	3.522	4.391	5.174	23	4.391	5	6	indispensible to task
10	Scheduling meetings	4	1	3	8	3	4	2.913	3.739	4.565	23	3.739	4	5	almost always employed
11	As a telephone directory	15	2	0	3	1	2	1.739	2.087	3.000	23	2.087	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.403	3.168	4.052					

Social Services

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Survey 2

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best Supported	
1	*Informal* communications	3	6	8	21	5	2	2.622	3.556	4.511	45	3.556	4	3	sometimes employed
2	Co-ordination within teams	7	5	11	12	7	3	2.511	3.356	4.289	45	3.356	4	4	frequently employed
3	Formal communications	3	4	20	9	7	2	2.489	3.422	4.378	45	3.422	3	4	frequently employed
4	Processing documents using mail attachments	4	9	17	8	6	1	2.222	3.133	4.111	45	3.133	3	3	sometimes employed
5	Confirming delivery of communications	5	13	11	9	1	5	2.182	3.068	3.955	44	3.068	2	3	sometimes employed
6	Recording messages	6	14	12	8	1	2	1.907	2.767	3.721	43	2.767	2	3	sometimes employed
7	Managing a personal task list	18	7	4	5	4	6	2.136	2.727	3.591	44	2.727	1	1	never employed
8	Managing a team task list	24	9	4	3	3	1	1.523	1.977	2.955	44	1.977	1	1	never employed
9	Maintaining a personal diary	5	4	3	3	11	17	3.558	4.442	5.047	43	4.442	6	6	indispensible to task
10	Scheduling meetings	6	4	5	4	15	9	3.186	4.047	4.837	43	4.047	5	6	indispensible to task
11	As a telephone directory	17	10	5	7	2	2	1.767	2.372	3.326	43	2.372	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.373	3.170	4.065					

Survey 3

Number	*Business Task Details*	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best Supported	
1	Informal communications	4	7	19	28	27	3	2.909	3.864	4.830	88	3.864	4	4	frequently employed
2	Co-ordination within teams	9	12	15	27	21	4	2.682	3.580	4.534	88	3.580	4	4	frequently employed
3	Formal communications	6	15	22	21	21	3	2.580	3.511	4.477	88	3.511	3	4	frequently employed
4	Processing documents using mail attachments	17	13	23	18	9	8	2.341	3.148	4.057	88	3.148	3	3	sometimes employed
5	Confirming delivery of communications	16	20	21	13	11	7	2.227	3.045	3.966	88	3.045	3	2	seldom employed
6	Recording messages	15	22	23	16	8	4	2.080	2.909	3.864	88	2.909	3	3	sometimes employed
7	Managing a personal task list	24	22	9	15	11	7	2.136	2.864	3.784	88	2.864	1	1	never employed
8	Managing a team task list	32	22	10	13	7	4	1.830	2.466	3.420	88	2.466	1	1	never employed
9	Maintaining a personal diary	12	7	8	10	23	28	3.375	4.239	4.920	88	4.239	6	6	indispensible to task
10	Scheduling meetings	14	7	10	12	23	22	3.170	4.011	4.761	88	4.011	5	6	indispensible to task
11	As a telephone directory	20	14	16	14	13	11	2.443	3.216	4.091	88	3.216	1	1	never employed
12	*All business tasks*	0	0	0	0	0	0	2.525	3.350	4.246					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Social Services

Survey 3

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	*Informal communications*	4	7	19	28	27	3	2.909	3.864	4.830	88	3.864	4	4	frequently employed
2	Co-ordination within teams	9	12	15	27	21	4	2.682	3.580	4.534	88	3.580	4	4	frequently employed
3	Formal communications	6	15	22	21	21	3	2.580	3.511	4.477	88	3.511	3	4	frequently employed
4	Processing documents using mail attachments	17	13	23	18	9	8	2.341	3.148	4.057	88	3.148	3	3	sometimes employed
5	Confirming delivery of communications	16	20	21	13	11	7	2.227	3.045	3.966	88	3.045	3	2	seldom employed
6	Recording messages	15	22	23	16	8	4	2.080	2.909	3.864	88	2.909	3	3	sometimes employed
7	Managing a personal task list	24	22	9	15	11	7	2.136	2.864	3.784	88	2.864	1	1	never employed
8	Managing a team task list	32	22	10	13	7	4	1.830	2.466	3.420	88	2.466	1	1	never employed
9	Maintaining a personal diary	12	7	8	10	23	28	3.375	4.239	4.920	88	4.239	6	6	indispensible to task
10	Scheduling meetings	14	7	10	12	23	22	3.170	4.011	4.761	88	4.011	5	6	indispensible to task
11	As a telephone directory	20	14	16	14	13	11	2.443	3.216	4.091	88	3.216	1	1	never employed
12	*All business tasks*	0	0	0	0	0	0	2.525	3.350	4.246					

Survey 3 Expectations

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	3	2	3	7	5	1	2.714	3.571	4.524	21	3.571	4	4	frequently employed
2	Co-ordination within teams	4	3	3	5	4	2	2.571	3.381	4.286	21	3.381	4	4	frequently employed
3	Formal communications	3	1	5	6	4	2	2.762	3.619	4.524	21	3.619	4	4	frequently employed
4	Processing documents using mail attachments	4	2	4	6	2	3	2.619	3.429	4.286	21	3.429	4	4	frequently employed
5	Confirming delivery of communications	6	6	3	3	0	3	2.000	2.714	3.571	21	2.714	1	1	never employed
6	Recording messages	3	5	3	4	4	2	2.476	3.333	4.238	21	3.333	2	3	sometimes employed
7	Managing a personal task list	5	2	4	4	5	1	2.476	3.238	4.190	21	3.238	1	4	frequently employed
8	*Managing a team task list*	7	4	1	4	2	3	2.286	2.952	3.810	21	2.952	1	1	never employed
9	Maintaining a personal diary	4	0	1	3	8	5	3.429	4.238	5.000	21	4.238	5	6	indispensible to task
10	Scheduling meetings	3	0	4	4	7	3	3.143	4.000	4.857	21	4.000	5	4	*frequently employed*
11	As a telephone directory	6	3	3	2	5	2	2.429	3.143	4.048	21	3.143	1	1	*never employed*
12	All business tasks	0	0	0	0	0	0	2.628	3.420	4.303					

Scoring

1 never employed
2 seldom employed
3 sometimes employed
4 frequently employed
5 almost always employed
6 indispensible to task

Social Services - Managers & Non Managers

Survey 3 Non Managers

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	2	6	14	21	22	2	2.940	3.910	4.881	67	3.910	5	4	frequently employed
2	Co-ordination within teams	5	9	11	24	17	1	2.701	3.627	4.612	67	3.627	4	4	frequently employed
3	Formal communications	4	12	19	16	14	2	2.507	3.448	4.418	67	3.448	3	4	frequently employed
4	Processing documents using mail attachments	13	12	17	14	7	4	2.224	3.030	3.970	67	3.030	3	3	sometimes employed
5	Confirming delivery of communications	11	16	14	10	11	5	2.299	3.134	4.060	67	3.134	2	2	seldom employed
6	Recording messages	11	17	16	15	6	2	2.075	2.910	3.881	67	2.910	2	3	sometimes employed
7	Managing a personal task list	17	16	6	14	9	5	2.209	2.955	3.881	67	2.955	1	1	never employed
8	Managing a team task list	24	17	7	12	5	2	1.806	2.448	3.418	67	2.448	1	1	never employed
9	*Maintaining a personal diary*	9	7	8	6	18	19	3.239	4.104	4.821	67	4.104	6	6	indispensible to task
10	*Scheduling meetings*	11	7	8	9	16	16	3.060	3.896	4.657	67	3.896	5	6	*indispensible to task*
11	As a telephone directory	15	11	13	11	8	9	2.418	3.194	4.060	67	3.194	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.498	3.332	4.242					

Survey 3 Managers

Number	Business Task Details	Frequencies 1	2	3	4	5	6	Fuzzy Score Min	Kernel	Max	No.	Mean	Mode	Best	Supported
1	Informal communications	2	1	5	7	5	1	2.810	3.714	4.667	21	3.714	4	4	frequently employed
2	Co-ordination within teams	4	3	4	3	4	3	2.619	3.429	4.286	21	3.429	1	4	frequently employed
3	Formal communications	2	3	3	5	7	1	2.810	3.714	4.667	21	3.714	5	4	frequently employed
4	Processing documents using mail attachments	4	1	6	4	2	4	2.714	3.524	4.333	21	3.524	3	4	frequently employed
5	Confirming delivery of communications	5	4	7	3	0	2	2.000	2.762	3.667	21	2.762	3	2	seldom employed
6	Recording messages	4	5	7	1	2	2	2.095	2.905	3.810	21	2.905	3	2	seldom employed
7	Managing a personal task list	7	6	3	1	2	2	1.905	2.571	3.476	21	2.571	1	1	never employed
8	Managing a team task list	8	5	3	1	2	2	1.905	2.524	3.429	21	2.524	1	1	never employed
9	Maintaining a personal diary	3	0	0	4	5	9	3.810	4.667	5.238	21	4.667	6	6	indispensible to task
10	Scheduling meetings	3	0	2	3	7	6	3.524	4.381	5.095	21	4.381	5	6	indispensible to task
11	As a telephone directory	5	3	3	3	5	2	2.524	3.286	4.190	21	3.286	1	1	never employed
12	All business tasks	0	0	0	0	0	0	2.610	3.407	4.260					

4.7.2. All Surveys - Comparison Tables

All and ITS Survey 1	All Survey 1			ITS Survey 1			Differences (ITS - All)			Congruence		Chi Square		
	Min	Kernel	Max	Min	Kernel	Max	Min	Kernel	Max	Dif min	Dif max	Chi Sq	P	
Informal communications	3.303	4.277	5.160	3.500	4.500	5.367	-1.660	0.223	2.064	0.025	-0.016	1.749	0.883	
Co-ordination within teams	2.627	3.559	4.483	3.000	4.000	4.900	-1.483	0.441	2.273	0.068	-0.024	8.026	0.155	
Formal communications	2.664	3.580	4.538	3.500	4.500	5.367	-1.038	0.920	2.703	0.084	-0.091	14.374	0.013	*
Processing documents using mail attachments	2.136	2.932	3.898	2.517	3.379	4.379	-1.381	0.447	2.244	0.065	0.034	7.314	0.198	
Confirming delivery of communications	2.829	3.769	4.650	3.179	4.143	4.929	-1.471	0.374	2.100	0.024	-0.095	3.343	0.647	
Recording messages	2.856	3.729	4.610	3.500	4.500	5.333	-1.110	0.771	2.477	0.127	-0.048	7.029	0.219	
Managing a personal task list	2.419	3.197	4.111	2.964	3.857	4.750	-1.147	0.661	2.331	0.115	-0.022	6.935	0.226	
Managing a team task list	1.746	2.360	3.333	2.000	2.893	3.893	-1.333	0.533	2.147	0.279	0.026	14.906	0.011	*
Maintaining a personal diary	3.744	4.650	5.308	3.643	4.536	5.250	-1.665	-0.114	1.506	-0.013	0.056	0.663	0.985	
Scheduling meetings	3.718	4.658	5.299	3.964	4.893	5.536	-1.335	0.235	1.818	-0.012	0.002	4.061	0.541	
As a telephone directory	1.598	2.094	3.051	2.000	2.786	3.750	-1.051	0.692	2.152	0.290	0.007	9.953	0.077	
All business tasks	2.694	3.528	4.404	3.070	3.999	4.859	-1.334	0.471	2.165	0.096	-0.015			

Notes:

1. Differences are the fuzzy TFN differences

2. Congruence measures the degree to which the fuzzy triangular envelopes differ by comparing the Min to Kernel (Dif min) and Kernel to Max (Dif max) distances for each pair of nmbers.

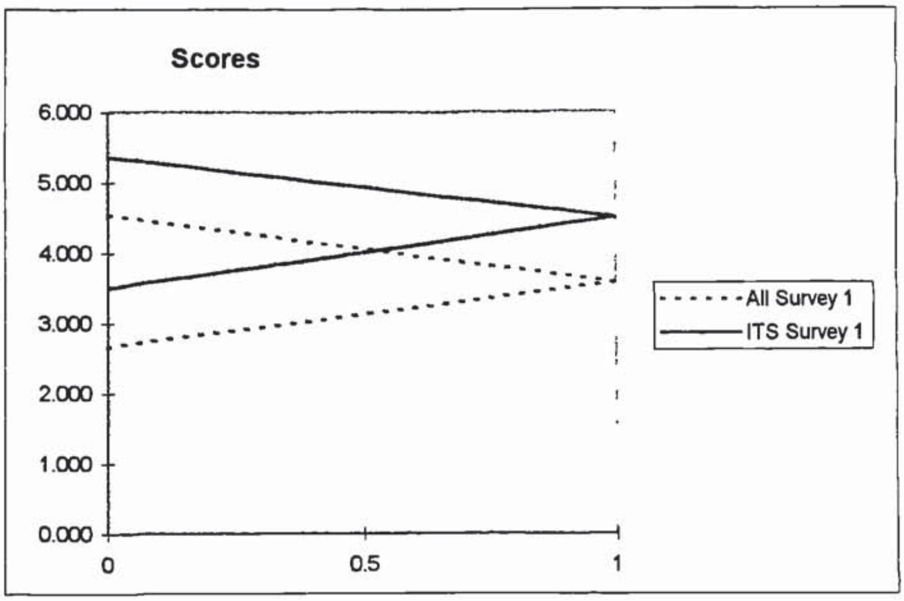
Chi-Square Null Hypothesis -The 2 sets of responses are from similar populatio

* <= 5%   ** <= 1%

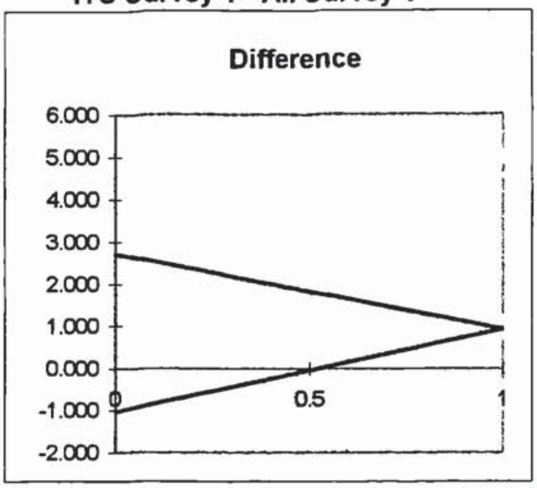
formal communications

All and ITS Survey 1

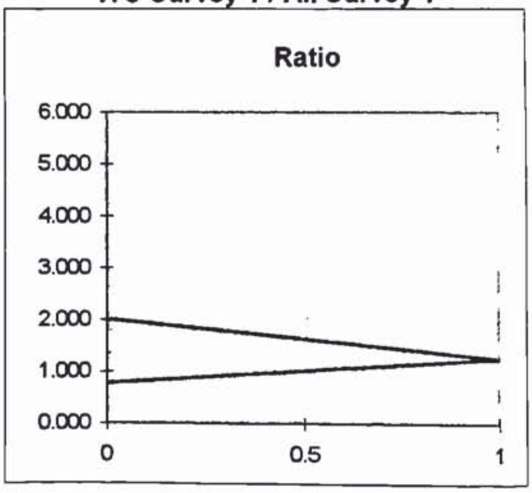
Scores	Min	Kernel	Max
All Survey 1	2.664	3.580	4.538
ITS Survey 1	3.500	4.500	5.367
ITS Survey 1 - All Survey 1	-1.038	0.920	2.703
ITS Survey 1 / All Survey 1	0.771	1.257	2.015



ITS Survey 1 - All Survey 1



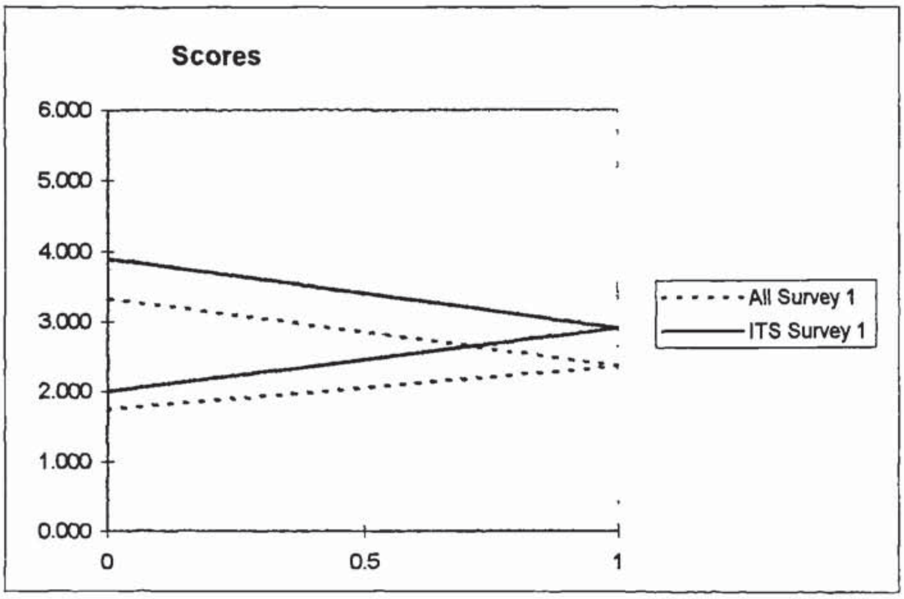
ITS Survey 1 / All Survey 1



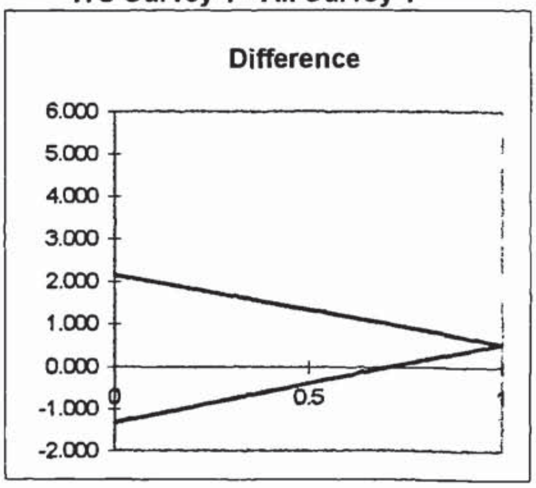
managing a team task list

All and ITS Survey 1

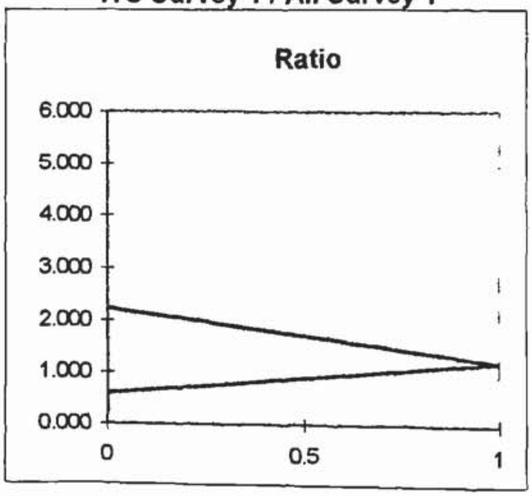
Scores	Min	Kernel	Max
All Survey 1	1.746	2.360	3.333
ITS Survey 1	2.000	2.893	3.893
ITS Survey 1 - All Survey 1	-1.333	0.533	2.147
ITS Survey 1 / All Survey 1	0.600	1.226	2.230



ITS Survey 1 - All Survey 1



ITS Survey 1 / All Survey 1



Social Services	**Soc Servs Survey 2**			**Soc Servs Survey 3**			Differences (S3 - S2)			Congruence		**Chi Square**	
	Min	Kernel	Max	Min	Kernel	Max	Min	Kernel	Max	Dif min	Dif max	Chi Sq	P
Informal communications	2.622	3.556	4.511	2.909	3.864	4.830	-1.602	0.308	2.207	0.021	0.010	7.956	0.159
Co-ordination within teams	2.511	3.356	4.289	2.682	3.580	4.534	-1.607	0.224	2.023	0.053	0.021	3.079	0.688
Formal communications	2.489	3.422	4.378	2.580	3.511	4.477	-1.798	0.089	1.988	-0.002	0.010	6.211	0.286
Processing documents using mail attachments	2.222	3.133	4.111	2.341	3.148	4.057	-1.770	0.014	1.835	-0.104	-0.069	6.324	0.276
Confirming delivery of communications	2.182	3.068	3.955	2.227	3.045	3.966	-1.727	-0.023	1.784	-0.068	0.034	5.736	0.333
Recording messages	1.907	2.767	3.721	2.080	2.909	3.864	-1.641	0.142	1.957	-0.031	0.001	2.734	0.741
Managing a personal task list	2.136	2.727	3.591	2.136	2.864	3.784	-1.455	0.136	1.648	0.136	0.057	4.743	0.448
Managing a team task list	1.523	1.977	2.955	1.830	2.466	3.420	-1.125	0.489	1.898	0.182	-0.023	4.668	0.458
Maintaining a personal diary	3.558	4.442	5.047	3.375	4.239	4.920	-1.672	-0.203	1.362	-0.020	0.077	1.370	0.928
Scheduling meetings	3.186	4.047	4.837	3.170	4.011	4.761	-1.667	-0.035	1.575	-0.020	-0.041	1.545	0.908
As a telephone directory	1.767	2.372	3.326	2.443	3.216	4.091	-0.882	0.844	2.323	0.168	-0.078	8.894	0.113
All business tasks	2.373	3.170	4.065	2.525	3.350	4.246	-1.541	0.180	1.873	0.029	0.000		

Notes:

1. Differences are the fuzzy TFN differences

2. Congruence measures the degree to which the fuzzy triangular envelopes differ by comparing the Min to Kernel (Dif min) and Kernel to Max (Dif max) distances for each pair of nmbers.

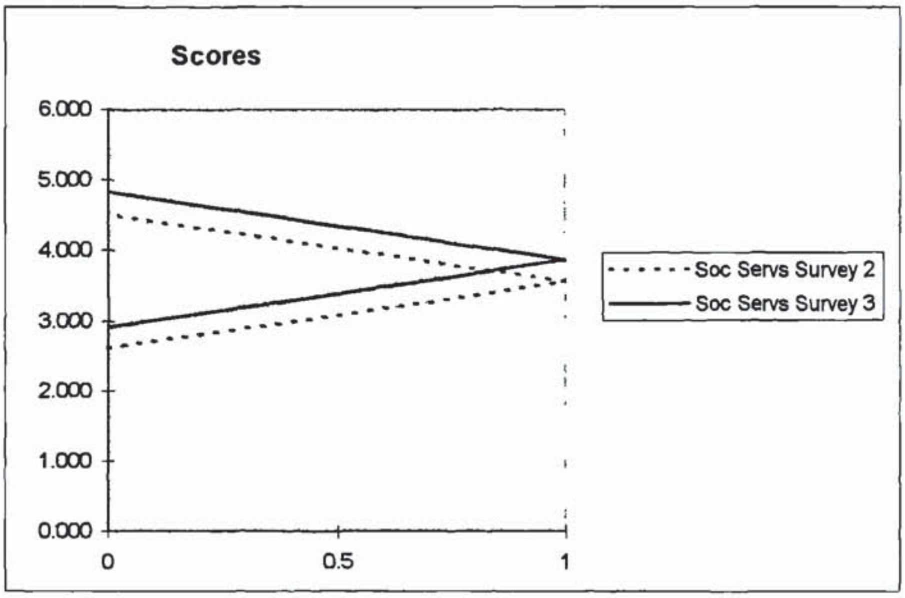
Chi-Square Null Hypothesis -The 2 sets of responses are from similar populations

* <= 5%   ** <= 1%

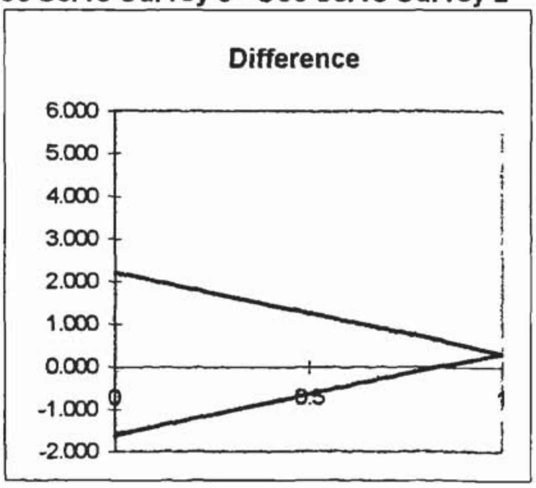
informal communications

Social Services

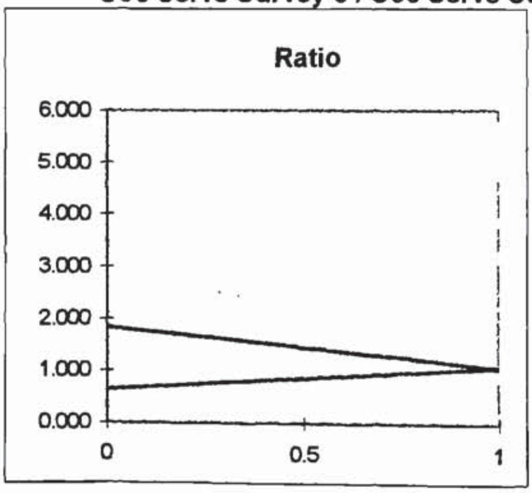
Scores	Min	Kernel	Max
Soc Servs Survey 2	2.622	3.556	4.511
Soc Servs Survey 3	2.909	3.864	4.830
Soc Servs Survey 3 - Soc Servs Survey 2	-1.602	0.308	2.207
Soc Servs Survey 3 / Soc Servs Survey 2	0.645	1.087	1.842



Soc Servs Survey 3 - Soc Servs Survey 2



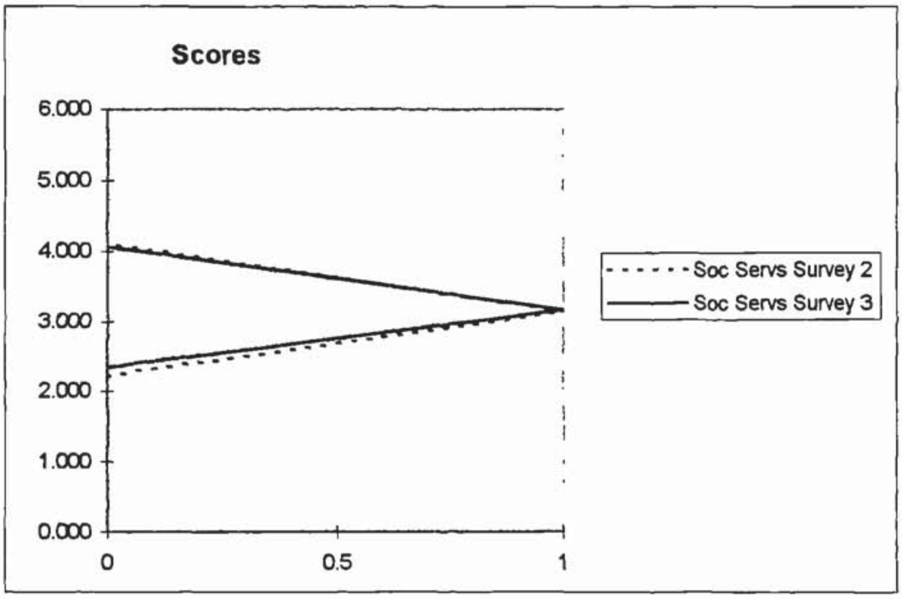
Soc Servs Survey 3 / Soc Servs Survey 2



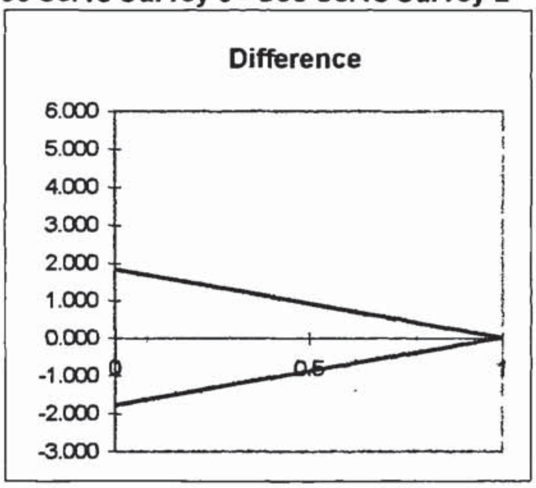
processing documents using mail attachments

Social Services

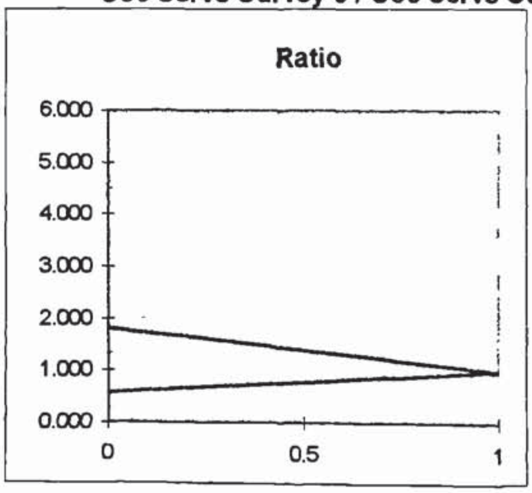
Scores	Min	Kernel	Max
Soc Servs Survey 2	2.222	3.133	4.111
Soc Servs Survey 3	2.341	3.148	4.057
Soc Servs Survey 3 - Soc Servs Survey 2	-1.770	0.014	1.835
Soc Servs Survey 3 / Soc Servs Survey 2	0.569	1.005	1.826



Soc Servs Survey 3 - Soc Servs Survey 2



Soc Servs Survey 3 / Soc Servs Survey 2



All Departments Surveyed	Survey 1			Survey 2			Differences (S2 - S1)			Congruence		Chi Square		
	Min	Kernel	Max	Min	Kernel	Max	Min	Kernel	Max	Dif min	Dif max	Chi Sq	P	
Informal communications	3.303	4.277	5.160	2.805	3.754	4.703	-2.355	-0.523	1.401	-0.026	0.067	17.611	0.003	**
Co-ordination within teams	2.627	3.559	4.483	2.534	3.415	4.331	-1.949	-0.144	1.703	-0.051	-0.008	3.221	0.666	
Formal communications	2.664	3.580	4.538	2.504	3.410	4.359	-2.034	-0.170	1.695	-0.010	-0.009	8.104	0.151	
Processing documents using mail attachments	2.136	2.932	3.898	2.359	3.265	4.222	-1.539	0.333	2.087	0.109	-0.009	9.058	0.107	
Confirming delivery of communications	2.829	3.769	4.650	2.364	3.246	4.136	-2.285	-0.523	1.307	-0.059	0.009	12.948	0.024	*
Recording messages	2.856	3.729	4.610	2.104	2.939	3.887	-2.506	-0.790	1.031	-0.038	0.066	20.903	0.001	**
Managing a personal task list	2.419	3.197	4.111	2.316	2.991	3.829	-1.795	-0.205	1.410	-0.103	-0.077	10.278	0.068	
Managing a team task list	1.746	2.360	3.333	1.819	2.379	3.336	-1.514	0.020	1.591	-0.054	-0.017	2.384	0.794	
Maintaining a personal diary	3.744	4.650	5.308	3.539	4.452	5.130	-1.769	-0.197	1.387	0.007	0.020	4.836	0.436	
Scheduling meetings	3.718	4.658	5.299	3.217	4.078	4.852	-2.082	-0.580	1.134	-0.079	0.133	9.927	0.077	
As a telephone directory	1.598	2.094	3.051	1.835	2.426	3.357	-1.216	0.332	1.758	0.096	-0.027	3.089	0.686	
All business tasks	2.694	3.528	4.404	2.491	3.305	4.195	-1.913	-0.223	1.500	-0.019	0.014			

Notes:

1. Differences are the fuzzy TFN differences

2. Congruence measures the degree to which the fuzzy triangular envelopes differ by comparing the Min to Kernel (Dif min) and Kernel to Max (Dif max) distances for each pair of nmbers.

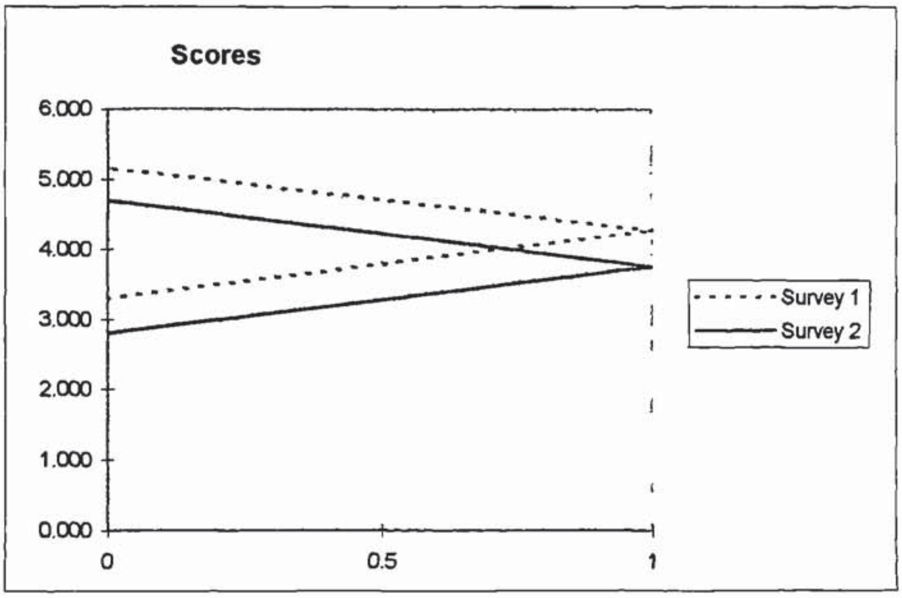
Chi-Square Null Hypothesis -The 2 sets of responses are from similar populations

* <= 5%   ** <= 1%

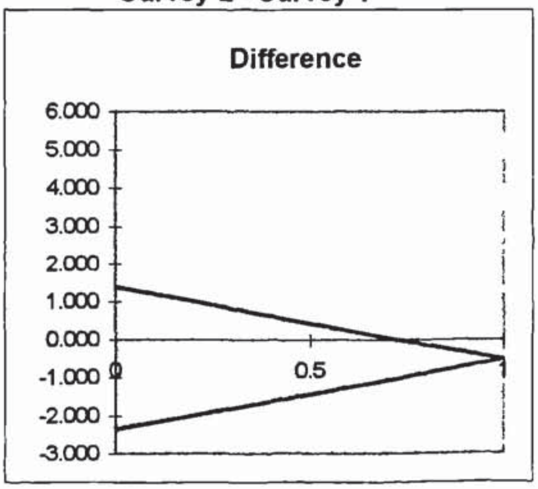
informal communications

All Departments Surveyed

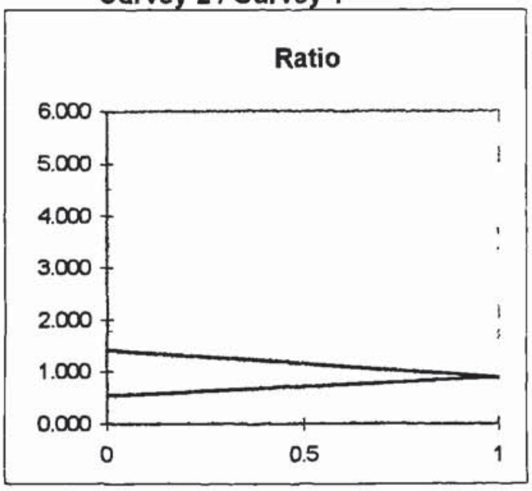
Scores	Min	Kernel	Max
Survey 1	**3.303**	**4.277**	**5.160**
Survey 2	**2.805**	**3.754**	**4.703**
Survey 2 - Survey 1	**-2.355**	**-0.523**	**1.401**
Survey 2 / Survey 1	**0.544**	**0.878**	**1.424**



Survey 2 - Survey 1



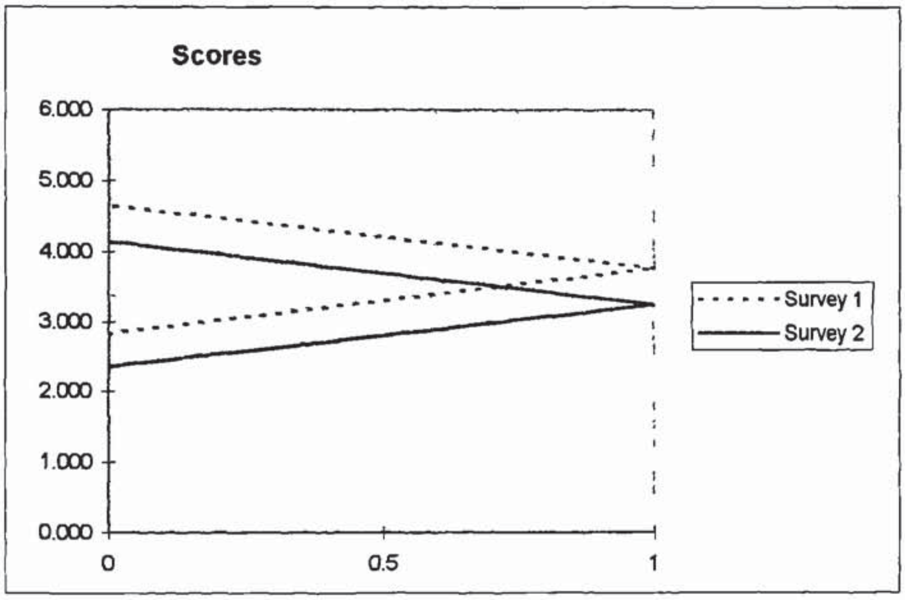
Survey 2 / Survey 1



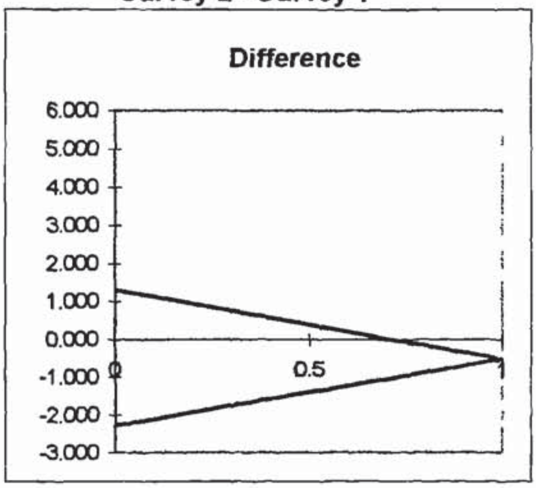
confirming delivery of communications

All Departments Surveyed

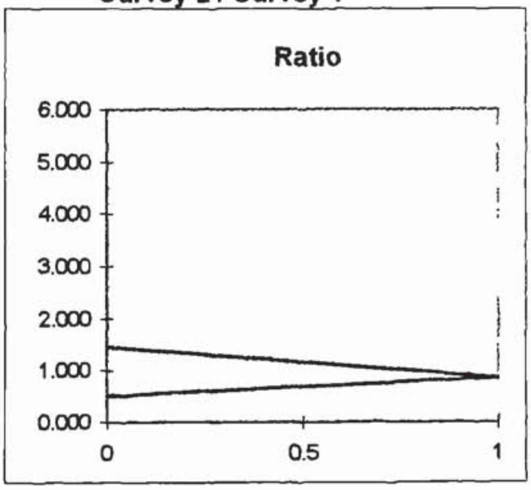
Scores	Min	Kernel	Max
Survey 1	2.829	3.769	4.650
Survey 2	2.364	3.246	4.136
Survey 2 - Survey 1	-2.285	-0.523	1.307
Survey 2 / Survey 1	0.509	0.861	1.462



Survey 2 - Survey 1



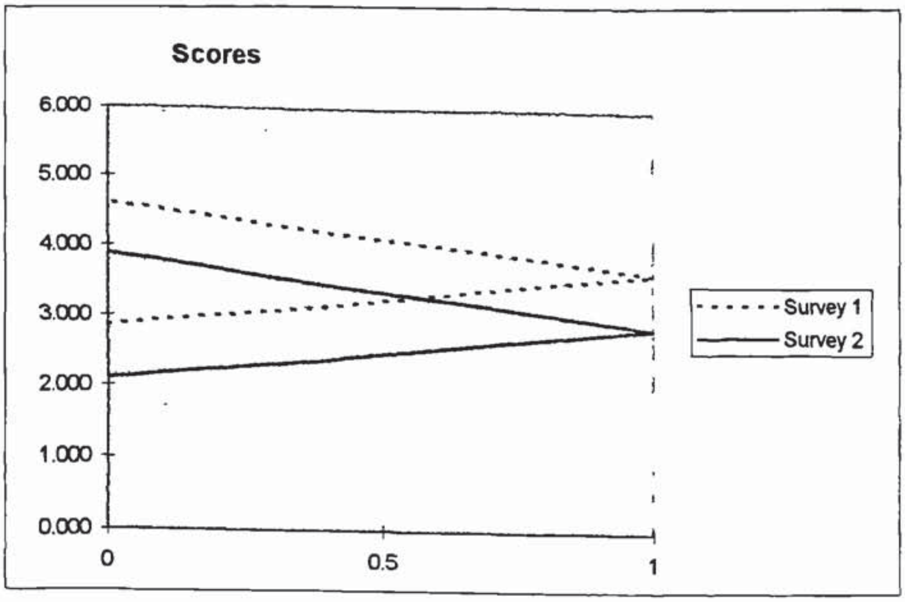
Survey 2 / Survey 1



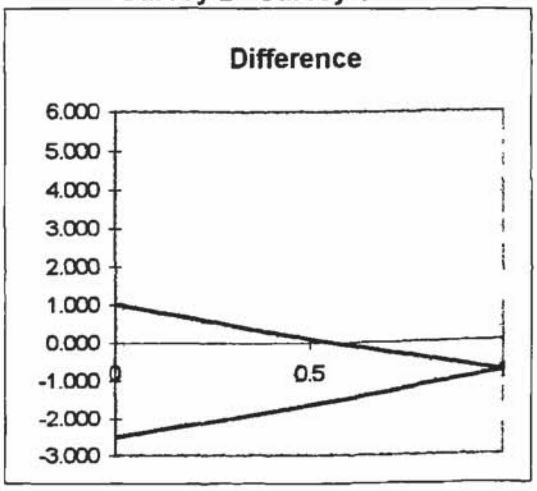
recording messages

All Departments Surveyed

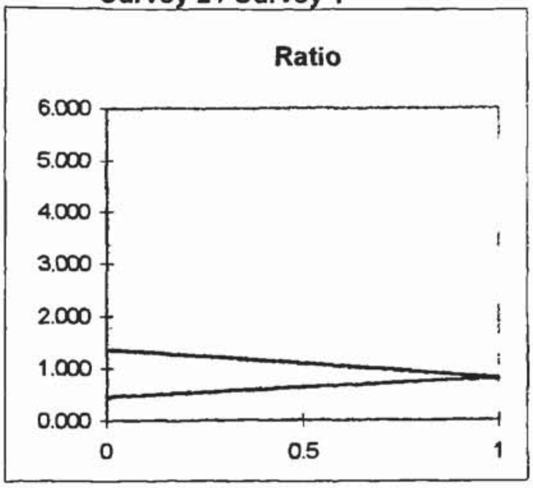
Scores	Min	Kernel	Max
Survey 1	2.856	3.729	4.610
Survey 2	2.104	2.939	3.887
Survey 2 - Survey 1	-2.506	-0.790	1.031
Survey 2 / Survey 1	0.456	0.788	1.361



Survey 2 - Survey 1



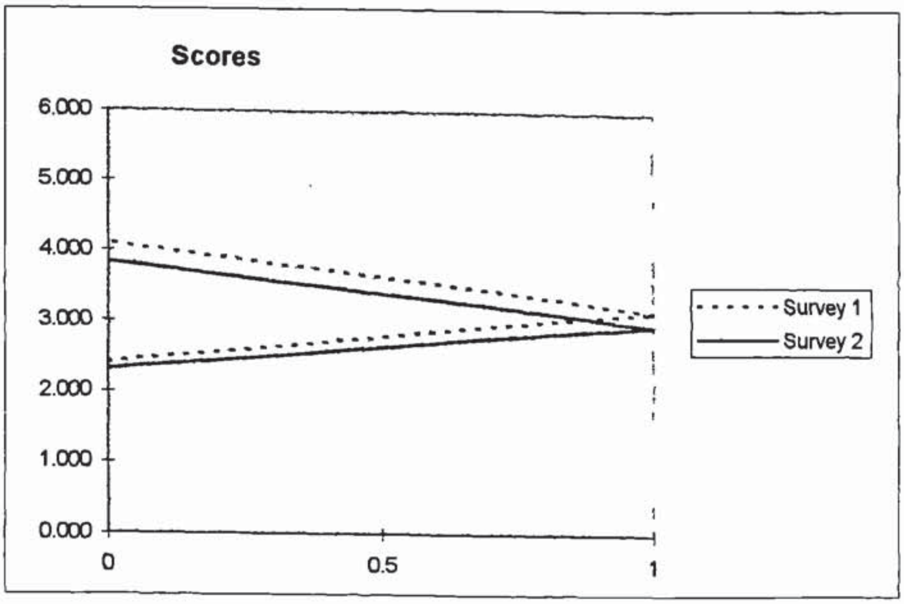
Survey 2 / Survey 1



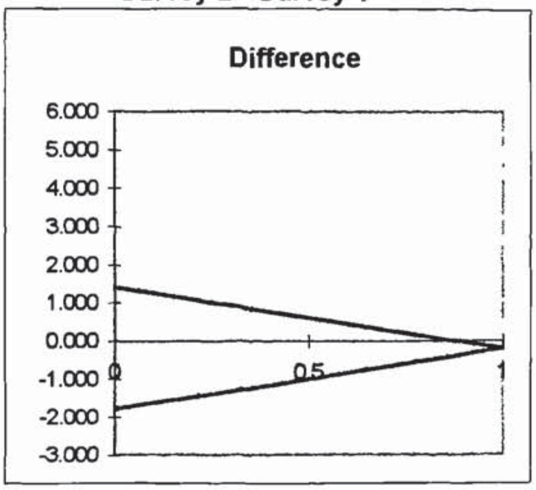
managing a personal task list

All Departments Surveyed

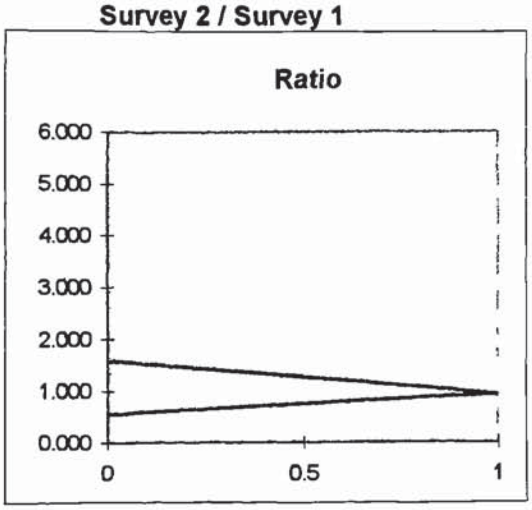
Scores	Min	Kernel	Max
Survey 1	2.419	3.197	4.111
Survey 2	2.316	2.991	3.829
Survey 2 - Survey 1	-1.795	-0.205	1.410
Survey 2 / Survey 1	0.563	0.936	1.583



Survey 2 - Survey 1



Survey 2 / Survey 1



4.7.3. All Surveys - Patterns of use

Patterns of GroupWise Use "Best Hypothesis"

	Business Task Details	All S1	All S2	ITS S1	SocSer2	SocSer3
1	Informal communications	4	4	5	3	4
2	Co-ordination within teams	4	3	5	4	4
3	Formal communications	4	4	5	4	4
4	Processing documents using mail attachn	3	3	4	3	3
5	Confirming delivery of communications	4	3	6	3	2
6	Recording messages	4	3	5	3	3
7	Managing a personal task list	1	1	6	1	1
8	Managing a team task list	1	1	3	1	1
9	Maintaining a personal diary	6	6	6	6	6
10	Scheduling meetings	6	6	6	6	6
11	As a telephone directory	1	1	3	1	1

Score

1	never employed
2	seldom employed
3	sometimes employed
4	frequently employed
5	almost always employed
6	indispensible to task

Key

All departments survey 1	ALL S1
All departments survey 2	ALL S2
IT Services survey 1	ITS S1
Social Services survey 2	SocSer2
Social Services survey 3	SocSer3

4.8. DISCUSSION OF RESULTS

The discussion of results is presented in a number of sections as follows.

Section 4.8.1. discusses qualitative findings from the surveys and relates them to the understandings of CIS effect that have been developed in Chapter 3.

Section 4.8.2. discusses the quantitative results from the surveys with an emphasis upon how the business tasks surveyed can be understood to be affected by GroupWise.

Section 4.8.3. looks at inter departmental and longitudinal comparisons and attempts to draw some inferences from the quantitative results presented.

Section 4.8.4. looks at the use of the fuzzy mathematical analysis of questionnaire responses with the intention of developing an initial evaluation of the usefulness of the techniques employed.

4.8.1. Qualitative Results

The main qualitative results are derived from the comments made on individual questionnaires, the record of the semi-structured interviews conducted as part of survey 1, the user described business tasks and (in survey 3) the most useful business tasks information.

If the business tasks which were referenced by the questionnaire are categorised depending upon whether they make use of specific designed features of the GroupWise technology (**design** theme) or are emergent features of use (**emergent** theme), the following typology is derived.

The **design theme** is represented by;

- Formal communications
- Recording messages
- Managing a personal task list
- Maintaining a personal diary
- Scheduling meetings
- As a telephone directory

The **emergent theme** is represented by;

- Informal communications
- Processing documents using mail attachments
- Co-ordination within teams
- Confirming delivery of communications

- Managing a team task list

Using the above typology as a reference frame, it can be seen from much of the qualitative material that there is a strong emphasis placed by respondents upon particular **designed** capabilities of the GroupWise software. Repeatedly, scheduling meetings and keeping a diary is raised as an important task for which the system is employed. Unprompted responses are likely to reflect users reactions to the technology in terms of how they conceptualise its use and for this reason the emphasis upon overt, designed application is considered significant.

Other important messages gained from examining the qualitative material, particularly the comments received, is a concern for appropriate use and utilisation. On the one hand respondents are keen to see use of the system extended and often articulate the positive benefits which they can receive if this is done. On the other hand they are concerned with abuse of the **system** for what are perceived as unwanted messages and clutter. It seems that persons who engage with the technology can identify fairly quickly its potential to help them in simple communications tasks, in these cases coverage becomes a very obvious requirement.

Only a relatively few staff articulate **emergent** uses for the technology which go far beyond the obvious designed features. It is possible that this might be related to the perception of the systems as being mainly concerned with communications and the use of Email, possibly users do not easily make the conceptual leap to using it more creatively to support co-operative tasks. However, since an aim of the current research has been to focus on broad organisation effects, wide coverage and longitudinal information, it is almost certain that detail of individual reactions and usage has been missed which would be articulated in a richer way with further qualitative study (Rudy , 1996).

4.8.2. Quantitative Results

In surveys 1,2 & 3 the combined results for all departments surveyed, and in the case of survey 3 for all respondents, show that the tasks judged highest in use and lowest in use are as follows.

Survey	Highest scoring 6 Tasks (in descending order)	Lowest Scoring 6 Tasks (in ascending order)
1	Scheduling meetings Maintaining a personal diary Informal communications Confirming delivery of communications Recording messages Formal communications	As a telephone directory Managing a team task list Processing documents using mail attachments Managing a personal task list Co-ordination within teams Formal communications
2	Maintaining a personal diary Scheduling meetings Informal communications Formal communications Co-ordination within teams Processing documents using mail attachments	Managing a team task list As a telephone directory Recording messages Managing a personal task list Confirming delivery of communications Processing documents using mail attachments
3	Maintaining a personal diary Scheduling meetings Formal communications Informal communications Processing documents using mail attachments Co-ordination within teams	Confirming delivery of communications Managing a team task list As a telephone directory Managing a personal task list Recording messages Co-ordination within teams

Figure 4.11. Highest and Lowest Scoring Tasks, all surveys.

The task which have been classified as most characteristic of emergent theme use of CIS have been shaded. This shows a tendency towards more effective use for design theme application over the range of tasks surveyed. Overall usage of GroupWise can be said to be concentrated towards those features associated with calendar/diary and scheduling of meetings together with informal communications. This tendency is consistent throughout departments and departments do not differ very significantly between each other or over time.

There are some departmental differences exhibited most significantly by IT Services and Personnel in survey 1.

IT Services shows a consistently higher score across all tasks surveyed than other departments. This might be seen as a reflection of the IT knowledge and familiarity present in the department and, perhaps, as a function of the fact that such departments tend to organise their activity around projects which call for a higher degree of team and task management than may be likely in other departments.

The Personnel Department records relatively high scores for scheduling meetings, confirming delivery of communications and recording messages. It may be that this is reflective of the particular task environment where formal communications has been brought within the usage of GroupWise because it offers such a convenient and auditable channel.

4.8.3. Comparisons

Comparison of results leads to a number of observations.

Patterns of Usage

Firstly, patterns of usage do not appear to differ greatly between surveys, either between the results for all departments or within departments surveyed on different occasions. By *patterns of usage* is meant relative scores amongst the various tasks surveyed. This is support for the possibility that attitudes to and usage of the technology are established early and remain, to a considerable extent, unchanged.

The patterns of usage are consistent across departments (Pattern Tables, p193) so that, for example, a higher scoring department such as IT Services still reflects a relative pattern of usage amongst the tasks which is reflective of other departments or all departments combined. A pattern of usage which is similar across a range of departments, even though varying in an absolute manner for particular tasks, suggests a characteristic of the particular technology being employed and the organisational situation in which it is placed.

Absolute values relating to surveyed tasks do vary within and between departments and surveys, but overall, ignoring the particularly high scoring departments ITS and Personnel, the mean values (fuzzy kernel value) only rises above *frequently employed* in the case of *informal communications, maintaining a personal diary and scheduling meetings*. This suggests that the technology has not yet embedded itself into day to day use in the majority of areas. More, it is seen as a useful tool for certain functions and as an additional informal channel of communication.

Usage Development over Time

Progressive development of usage, whilst maintaining the overall pattern is recognisable in some of the longitudinal data. For example, a comparison of the survey 2 and 3 results for Social Services (Comparison Tables, p184) shows a tendency towards slightly higher scores for a number of tasks surveyed. Use for informal communications has improved with the best supported hypothesis for use now *frequently employed* rather than *sometimes employed*. There is also an improvement in terms of management of a team task list which may be considered significant as coverage has improved in the time between the two surveys.

Overall though, progressive development in usage is not striking in any of the surveys. Again, this tends to support the hypothesis that patterns of usage are set early in the implementation of the system and it might be expected that users' prior experience, existing technological frame and training given at implementation could be important in determining this pattern of usage.

A final observation concerning the development over time is the way in which the task "confirming delivery of communications" falls down the order of scores in successive surveys, in this case breaking the generally pervasive pattern of use. This is shown both in Figure 4.11. and in the pattern table reported following page 193. A possibility is that this may reflect the move from earlier departmental surveys in headquarters functions where confirmation of communications is considered more important than in the wider and more operational areas covered in the later surveys.

Expectations

Comparisons between surveyed expectations of use and usage recorded provide some mixed messages. Managers have tended to expect greater use of the system in relation to managing team task lists and processing documents using mail attachments for example, as shown on both the survey 1 results (Summary Tables, p171) and the social services survey 3 results (Summary Tables, p178). They have tended to underestimate the usage for informal communications. In this respect a comparison with managers own scores is also of interest. Non managers have scored processing documents using mail attachments quite significantly lower than have managers. It is possible that managers have more cause to use this capability of the system and thus place more significance on its importance.

Overall

Overall the results provide a picture of usage across the surveyed tasks that varies task by task amongst departments and between different surveys applied to the same department at different times. Patterns of use do not vary significantly over time with only moderate improvements being registered as coverage improves as in for example the Social Services department figures (Summary Tables, p177).

4.8.4. Fuzzy Analyses

The interpretations and inferences to be drawn from the fuzzy arithmetical treatment and presentation of questionnaire results also need to be considered.

Triangular fuzzy score formulation

The formulation for analysing questionnaire data based upon triangular fuzzy numbers has been demonstrated in use across a range of questionnaire data. The usefulness of this method of presentation is that it expresses both in numerical and in graphical form an imprecise measurement from *lowest likely* through *most likely* to *greatest likely* value expressed with reference to the original scoring scale.

The technique does not capture the shape of the distribution of responses from the questionnaire data because the weighted triangular scores are constrained to be of particular width (1 at the two extremes of the scale and 2 for all other scores). Moreover, the averaging process employed produces a result which states both the fuzzy minimum and fuzzy maximum as being closer to the kernel (equivalent to the mean value) than any of the outlying responses.

In situations where there is single clear peak in responses corresponding to a particular score the technique gives a useful and computable score which represents the *possibilistic* nature of the distribution of responses. However, where a distribution of responses exhibits a clustered profile it would, perhaps, be more appropriate to represent it as two distinct populations with separate triangular scores.

Reactions to the presentation of questionnaire scores as triangular fuzzy numbers has been generally positive, although it is clear that most persons encountering the concept of a fuzzy number for the first time do have certain difficulties fitting it within their conceptual frame. For example, when presenting the results of the study described in section 3.5. (p117) to a conference audience, most attendees who commented seemed totally happy with the concept of fuzziness in defining objectives and equally happy with the idea that achievement against these objectives could be fuzzily described. However, more detailed discussions with individuals revealed that they tended to conceptualise fuzziness in the same manner as probability. Whilst there is some relationship between probability and likelihood, this is far from simple and it has not been sought to establish an analytical relationship between the concepts in this work.

The presentation of results at Northampton County Council was well received and managers seemed happy with the concept that surveyed usage in respect of particular co-operative tasks could be expressed over a range of vales from minimum likely to greatest likely. Some interpretation was provided in various reports which drew qualitative conclusions from the numerical results. In general, managers tended to focus upon the qualitative conclusions rather than the numerical presentation and this led to the development of the automatic interpretative scheme used in this thesis. In this approach it seems that the triangular fuzzy number presentation is no different from more usual forms of statistical analyses in that it needs interpretation to be useful to practitioners. However, in as much as it is able to easily and automatically articulate results over an interpretative range against linguistic questionnaire scales, it may be seen as a potentially useful complement to more traditional statistical analysis and interpretation.

In general it appears to be that the fuzziness concept is interesting and to some extent useful, but it is not currently an easily shared paradigm in practice.

Graphical presentation

The graphical representation of triangular fuzzy scores from questionnaire results appears to have been accepted alongside the raw scores and interpretation. No specific activity was carried out to evaluate the preferences of recipients to information presented in a variety of ways, except that it was clear that managers viewing the reports tended to dwell upon the visual presentations of the results and then to move on to the qualitative interpretation.

Best hypothesis

The best hypothesis formulation was developed only later in the research in an attempt to provide some guidance on the interpretation of scores where distributions of responses were erratically defined. Inspection of the best hypothesis together with the fuzzy triangular score gives a clue as to how heavily the responses are bunched around the fuzzy kernel. Because the tendency of the averaging process is to describe a limited fuzzy region about the mean of the responses, the best hypothesis, not being sensitive to out lying values, provides another way of gaining information on the shape of the underlying distribution. The definition of the fuzzy minimum, fuzzy kernel and fuzzy maximum takes into account all responses, but the best hypothesis homes in on the centre of gravity of the scores, eliminating relative minority values.

In the extreme case in an application of the type presented, it might be sensible to take the best hypothesis as a proxy for the true usage of the CIS system under study. For example, looking at the various tasks over a number of surveys reveals that the best hypotheses for managing a personal task list and managing a team task list are both *never employed*. This could be taken as a clear signal that a significant body of staff are not employing these features of the system and appropriate actions could be taken, either to attempt to change practices significantly or to withdraw the relevant facilities from use.

It is also possible using the formulation developed to extend to a "second best supported hypothesis" or a 'third...etc." or a "least well supported hypothesis". If successively ranked best supported hypotheses lie adjacent to one another they might be taken to offer support for one another. For example, if the first and second best supported hypotheses are evaluated for the case of Social Services Survey 3 for managing a team task list they turn out to be *never employed* and *seldom employed*, quite a strong affirmation of low utility for this particular co-operative task.

Comparisons

One of the main purposes for the formulation based upon triangular fuzzy numbers was to obtain computable scores upon which analytical comparisons might be made. This has been achieved and a number of sample comparisons have been made. Samples of these are shown on pages 180 to 191.

1. Visual presentation of scores together in the same graph allow direct inspection of the relative triangular fuzzy envelopes and assessment of the differences between them.

2. Congruence of two fuzzy triangular numbers allows their shapes to be compared independently of their relative sizes.

3. Differences give a measure of overlap which may be presented visually as well. The size of the differences may be interpreted with reference to the original scale.

4. Ratios give a measure of relative performance value, one score with another. Clearly numbers greater than 1.0 reveal better performance and less than 1.0 poorer performance.

An important consideration is the degree to which comparisons may be employed as a complement to more standard statistical measures. As a way of beginning to answer this, a Chi-Square test has been included within the comparison tables (4.7.2.), calculated as if the scores had been made against a nominal scale. In each comparison table the Chi-Square test has been conducted using the frequency tables of responses from the two surveys being compared, the null hypothesis being that they represent responses from similar populations.

An instructive example are some results for ITS versus All Departments for the first survey (p181). The tasks "formal communications" and "managing a team task list" have been compared using all the methods developed for comparing fuzzy triangular scores. In the first case the Chi-Square value is 14.374 and in the second 14.906. However, although the fuzzy triangular scores differ between ITS and All Departments for both tasks, the difference is visibly and significantly greater in the case of formal communications than in the case of managing a team task list. So, in this case, the Chi-Square statistic is indicating that these tasks have probabilities of being from similar populations which are similarly small (from the table, 0.013 for formal communications and 0.011 for managing a team task list). The hypothesis that they are from similar populations may therefore be rejected at the 0.05 significance level.

The nature of the differences in fuzzy score can however illustrate something of the variability in underlying data. The kernel value of the difference between two fuzzy triangular scores is simply the difference in the means for the two sets of data. This has been used to measure the *gap* between two attributes, for example in judgements of IT strategy effectiveness (Worrall, Remenyi and Money, 1997). Extending these considerations the fuzzy minimum of the difference expresses the difference between the minimum of first score and the maximum of the second, in effect the *worst* gap. The fuzzy maximum of the difference expresses the difference between maximum of the first score and the minimum of the second, in effect the *best* gap. Considering an example from the results (p181), the difference between All Departments Survey 1 and ITS Survey 1 for recording messages is calculated as fuzzy triangular score (-1.110, 0.771, 2.477). So, on a kernel (mean) gap basis, ITS exceeds All Departments by 0.771 on the scale; on a minimum (worst) gap basis, ITS undershoots All Departments by 1.110 on the scale and, on a maximum (best) gap basis, ITS exceeds All Departments by 2.477 on the scale.

A possible summary at this stage is that methods of comparison using fuzzy triangular measures may be useful in complement to other approaches but that more experience needs to be built in their use and interpretation.

5. CONCLUSIONS

"Write me down a victory."

Arthur Wellesley, 1 st Duke of Wellington speaking to Thomas Arbuthnot concerning the dispatch following the difficult but ultimately successful battle of Albuera in 1811.

Conclusions are grouped into 5 main sections as follows.

- Section 5.1. summarises the principal conclusions which have emerged through literature review and case study analyses of Chapter 2.
- Section 5.2. draws conclusions from the longitudinal study of GroupWise implementation within Northampton County Council which has been detailed in Chapter 4.
- Section 5.3. discusses conclusions relating to the development and employment of the fuzzy arithmetical treatment of survey results which was developed in Chapter 3 and employed for the analyses presented in Chapter 4.
- Section 5.4. briefly covers the agenda for future research.
- Section 5.5. is a short reflection on the research.

5.1. CIS ORGANISATIONAL EFFECT

The term co-operative information systems (CIS) has been used within this research to refer to information systems and technology (IST) which offers a variety of novel ways in which communication and co-ordination between people in the pursuit of the completion of shared tasks (or co-operative work) may be effected. This *groupware* focus of the research has been the overall effect upon the organisations implementing the technology, so consideration has been given largely to those technologies that are being most widely used and developed by organisations, namely, Email, Shared Diary systems, Task Management, Shared Workspace and related communications technologies.

The research focus has not intended to be technological but to seek a method of measuring the way in which use of these technologies affect how individuals and groups carry out their business linked co-operative work. Organisational culture is acknowledged to be an important factor in the way technologies are absorbed and adapted to use, however, the current research has not sought to incorporate cultural parameters into any measurement model.

5.1.1. The Essence of Co-operative Work

The first broad conclusion that emerges from the literature, from published case studies and from consultancy and action research is that the essence of co-operative work is difficult to define in any empirical way. Bannon speaks of the need to *articulate* co-operative work by which he means (it seems), understand what it is that people are doing that contributes to the output of the work (Bannon, 1998). This articulation can then lead to ways of improving the situation by application of specific technologies. From this departure point, unless the view of co-operative systems is to be technologically focused, there are two broad approaches. Firstly, the researcher may seek to understand in detail how people are interacting with and using the technology; this being the approach of many case studies and qualitative research programmes. Secondly the researcher may step back from the effects and develop broad models which encompass organisational transformation at a rather global level, perhaps optimistically assuming that all technologies offering improved communication and co-ordination possibilities will help to develop the flexible and learning organisation.

In contrast to these two approaches, the present research has commenced from the assumption that the purpose of CIS technologies is to affect the way in which people carry out their day to day business tasks. So, the impact of any implemented technology will be felt by users in terms of how useful it proves to the performance of particular types of task. These tasks may be specific **designed** tasks such as maintaining a diary or more synthetic **emergent** ones such as co-ordination of a team of people.

So, the articulation of co-operative work, in this research, is achieved through consideration of specific tasks or types of task. The essence of co-operative work is expressed through the description of these tasks, and the impact or influence of particular CIS technologies can be measured by examining to what extent users employ the technology for completion of these tasks.

5.1.2. Co-operative Task Transformation

The model developed in Chapter 2 and repeated here shows how co-operative work tasks can be classified.

		Asynchronous		Synchronous	
	Division of labour	Equal power	Un-equal power	Equal power	Un-equal power
Distributed	**Local**	**A4**	**B4**	**A3**	**B3**
	Pre-determined	**C4**	**D4**	**C3**	**D3**
Co-located	**Local**	**A2**	**B2**	**A1**	**B1**
	Pre-determined	**C2**	**D2**	**C1**	**D1**

Figure 5.1. Co-operative work typology, (Copy of Figure 2.13.)

From this model it is not difficult to see that the effect of a particular CIS technology implementation might be to change the nature of a particular task, affecting time and/or place, and/or power relations and/or how division of labour is determined.

There is tacit acceptance of this model within the literature but systematic studies of how tasks are affected by technology are rare. Some broad surveys (Finnegan and O'Mahony, 1996) have been carried out however and, as has been seen, other commentators have developed qualitative accounts of changes in work patterns and support for co-operative tasks (Bannon and Schmidt, 1992) ,(Bannon 1998), (Orlikowski, 1992, 1996), (Rudy, 1996), (Turner, 1998).

A conclusion of the present research is that the way in which co-operative tasks are transformed is the most direct way of measuring the overall effect of CIS technologies within an organisation.

5.1.3. Technologies and Culture

The present study has not concentrated closely upon organisational culture. But a subsidiary conclusion must be that organisational culture is one of the dominant environmental issues facing implementers of CIS technology. The conclusions is supported time and time again in the discussion of case study research, (Hassall and Macefield, 1995), (Orlikowski, 1992 and 1996), (Ciborra, 1996), (Bikson, 1996) and others; indeed, is widely accepted in information systems literature in general (Walsham, 1993), (Kendall and Kendall, 1994), (Laudon and Laudon, 1995).

The position that *existing* culture is crucial to how CIS technologies affect an organisation has an interesting corollary in relation to views that are expressed by many commentators about the transforming potential of such technologies, for example (Borman, 1994). (Blackler, 1995), (Venkatraman, 1996). This corollary, powerfully illustrated by the case of the Consultancy Company in (Orlikowski, 1992) and the World

Bank (Bikson, 1996), is that such technologies *of themselves* are unlikely to have radical transforming effects, at least in the short to medium term.

5.1.4. Conceptual Map Of CIS Effect

The following visualisation has already been presented in section 2.6.

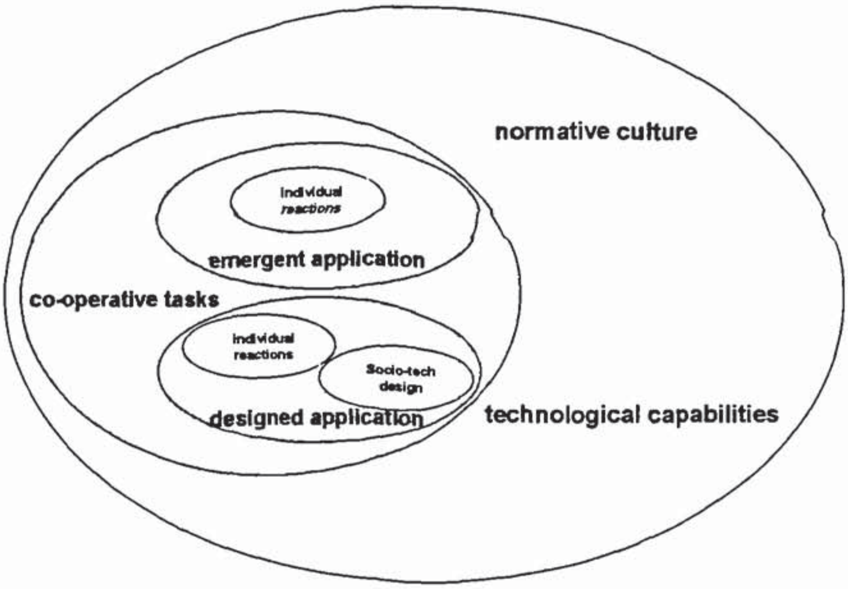


Figure 5.2. Conceptual Map of CIS Effect.

This makes clear the view that applications of CIS to co-operative tasks may be considered as **designed** or **emergent**. In designed applications some clear rationale is developed for supporting a process within the organisation. In emergent applications the onus is upon the joint actions of individual users and groups of users to give structure to the use of the technical features of the CIS. The model represents a conceptual map where, clearly, varying degrees of designed or emergent use may be present in any work situation. The conceptual map is a way of thinking about CIS effect which incorporates the tasks, their differentiation, the reactions of individual users and the cultural and technological environment within which the CIS is implemented.

5.1.5. Users and Applications

A consideration which arises from the characterisation of co-operative task application for CIS is that, whereas designed applications will be dependent upon how well they are developed and implemented for success, emergent applications depend much more upon the framing ascribed to technological capabilities by users. The framing will be influenced by prior experience, understanding of the technologies, normative culture and conceptual capabilities. In a sense, users are being asked to do something they have never done before, to design their own information systems to meet the needs of shifting task and role requirements and also rapidly changing technology.

These ideas are supported by both literature of case studies and experiences in consultancy and action research. Where an information systems application is designed to fulfil a particular business task, users reactions depend upon how well the application is designed in business, ergonomic and other terms. In general, where a clear rationale for use is provided the application will be taken up by users and will thus affect the nature of the task. Where users are left to their own devices, so that employment of the technology to support business tasks requires adjustment of their practices and modes of working, as well as incorporation of technological capabilities, an inertia is demonstrable that limits the capability of new modes of working to emerge. This conclusion suggests that the ability of new technologies to transform organisational culture exhibits a dynamic potential which is as much influenced by the dominant culture(s) within the organisation as by the capabilities of the technology.

5.2. LONGITUDINAL STUDY OF GROUPWISE

The longitudinal study of GroupWise implementation at Northampton County Council allows some initial conclusions to be drawn about the impact and effect of such technologies when placed into general use across an organisation. The organisation is a diverse one with staff from many different backgrounds, professions and experiences working in a variety of tasks and roles.

Conclusions based upon a single organisational study should always be treated with caution. However, in this case the ability to compare between different groups of staff working in different departments can give some ideas about how persons with differing backgrounds may react to the implementation of such technologies. Also, the longitudinal nature of the data provides scope for insights into the speed with which task and activities across the organisation are affected. Finally, triangulation between the results of these surveys and the conclusions of researchers reported in Chapter 2 may provide support or otherwise for the conclusions reached.

5.2.1. Patterns of Use

Perhaps the most striking conclusion to be drawn from the results of surveys is the persistence in patterns of use that are established across groups of users fairly early on in the implementation of the technology. This is illustrated well by looking at best hypothesis scores between departmental surveys at various stages.

Business Task Details	All S1	All S2	ITS S1	SocSer2	SocSer3
Informal communications	4	4	5	3	4
Co-ordination within teams	4	3	5	4	4
Formal communications	4	4	5	4	4
Processing documents using mail attachments	3	3	4	3	3
Confirming delivery of communications	4	3	6	3	2
Recording messages	4	3	5	3	3
Managing a personal task list	1	1	6	1	1
Managing a team task list	1	1	3	1	1
Maintaining a personal diary	6	6	6	6	6
Scheduling meetings	6	6	6	6	6
As a telephone directory	1	1	3	1	1

KEY
All S1 : All Departments Survey 1
All S2 : All Departments Survey 2
ITS S1 : IT Services Survey 1
SocSer2 : Social Services Survey 2
SocSer3 : Social Services Survey 3

Figure 5.3. Patterns of Use, Best Hypothesis.

What appears to be happening is that users develop an accommodation to the new technology early on, including ideas of how they should employ it and what its limitations are. This does not appear to shift significantly over time, patterns of use becoming rapidly set and clearly denying the validity of optimistic statements about "early days".

As has been noted, "confirming delivery of communications" breaks the generally consistent pattern by falling down the order of scores in successive surveys, and it is possible that this represents a genuine change in the nature of co-operative work as the surveys move from headquarters towards operational departments. However, it is considered that this particular instance does not detract in a significant manner from the conclusion that there is persistence in the patterns of usage over time.

The implications of this finding for implementers is clear. The paradigm for use will be established early, so great care needs to be taken over introduction of CIS technologies in order that users have the opportunity to develop productive usage patterns quickly. The current study did not address how this should be done but there is clearly some linkage with the ideas of users *technological frame* discussed by (Orlikowski, 1996) and incorporated into the conceptual model described in Figure 5.2. (p207). Some recent research tends to support this conclusion in relation to CIS, for example in *Understanding the Business Benefits of IT-Enabled Communications in Organisations: Developing a Suitable Research Model*, Breu and Ward, consider that *"If the initial opportunity at implementation stage is not exploited, ineffective use become routinised, which then can be changed only through purposeful intervention."* (Breu and Ward, 1999).

5.2.2. Emergent versus Design Led Application

The analysis of survey results suggests that users judge it easier to apply CIS technologies to specific tasks for which technological features are provided than to develop their own uses to support tasks (emergent application). This may be illustrated by looking at comparisons of average fuzzy scores across different task elements within the questionnaires (*emergent* theme tasks are shaded).

All Departments Surveyed	**Survey 1**			**Survey 2**		
	Min	**Kernel**	**Max**	**Min**	**Kernel**	**Max**
Informal communications	3.303	4.277	5.160	2.805	3.754	4.703
Co-ordination within teams	2.627	3.559	4.483	2.534	3.415	4.331
Formal communications	2.664	3.580	4.538	2.504	3.410	4.359
Processing documents using mail attachments	2.136	2.932	3.898	2.359	3.265	4.222
Confirming delivery of communications	2.829	3.769	4.650	2.364	3.246	4.136
Recording messages	2.856	3.729	4.610	2.104	2.939	3.887
Managing a personal task list	2.419	3.197	4.111	2.316	2.991	3.829
Managing a team task list	1.746	2.360	3.333	1.819	2.379	3.336
Maintaining a personal diary	3.744	4.650	5.308	3.539	4.452	5.130
Scheduling meetings	3.718	4.658	5.299	3.217	4.078	4.852
As a telephone directory	1.598	2.094	3.051	1.835	2.426	3.357
All business tasks	2.694	3.528	4.404	2.491	3.305	4.195

Figure 5.4. Emergent versus Designed Application.

Some caution is needed here in that one of the most popular uses of GroupWise is connected with the ability to see another persons diary. It is certainly possible to argue that use of the diary in this way contributes for example to "co-ordination within teams", but co-ordination is an active process whereas reviewing diaries is more passive.

The implications for implementers could be several, ranging from the need for more designed applications to help set the technological agenda. The quote below from the minutes of a meeting following the second survey of GroupWise usage and repeated from Chapter 4 illustrates the developing thoughts on implementation at Northamptonshire County Council.

'the evolutionary process in relation to the use of GroupWise may be enhanced and further enabled by development of specific workflow applications linked to business processes and by addressing the failure of people to engage fully with the capabilities of the new technology." (Minutes of ISCMG Meeting , 30 th June 1998).

An argument developing from this is that GroupWise and related CIS technologies may have been oversold in terms of their ability, of themselves, to affect the way in which work is carried out. In the absence of specific procedures it seems that most users find it difficult to conceptualise, develop and then implement new applications of the technology. Thus leading managers, as the quote above suggests, to both seek more formalisation of applications and improved developmental training for staff.

5.2.3. Managers Expectations

In general, the results of the research have suggested that managers have rather modest expectations from their staff in using the GroupWise technology. This could be for a number of reasons including superior knowledge and overview of business processes linked to an appreciation of the technology, exposure to the experiences of other organisations, a degree of personal cynicism about the technology's capabilities as well as about their own staffs' abilities to appreciate the new paradigm.

The small but fairly consistent degree to which overall judgements of the usefulness of GroupWise for informal communications exceeds managerial expectations is an interesting point to reflect upon. It could be that managers, accustomed to thinking of IT systems as being used largely to support business processes directly, are inclined to underestimate the social dimension in relation to CIS technologies and particularly their ability to support informal communications.

'the use of (sic) *informal communications was higher than managers expected."*

Minutes of ISCMG Meeting , 27 th February 1997.

A number of possibilities flow from this. Firstly, managers may have a constraining effect upon positive use of CIS technology if they retain rather limited views about its capabilities to transform work-tasks, leading to a self fulfilling prophecy where the introduced technology is indeed of limited effectiveness in practice. Secondly, if a low (or no) expectation is adopted at the outset of the implementation the ability to manage towards successful outcomes is prevented since there will be no way in which lack of success can be signalled.

The qualitative results incorporating analysis of comments received on questionnaires together with analysis of respondent specified and most useful business tasks tends towards support of the view that, for the GroupWise technology implemented, designed application is more effective than emergent application.

5.2.4. Coverage and Usage

A clear message emerging from the qualitative results is the issue of coverage. In almost all of the surveys analyses it is clear that a significant number of respondents had felt limitations in relation to coverage. Thus, once the practice of electronic communication had been established for some respondents and groups, failure to be able to interact with other respondents and groups presented an irritating constraint.

This conclusion is at one level banal and obvious. However an interesting contrast may be made with the fact that the diary and calendar management features of the system, including arranging meetings, presents a consistently high score in most surveys. Thus coverage in this case does not appear to represent a significant issue provided some reasonable number of persons with whom diary and meeting co-ordination is to take place have the system available. This surely suggests that the advantages of the automation offered for this process, in this organisation at least, is sufficiently great to overcome the need for total coverage.

It seems that the relationship between coverage and usage is not a simple one and relates to the specific tasks being undertaken. This is an endorsement of the approach taken in the current research to emphasise evaluation of use of CIS for specific and differentiable co-operative tasks.

Some drift towards improved usage as coverage increases has been recorded in the case of for example the Social Services Department between surveys 2 and 3 (p177). It should again be noted though that *patterns* of usage do not appear to change significantly over time.

5.2.5. Scope for Improvement

If the scores for the highest scoring department (IT Services) were to be taken as a target it is clear that, in most cases, there is scope to improve usage and application of the system in most departments in the County Council by around 0.5 point in the scale. In overall terms this represents a movement from "somewhere between *sometimes employed* and *frequently employed*" to a more positive "*frequently employed*".

Bigger differences seem to be exhibited in design theme tasks between the highest scoring department and other departments than in the emergent theme tasks. This points toward two interesting conclusions.

Firstly, the closer scores on emergent tasks between ITS and the other departments suggests that creative application of the technology for business tasks is not, perhaps, directly a function of technical skill in its use.

Secondly, wider differences in score on designed tasks between ITS and other departments suggests that technical skill levels may be an important factor in users adoption of the technology for these sorts of pre-defined and designed tasks.

5.3. FUZZY ARITHMETICAL TREATMENT OF QUESTIONNAIRE RESULTS

A number of conclusions emerge from the development of the fuzzy arithmetical treatment of questionnaire results.

When the work was started the aim was to produce computable model to evaluate performance and allow meaningful and automatic comparisons of performance within and between organisations and technologies. Through the research the emphasis has shifted slightly into the need to provide better forms of automated interpretation of survey results, based upon the fuzzy arithmetical model, but also using other principles from artificial intelligence. The conclusions below are presented to reflect both these themes.

5.3.1. Fuzzy Triangular Numbers, Interpretation and Visualisation

The representation of the results of sample surveys by developing fuzzy triangular numbers from the resulting frequency tables for responses has been demonstrated. The presentation of these triangular fuzzy numbers in a graphical manner makes it possible to represent a *possibilistic* space interpreted upon the original questionnaire scale.

Because the numbers are analytically defined it is possible to provide an automated translation of the *meaning* of the resulting score based upon the original questionnaire scale.

The combination of the capability for visual presentation together with automated translation based upon the original questionnaire scale presents the possibility for enhanced automated processing of sample survey results.

Whilst the method for extracting fuzzy scores has been developed and demonstrated and automated translation has be employed for this survey; the relationship between this method of presenting results and more conventional statistical methods has only been examined in a cursory fashion. What can be said is that the techniques developed and demonstrated offer a number of possibilities for further development.

5.3.2. Comparisons Using Fuzzy Triangular Numbers

Comparisons have been essayed between various fuzzy triangular scores for co-operative tasks within different departments and between the same department at different times.

Possible comparisons are based upon both differences and ratios of fuzzy triangular scores and these have been demonstrated.

It is clear from analyses conducted that comparisons made between fuzzy triangular scores differ from more typical comparisons between frequency tables such as Chi-Square. In the case of the latter, the comparison is attempting to determine if response frequencies might reasonably be expected to represent essentially similar or essentially dissimilar distributions of response. In the case of the fuzzy triangular score the attempt is being made to represent some aggregate of the response distributions and it is therefore clear, as in the case of an average derived in an analogous way, that different distributions of response can lead to similar triangular fuzzy envelopes.

The conclusion is that the fuzzy triangular representation as developed must be viewed as different and hopefully complementary to other methods of comparison. It provides (retains) more information from its source frequency table than do a measures such as the mean or mode. Moreover, by being linked to an underlying linguistic scale it can (with caution) provide ways of aggregating measures from different items within a questionnaire.

5.3.3. Best Hypothesis Formulation

The approach in this case was evolved with the aim of improving the interpretative capabilities of measures based upon fuzzy triangular numbers.

A "best hypothesis" may be viewed as providing a modality for decision. In artificial intelligence applications concerned with control, the *vote* of several sensors in favour of a particular hypothesis (or decision) may be employed to trigger a control process. In the formulation developed in this thesis this is extended to include votes for particular responses within the questionnaire scale. Each of these hypothesis is then supported to some degree by votes for adjacent points or hypotheses. As has been discussed in section 3.4.6. (p115) the method is essentially a way of finding a kind of "centre of gravity" for the responses and makes sense when compared to measures such as the modal value.

A difficulty with the present formulation is the weighting of support provided for a given hypothesis by scores for adjacent hypothesis. The present formulation makes all weights equal as though a vote for adjacent hypotheses is equal to a vote for the hypothesis in question. A justification for this is that no rational process has yet been developed to provide an alternative weighting, but it might be presumed that some form of process could be developed based perhaps upon the internal structure of the data.

The best hypothesis formulation does provide a powerful and polarised conclusion for each questionnaire response which, taken together with the fuzzy triangular score, adds richness to the interpretation of results.

5.3.4. Managers Reactions to Alternative Formulations

Managers at Northampton County Council were exposed to a number of versions of the triangular fuzzy number presentation of questionnaire scores within the various reports which were presented. The concept of fuzziness in both objectives and measurement seems to be readily accepted and a number of managers who were interviewed as part of the structured interviews were keen to discuss the reasoning behind the approach. When presented with graphical results however, it was clear that most people were immediately forced to try to find an interpretation of what the triangular presentations "really meant". In part the automatic interpretation method was developed to help to alleviate this difficulty.

Towards the end of the research the best hypothesis formulation was developed and it was noted following the submission of the final report to Northampton County Council that this was particularly useful when consolidated into the form of the pattern table. The ISCMG Client Consultant for example noted that this was *".. the bit people should be looking at."*, moreover that it *".. bears out what is said elsewhere."*. So a conclusion is that the best hypothesis formulation has presented as useful in a way that the fuzzy triangular scores, in the absence of suitable interpretation, have not.

5.4. AREAS FOR FUTURE RESEARCH

Areas for future research fall into two main categories. Firstly, there is a need to obtain further experience with use of the co-operative task model in evaluating the effect of CIS across different organisations and using different underlying technologies. Secondly, there are a number of opportunities for development of the techniques for fuzzy analysis of questionnaire data. These are presented in turn.

5.4.1. Extension of Use of Co-operative Task Model of CIS Effect

Future research areas should include the following.

1. Survey using the same or similar task structure in another Local Authority using GroupWise to determine the possible generalisability of findings with respect to the technology within this type of organisational context.
2. Survey using the same or similar task structure another Local Authority using another groupware product to determine the possible generalisability of findings independent of the technology within this type of organisational context.
3. Survey a range of other types of organisations including users of both GroupWise and other products.

The main aims of this research would be to confirm or otherwise the findings in relation to adoption speed and patterns of use the questions being.

- Is the suggestion that user attitudes to CIS technologies and use are formed early in implementation justified?
- Does it appear generally true that patterns of use are established early within CIS implementation?
- Does it appear generally true that patterns of use are closely related to the particular CIS technology or product being implemented.

5.4.2. Fuzzy Analysis of Questionnaire Data

Future research areas should include the following.

1. Development of the analytical framework underlying the fuzzy triangular and best hypothesis formulations to better understand their relationship to conventional statistical techniques.
2. Development of the interpretative framework for the fuzzy triangular number formulation.

3. Testing the fuzzy triangular and best hypothesis formulations using a variety of surveys to conduct a more rigorous comparison with conventional analysis methods.

5.5. REFLECTION

In attempting to put all the detailed qualitative and quantitative results reported here into perspective, one perception is thrown into sharp relief. This is that attempts to employ information technologies to accomplish changes in working practices within organisations are fraught with difficulty. Technology can provide new capacities and capabilities, but co-operative work output results from a rich interaction of human and technological factors. Managers who seek a change in organisational culture and practices cannot therefore rely upon co-operative information systems to provide a "technological fix".

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CHAPTER HEADING QUOTATIONS

Chapter 1. The Eliot quotation is taken from *The New Golden Treasury of English Verse*, Edited by Edward Leeson, Pan Books, England, 1980.

I am fascinated by Eliot because I find his poetry so difficult to understand. Some fragments however seem to have a great resonance and this one has an effect for me like the throwing of a stone into a placid body of water... the ripples spread wide ...

Chapter 2. This was from *The Complete Works of William Shakespeare* published by Avenel Books, New York, 1975.

I remembered this quotation from the play. On re-reading to find the reference I was struck again, as many others have been, by how much of Shakespeare's language seems to have been taken into ordinary usage in the form of common phrases.

Chapter 3. This is a quotation from Waddington, C H, 1977, *Tools for Thought*, Paladin, UK, Chapter 8, p129. Waddington is reporting a conversation with David Keilin, a famous biochemist, sometime during the 1930's.

Having wrestled with the qualitative versus quantitative paradigm debate I was appreciative of this common sense approach to designing research.

Chapter 4. Is taken from Beer, S, 1985, *Diagnosing the System for Organizations,* John Wiley and Sons Ltd, UK, ISBN 0-471-90675-1, p99. Beer describes this as a "key aphorism" and uses it in a number of places within his work.

A warning that the story presented may not describe the real purpose of the system under study.

Chapter 5. Quoted from Elizabeth Longford's biography of Wellington, *Wellington the Years of the Sword*, Panther, 1971.

Wellington was recognised as having the ability to cut quickly to the heart of many matters. It re-inforced for me the importance of drawing definite conclusions from the research.

APPENDIX 1

SURVEY QUESTIONNAIRES

USER QUESTIONNAIRE

«Name»
«Location»

GROUPWISE Evaluation Questionnaire

Dear GROUPWISE user

As you may be aware, I have been carrying our some research over the last 2 years on the use and effectiveness of GROUPWISE within Northamptonshire County Council.

It is now very important for the outcomes of the research to complete a final survey across a department which is geographically spread, The Social Services department was suggested and Mr Brian Frisby has given me approval to forward the attached questionnaire directly to you.

I should be most grateful if you could complete the questionnaire as soon as you are able and return it to Dianne Wright in the Information Systems team at John Dryden House. The questionnaire should take no more than 10 minutes to complete and I would like your response even if you have already taken part in an earlier survey.

The results of this survey will be analysed on a aggregated basis and taking care to ensure the anonymity of any individual comments and opinions expressed.

If you have any questions about the survey I shall be happy to answer them. You can contact me on 0976 766 592 during office hours.

Thank you in anticipation of you assistance.

Yours sincerely

John Hassall
Senior Lecturer
Wolverhampton University

USER - QUESTIONNAIRE «Name»

1. Please respond to each question by placing a CROSS, TICK or other mark IMMEDIATELY FOLLOWING the appropriate score.
2. You are asked to score the questions according to the value you judge to reflect CURRENT experience in using GROUPWISE.

SECTION 1.-.Use of GROUPWISE Facilities for a Variety of Business Tasks

Score each business task described against the guidelines shown here.

GROUPWISE is..

1. **Indispensable to task.**	(No other acceptable method of performing task)
2. **Almost always employed.**	(Normal method for task, other methods occasionally used)
3. **Frequently employed.**	(A variety of methods for task , GROUPWISE is one)
4. **Sometimes employed.**	(GROUPWISE is useful and employed on some occasions)
5. **Seldom employed.**	(May have been tried once or twice, not normally used)
6. **Never employed.**	(Has never been used, in all likelihood will never be used)

Informal communications, keeping people informed
Score= 1... 2... 3... 4... 5... 6...

Co-ordination & communication within teams in relation to shared tasks
Score= 1... 2... 3... 4... 5... 6...

Distribution of formal communications such as memos
Score= 1... 2... 3... 4... 5... 6...

Editing and processing documents using mail attachments
Score= 1... 2... 3... 4... 5... 6...

Confirming that communications (memos etc.) have been delivered to recipients
Score= 1... 2... 3... 4... 5... 6...

Taking and recording messages other than telephone messages
Score= 1... 2... 3... 4... 5... 6...

Recording and managing a personal task list
Score= 1... 2... 3... 4... 5... 6...

Recording and managing tasks to be performed by other individuals or teams
Score= 1... 2... 3... 4... 5... 6...

Maintaining a personal diary
Score= 1... 2... 3... 4... 5... 6...

Scheduling of meetings
Score= 1... 2... 3... 4... 5... 6...

As a telephone directory
Score= 1... 2... 3... 4... 5... 6...

SECTION 2 - Other information relating to the use of GROUPWISE

You are asked to briefly describe the 3 business tasks for which you find the application of GROUPWISE most useful.

TASK 1

....

TASK 2

....

TASK 3

....

Comments - you are invited to make any comments/observations you wish about the use of GROUPWISE, your experience with the system or ideas about future developments.

MANAGER QUESTIONNAIRE

Name, Title, Company, Address

GROUPWISE Evaluation Questionnaire

Dear GROUPWISE user

As you may be aware, I have been carrying our some research over the last 2 years on the use and effectiveness of GROUPWISE within Northamptonshire County Council.

It is now very important for the outcomes of the research to complete a final survey across a department which is geographically spread, The Social Services department was suggested and Mr Brian Frisby has given me approval to forward the attached questionnaire directly to you.

I should be most grateful if you could complete the questionnaire as soon as you are able and return it to Dianne Wright in the Information Systems team at John Dryden House. The questionnaire should take no more than 10 minutes to complete and I would like your response even if you have already taken part in an earlier survey.

The results of this survey will be analysed on a aggregated basis and taking care to ensure the anonymity of any individual comments and opinions expressed.

If you have any questions about the survey I shall be happy to answer them. You can contact me on 0976 766 592 during office hours.

Thank you in anticipation of you assistance.

Yours sincerely

John Hassall
Senior Lecturer
Wolverhampton University

MANAGER - QUESTIONNARE

1. Please respond to each question by placing a CROSS, TICK or other mark IMMEDIATELY FOLLOWING the appropriate score.
2. You are asked to score the questions according to the value you judge to reflect CURRENT experience in using GROUPWISE.

SECTION 1.-.Use of GROUPWISE Facilities for a Variety of Business Tasks

Score each business task described against the guidelines shown here.

GROUPWISE is..

1. **Indispensable to task.** (No other acceptable method of performing task)
2. **Almost always employed.** (Normal method for task, other methods occasionally used)
3. **Frequently employed.** (A variety of methods for task , GROUPWISE is one)
4. **Sometimes employed.** (GROUPWISE is useful and employed on some occasions)
5. **Seldom employed.** (May have been tried once or twice, not normally used)
6. **Never employed.** (Has never been used, in all likelihood will never be used)

As a manager you are asked to provide TWO scores for each task. The first is your own score and refers to your own use of GROUPWISE. The second is your EXPECTATION of how your staff should currently be using GROUPWISE; in other words you are being asked to provide a judgement of how useful the system should be, based upon your knowledge of the business tasks performed within your department.

Informal communications, keeping people informed

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Co-ordination & communication within teams in relation to shared tasks

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Distribution of formal communications such as memos

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Editing and processing documents using mail attachments

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Confirming that communications (memos etc.) have been delivered to recipients

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Taking and recording messages other than telephone messages

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Recording and managing a personal task list

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Recording and managing tasks to be performed by other individuals or teams

Own Score= 1... 2... 3... 4... 5... 6...
Staff Score= 1... 2... 3... 4... 5... 6...

Maintaining a personal diary

Own Score=	1...	2...	3...	4...	5...	6...
Staff Score=	1...	2...	3...	4...	5...	6...

Scheduling of meetings

Own Score=	1...	2...	3...	4...	5...	6...
Staff Score=	1...	2...	3...	4...	5...	6...

As a telephone directory

Own Score=	1...	2...	3...	4...	5...	6...
Staff Score=	1...	2...	3...	4...	5...	6...

SECTION 2 - Other information relating to the use of GROUPWISE

You are asked to briefly describe the 3 business tasks for which you find the application of GROUPWISE most useful.

TASK 1

....

TASK 2

....

TASK 3

....

Comments - you are invited to make any comments/observations you wish about the use of GROUPWISE, your experience with the system or ideas about future developments.

APPENDIX 2

Questionnaire format for Structured Interviews

Name:

Date:

Mgr (y/n):

Q L1		**Q L 2**		**Q L 3**	
Brief description of job role					
What do you most use GW for	Informal Communications Formal Communications Something Else	Informal example		Frequency	
		Formal Example		Frequency	
		If something else what		Frequency	
For what is GW most useful for you		Frequency			

Do you find GW helpful for working in teams					
	Yes	For what tasks			
		T1		Frequency	
		T2		Frequency	
		T2		Frequency	
	No	Can you think of how it might be useful		Frequency	

Do you find GW helpful for preparing documents (reports etc.)					
	Yes	Which ones (could be used)		Frequency	
				Frequency	
				Frequency	
	No				
	Didn't know it could				

Do you find GW helpful for formal communications					
	Yes	Which ones (could be used ?)		Frequency	
				Frequency	
				Frequency	
	No				
What are the best and worse things about GW		Best			

		Worst	
Do you judge your training on GW to have been			
	Good		
	Adequate		
	Could have been better	How could training have been improved	
Your IT experience prior to using GW	Used a system like GW before	Y or N	
	Programming experience/IT professional	Years	
	Applications such as (eg.) an accounting	Years	
	Spreadsheets - user tools	Years	
	Word-processing	Years	
	Little IT usage or experience before using GW	Years	

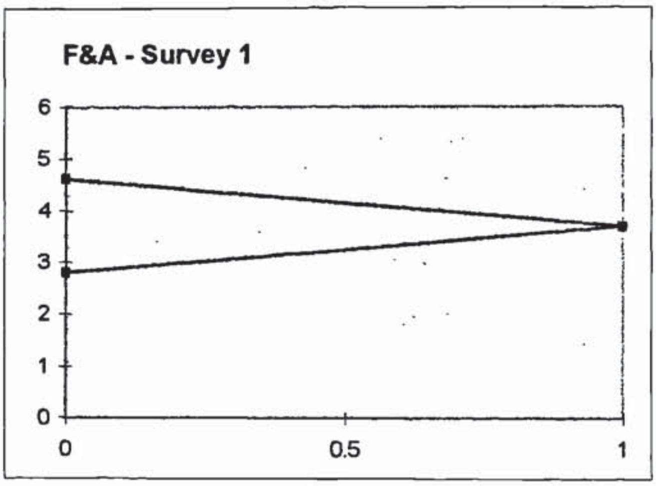
APPENDIX 3

TASK/COMPONENT SCORES AND ANALYSES NOT INCLUDED WITHIN THE BODY OF THE THESIS

Finance and Admin Survey 1

all business tasks

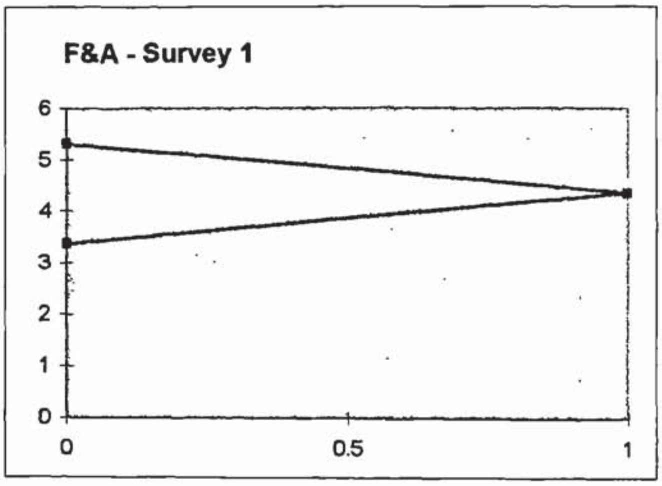
Min	Kernel	Max
2.8	3.704	4.613



The score for all business tasks is a Kernel value of 3.704 , with a Minimum of 2.8 and a Maximum of 4.613 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for all business tasks.

informal communications **Emergent**

Min	Kernel	Max	*Best supported hypothesis*
3.364	4.364	5.318	.... sometimes employed for informal communications

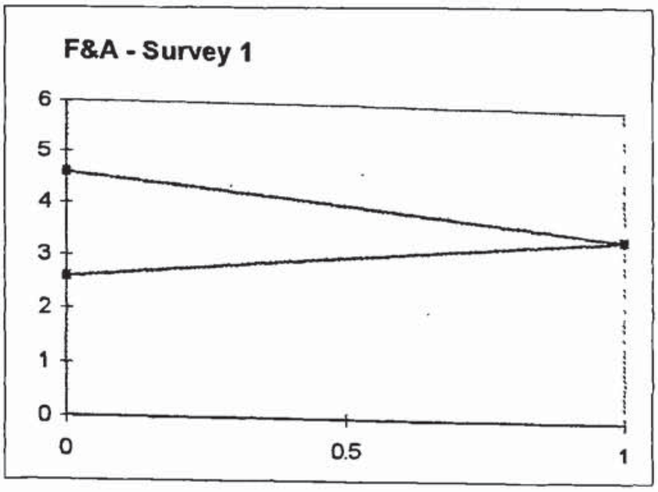


The score for informal communications is a Kernel value of 4.364 , with a Minimum of 3.364 and a Maximum of 5.318 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat more than

co-ordination within teams

Emergent

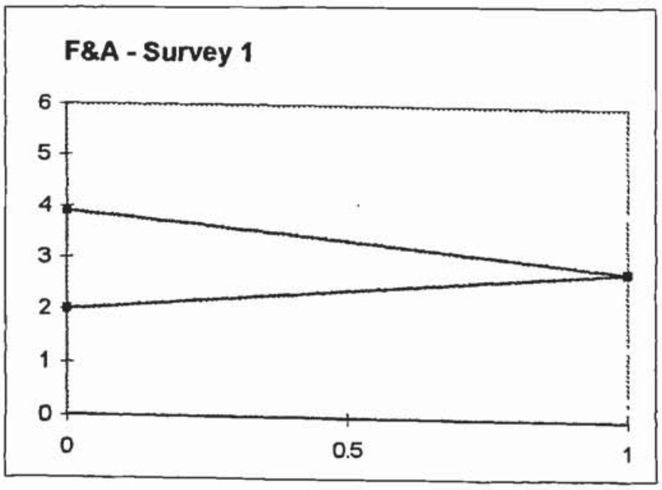
Min	Kernel	Max	Best supported hypothesis
2.591	**3.591**	**4.591**	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.591 , with a Minimum of 2.591 and a Maximum of 4.591 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for co-ordination within teams .

processing documents using mail attachments

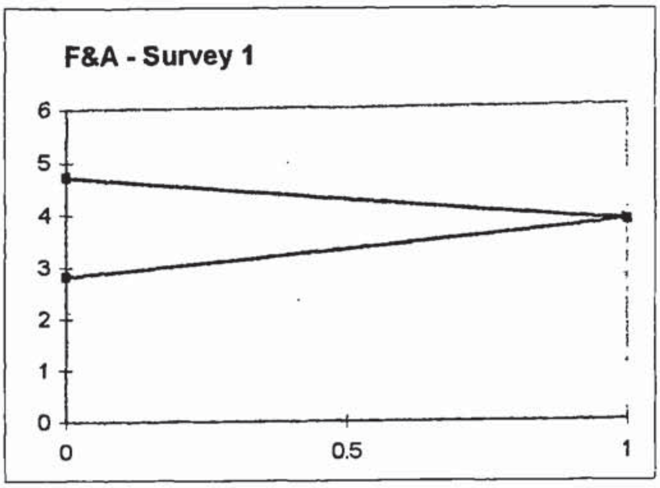
Min	Kernel	Max	Best supported hypothesis
2	**2.909**	**3.909**	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 2.909 , with a Minimum of 2. and a Maximum of 3.909 . The Kernel (most likely) value may be interpreted as close to sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as close to seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using mail attachments.

confirming delivery of communications **Emergent**

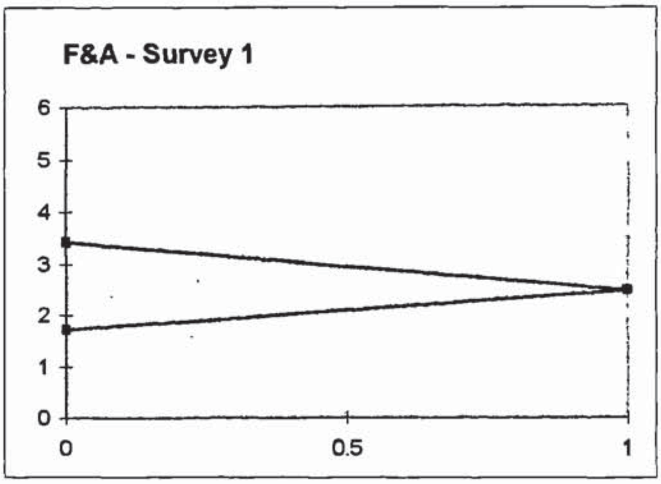
Min	Kernel	Max	Best supported hypothesis
2.818	3.773	4.727	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.773 , with a Minimum of 2.818 and a Maximum of 4.727 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.714	2.429	3.429	.... never employed for managing a team task list



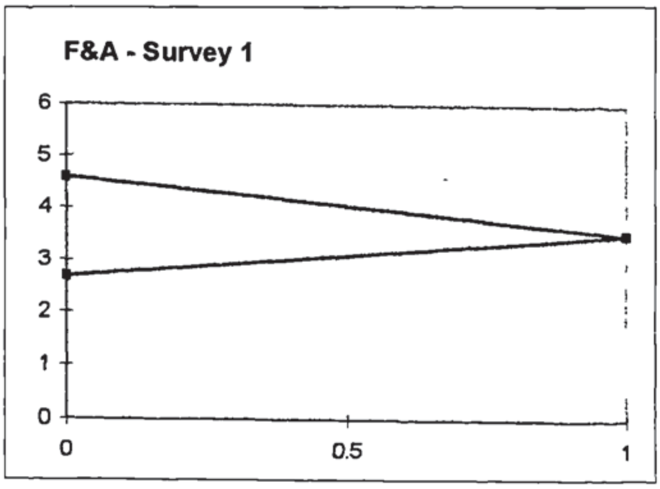
The score for managing a team task list is a Kernel value of 2.429 , with a Minimum of 1.714 and a Maximum of 3.429 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a team task list

formal communications

Design

Min Kernel Max **Best supported hypothesis**

2.682 3.591 4.591 .... frequently employed for formal communications



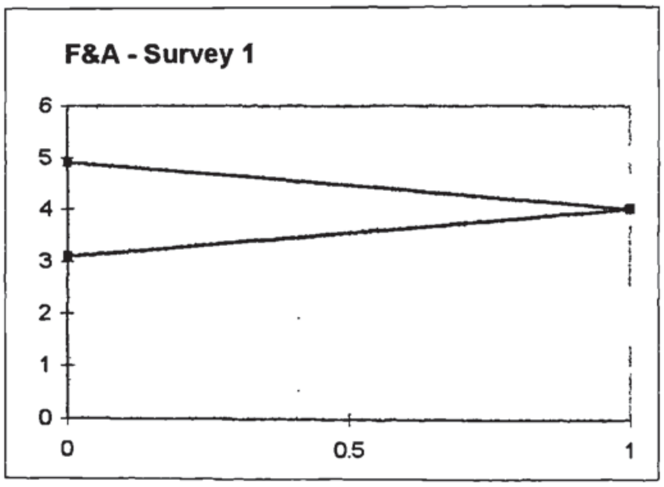
The score for formal communications is a Kernel value of 3.591 , with a Minimum of 2.682 and a Maximum of 4.591 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min Kernel Max **Best supported hypothesis**

3.091 4.045 4.909 .... sometimes employed for recording messages

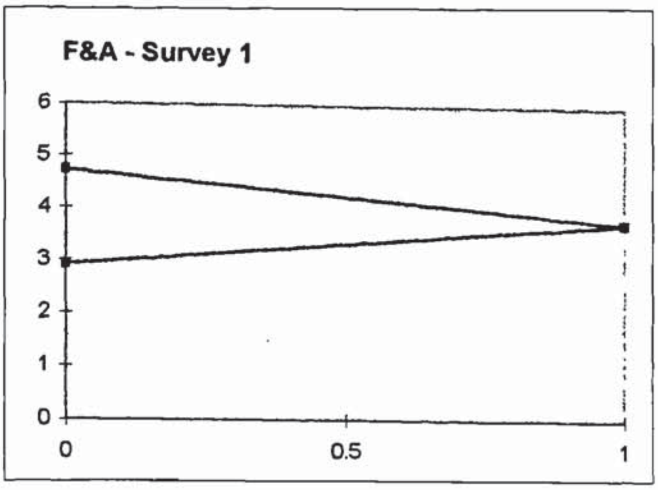


The score for recording messages is a Kernel value of 4.045 , with a Minimum of 3.091 and a Maximum of 4.909 . The Kernel (most likely) value may be interpreted as close to frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as close to almost always employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.909	**3.818**	**4.727**	.... frequently employed for managing a personal task list

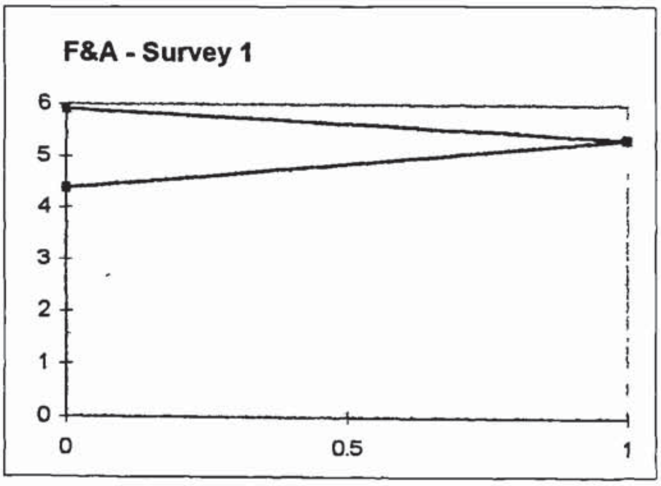


The score for managing a personal task list is a Kernel value of 3.818 , with a Minimum of 2.909 and a Maximum of 4.727 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
4.364	**5.364**	**5.909**	.... indispensible to task for maintaining a personal diary

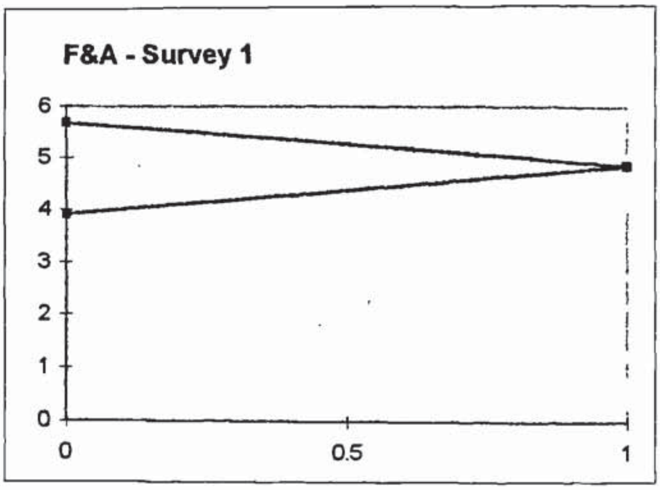


The score for maintaining a personal diary is a Kernel value of 5.364 , with a Minimum of 4.364 and a Maximum of 5.909 . The Kernel (most likely) value may be interpreted as somewhere between almost always employed and indispensible to task for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as close to indispensible to task for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.909	**4.909**	**5.682**	.... indispensible to task for scheduling meetings

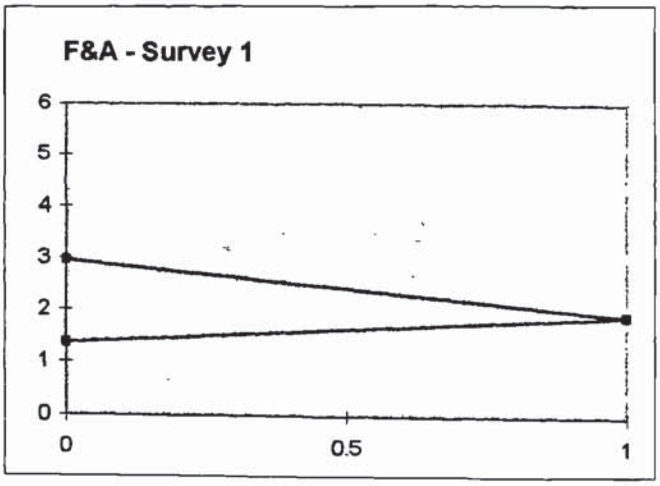


The score for scheduling meetings is a Kernel value of 4.909 , with a Minimum of 3.909 and a Maximum of 5.682 . The Kernel (most likely) value may be interpreted as close to almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than indispensible to task for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.364	**1.955**	**2.955**	.... never employed for as a telephone directory

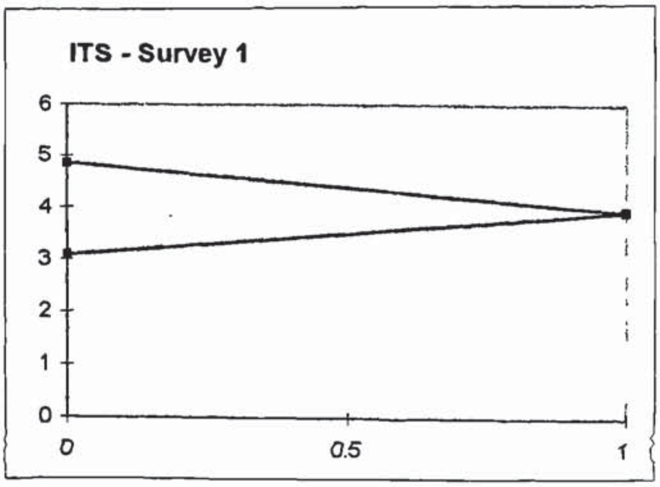


The score for as a telephone directory is a Kernel value of 1.955 , with a Minimum of 1.364 and a Maximum of 2.955 . The Kernel (most likely) value may be interpreted as close to seldom employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to sometimes employed for as a telephone directory.

ITS Survey 1

all business tasks

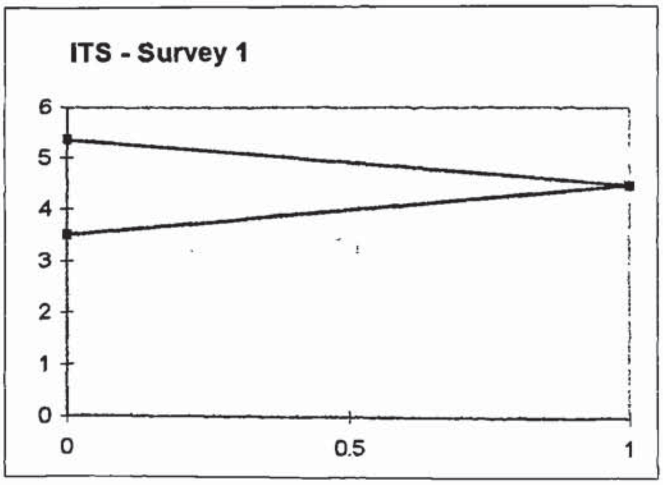
Min	Kernel	Max
3.07	3.999	4.859



The score for all business tasks is a Kernel value of 3.999 , with a Minimum of 3.07 and a Maximum of 4.859 . The Kernel (most likely) value may be interpreted as close to frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for all business tasks.

informal communications **Emergent**

Min	Kernel	Max	*Best supported hypothesis*
3.5	4.5	5.367	.... almost always employed for informal communications

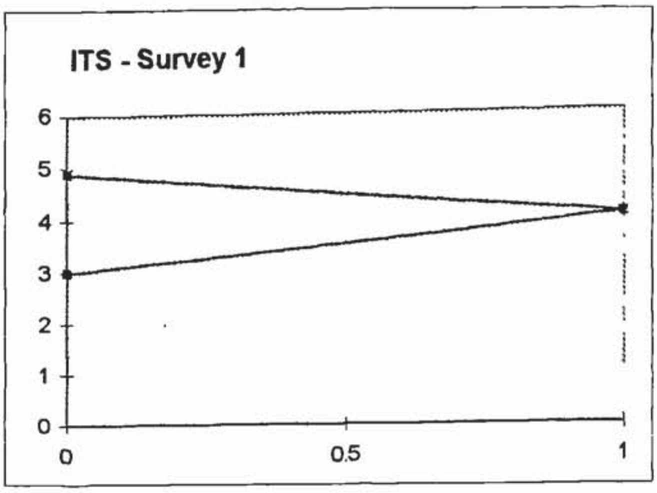


The score for informal communications is a Kernel value of 4.5 , with a Minimum of 3.5 and a Maximum of 5.367 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhere between

co-ordination within teams

Emergent

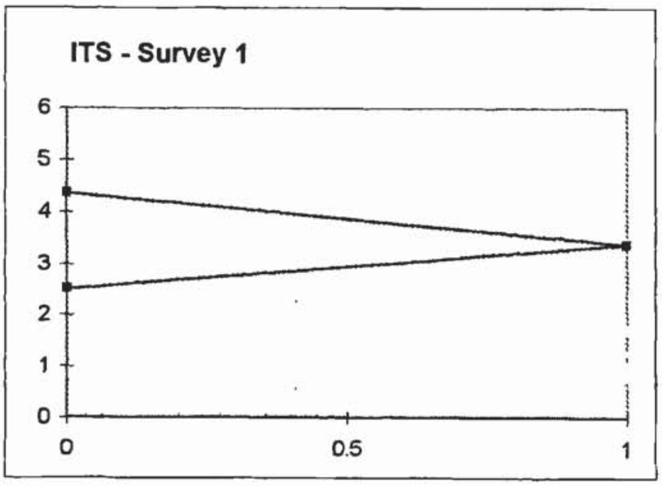
Min	Kernel	Max	Best supported hypothesis
3	4	4.9	.... almost always employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 4. , with a Minimum of 3. and a Maximum of 4.9 . The Kernel (most likely) value may be interpreted as close to frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as close to sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as close to almost always employed for co-ordination within teams .

processing documents using mail attachments

Min	Kernel	Max	Best supported hypothesis
2.517	3.379	4.379	.... frequently employed for processing documents using mail attachments

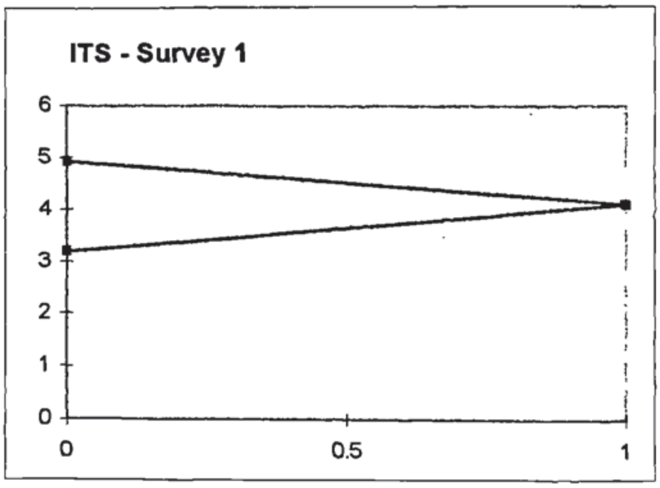


The score for processing documents using mail attachments is a Kernel value of 3.379 , with a Minimum of 2.517 and a Maximum of 4.379 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhere between frequently

confirming delivery of communications

Emergent

Min	Kernel	Max	Best supported hypothesis
3.179	4.143	4.929	.... almost always employed for confirming delivery of communications

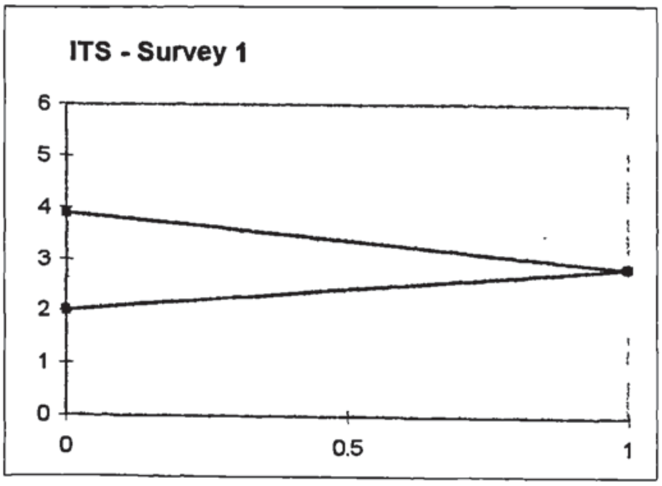


The score for confirming delivery of communications is a Kernel value of 4.143 , with a Minimum of 3.179 and a Maximum of 4.929 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to almost always employed for confirming delivery of communications.

managing a team task list

Emergent

Min	Kernel	Max	Best supported hypothesis
2	2.893	3.893	.... sometimes employed for managing a team task list

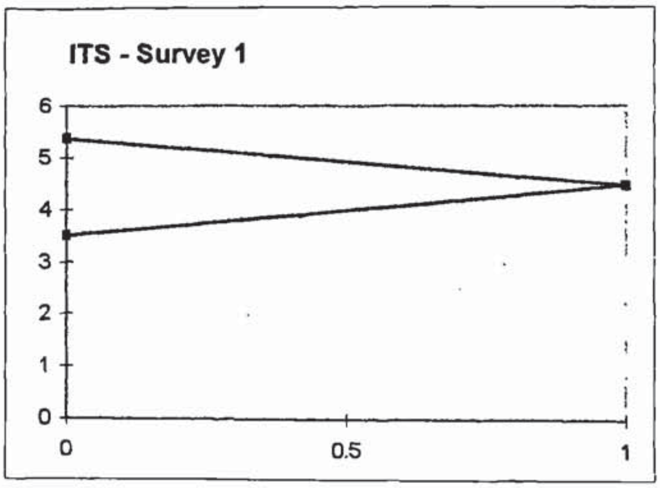


The score for managing a team task list is a Kernel value of 2.893 , with a Minimum of 2. and a Maximum of 3.893 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as close to seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
3.5	**4.5**	**5.367**	.... almost always employed for formal communications

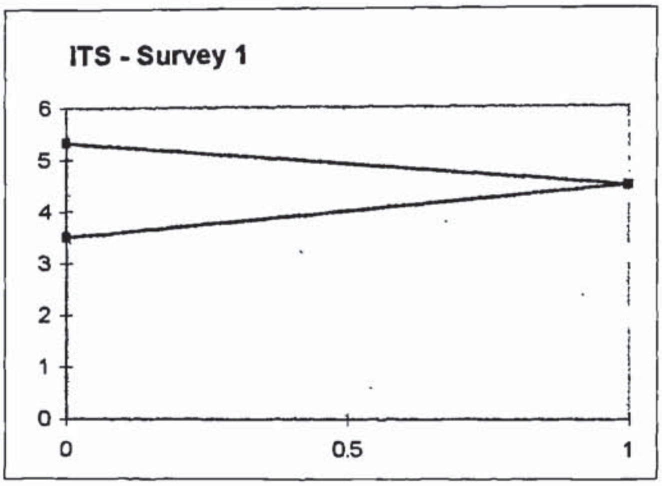


The score for formal communications is a Kernel value of 4.5 , with a Minimum of 3.5 and a Maximum of 5.367 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
3.5	**4.5**	**5.333**	.... almost always employed for recording messages

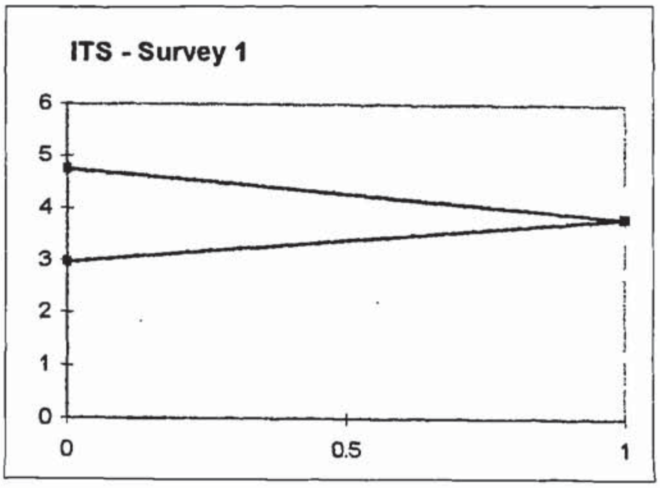


The score for recording messages is a Kernel value of 4.5 , with a Minimum of 3.5 and a Maximum of 5.333 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between almost

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.964	3.857	4.75	.... indispensible to task for managing a personal task list

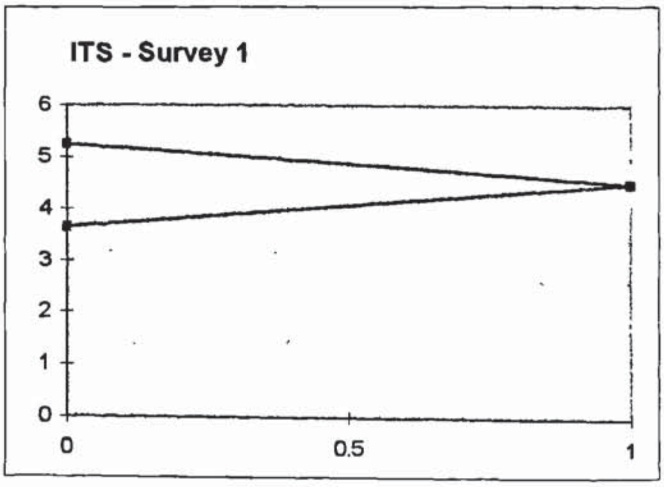


The score for managing a personal task list is a Kernel value of 3.857 , with a Minimum of 2.964 and a Maximum of 4.75 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.643	4.536	5.25	.... indispensible to task for maintaining a personal diary

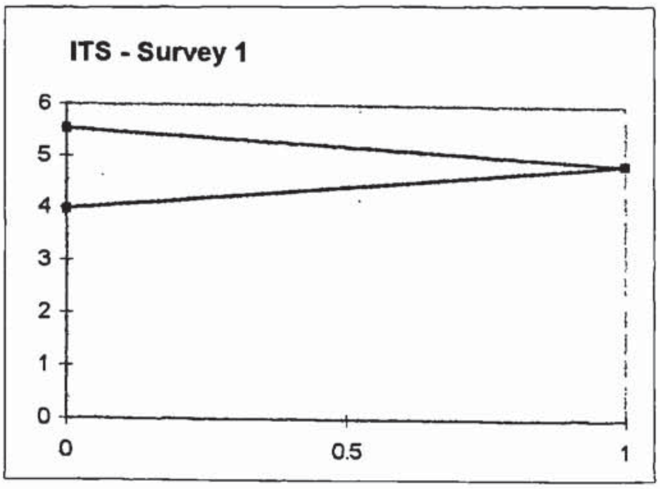


The score for maintaining a personal diary is a Kernel value of 4.536 , with a Minimum of 3.643 and a Maximum of 5.25 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.964	**4.893**	**5.536**	.... indispensible to task for scheduling meetings

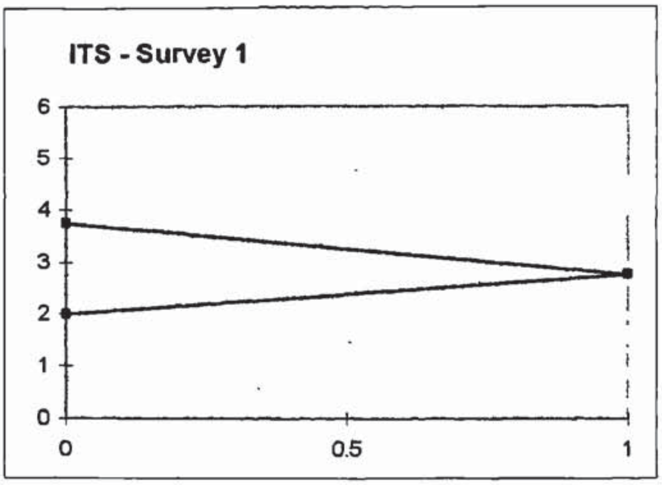


The score for scheduling meetings is a Kernel value of 4.893 , with a Minimum of 3.964 and a Maximum of 5.536 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2	**2.786**	**3.75**	.... sometimes employed for as a telephone directory

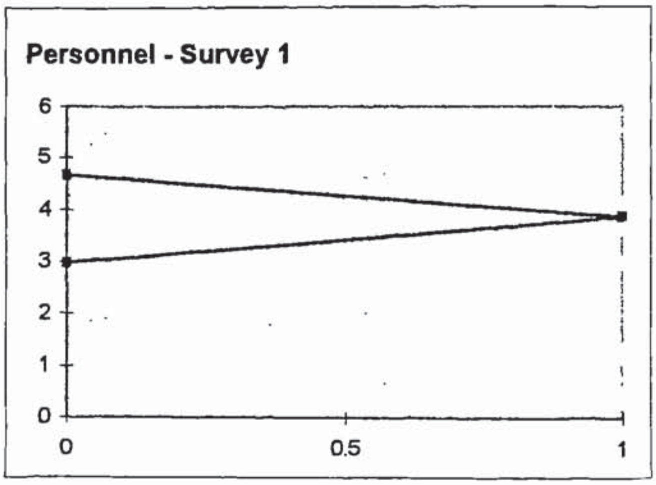


The score for as a telephone directory is a Kernel value of 2.786 , with a Minimum of 2. and a Maximum of 3.75 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as close to seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for as a telephone directory.

Personnel Survey 1

all business tasks

Min	Kernel	Max
2.979	3.881	4.664

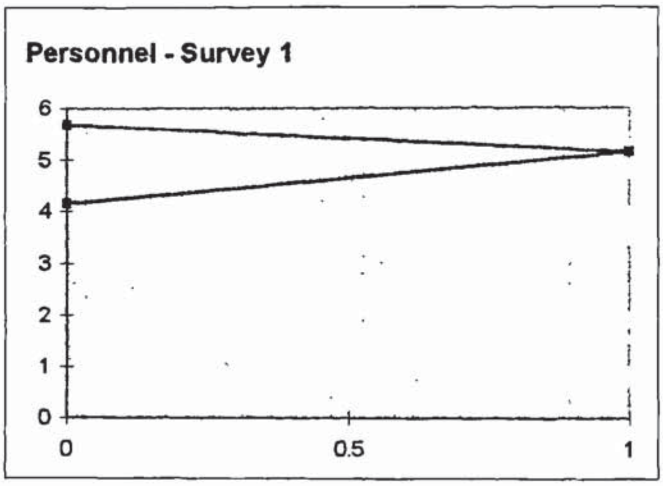


The score for all business tasks is a Kernel value of 3.881 , with a Minimum of 2.979 and a Maximum of 4.664 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
4.154	5.154	5.692	.... frequently employed for informal communications

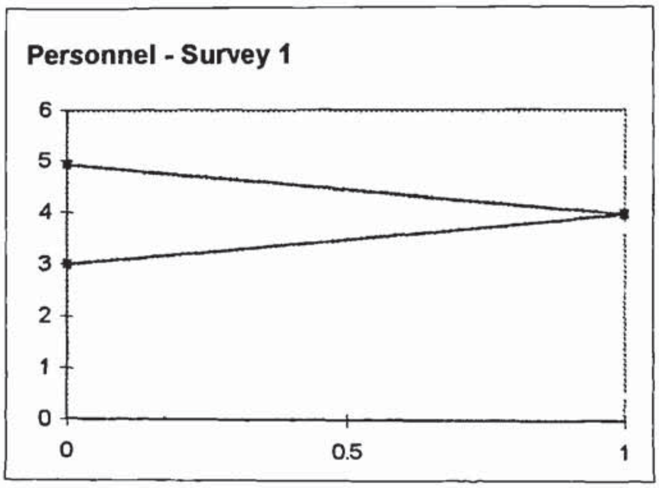


The score for informal communications is a Kernel value of 5.154 , with a Minimum of 4.154 and a Maximum of 5.692 . The Kernel (most likely) value may be interpreted as somewhat more than almost always employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat more than frequently employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than indispensible to task for informal communications.

co-ordination within teams

Emergent

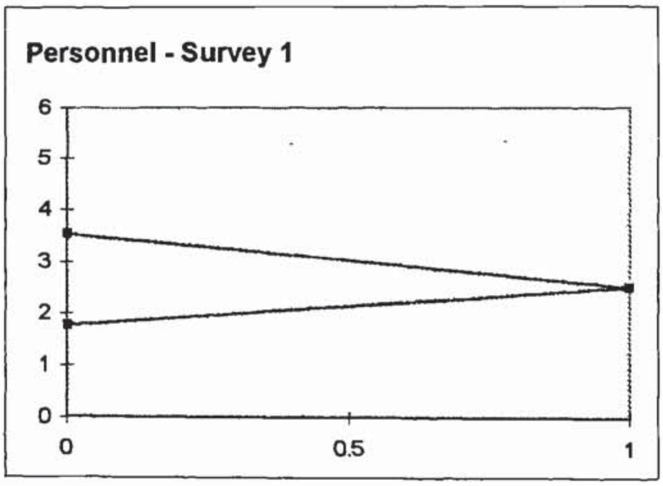
Min	Kernel	Max	Best supported hypothesis
3	4	4.923	.... indispensible to task for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 4. , with a Minimum of 3. and a Maximum of 4.923 . The Kernel (most likely) value may be interpreted as close to frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as close to sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as close to almost always employed for co-ordination within teams .

processing documents using mail attachments

Min	Kernel	Max	Best supported hypothesis
1.769	2.538	3.538	.... never employed for processing documents using mail attachments

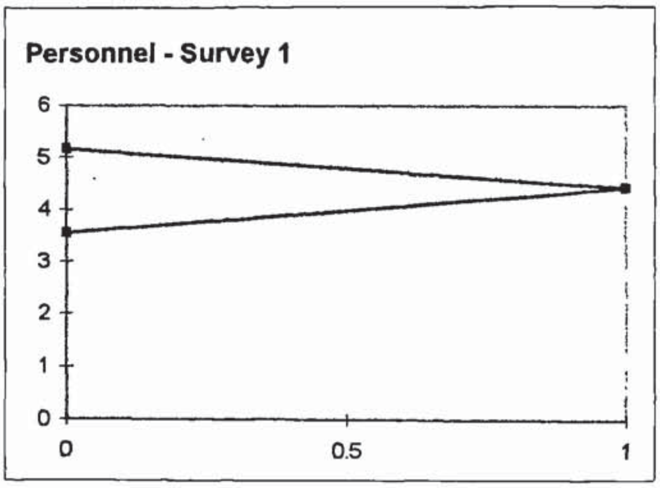


The score for processing documents using mail attachments is a Kernel value of 2.538 , with a Minimum of 1.769 and a Maximum of 3.538 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently

confirming delivery of communications

Emergent

Min	Kernel	Max	Best supported hypothesis
3.538	4.462	5.154	.... indispensible to task for confirming delivery of communications

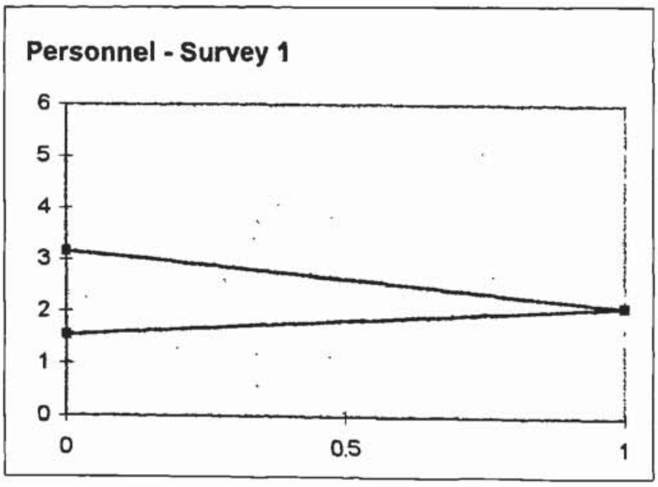


The score for confirming delivery of communications is a Kernel value of 4.462 , with a Minimum of 3.538 and a Maximum of 5.154 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for confirming delivery of communications.

managing a team task list

Emergent

Min	Kernel	Max	Best supported hypothesis
1.538	2.154	3.154	.... never employed for managing a team task list

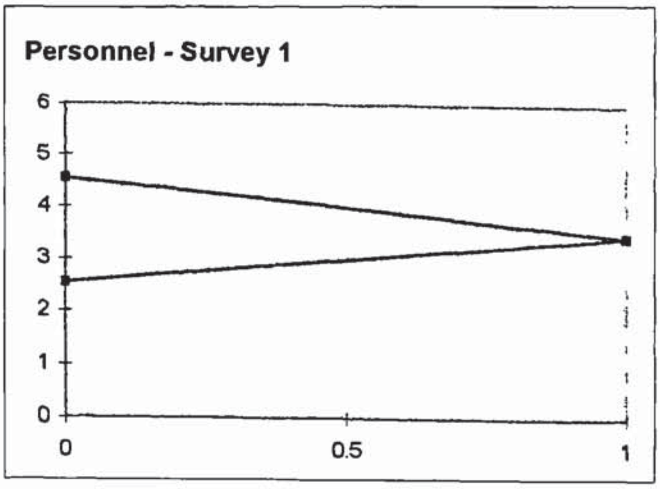


The score for managing a team task list is a Kernel value of 2.154 , with a Minimum of 1.538 and a Maximum of 3.154 . The Kernel (most likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for managing a team task list

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.538	3.538	4.538	.... indispensible to task for formal communications

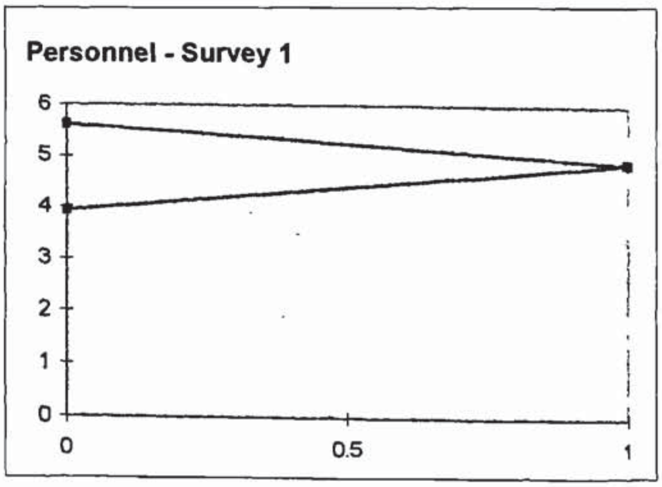


The score for formal communications is a Kernel value of 3.538 , with a Minimum of 2.538 and a Maximum of 4.538 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
3.923	4.923	5.615	.... frequently employed for recording messages

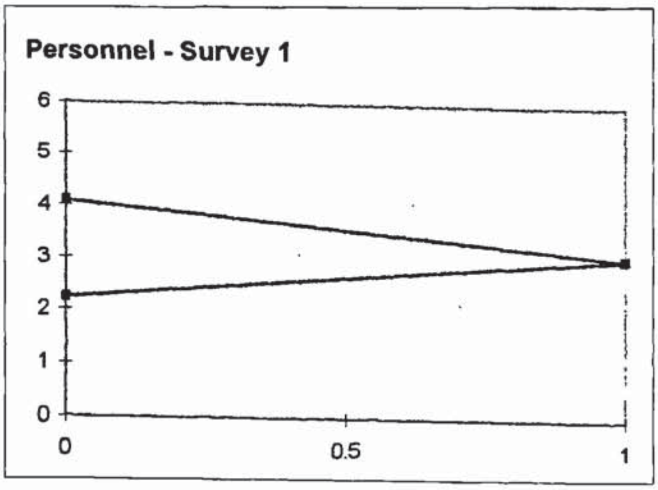


The score for recording messages is a Kernel value of 4.923 , with a Minimum of 3.923 and a Maximum of 5.615 . The Kernel (most likely) value may be interpreted as close to almost always employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to frequently employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.231	3.154	4.077	.... sometimes employed for managing a personal task list

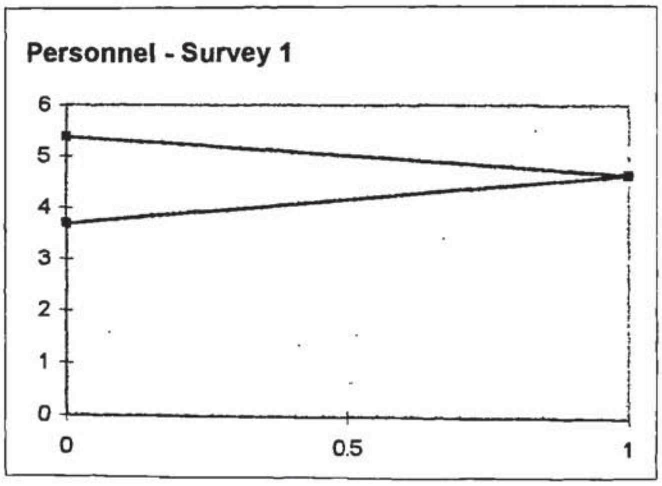


The score for managing a personal task list is a Kernel value of 3.154 , with a Minimum of 2.231 and a Maximum of 4.077 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.692	4.692	5.385	.... indispensible to task for maintaining a personal diary

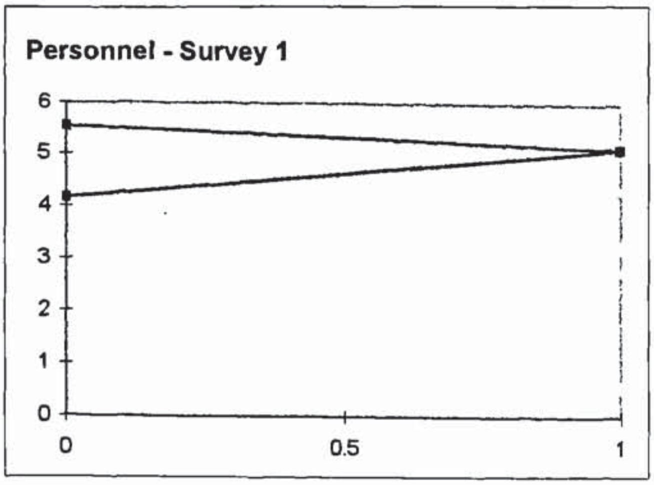


The score for maintaining a personal diary is a Kernel value of 4.692 , with a Minimum of 3.692 and a Maximum of 5.385 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
4.154	**5.154**	**5.538**	.... indispensible to task for scheduling meetings

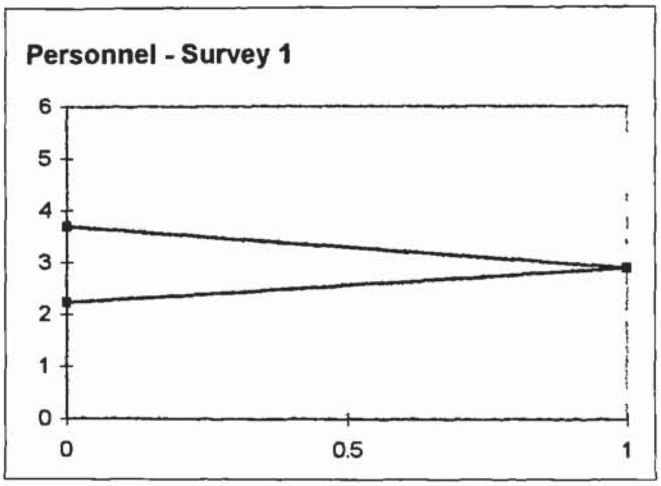


The score for scheduling meetings is a Kernel value of 5.154 , with a Minimum of 4.154 and a Maximum of 5.538 . The Kernel (most likely) value may be interpreted as somewhat more than almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat more than frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.231	**2.923**	**3.692**	.... never employed for as a telephone directory

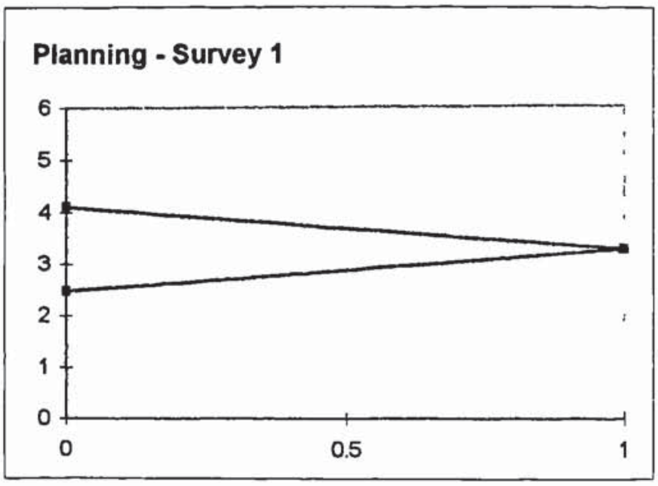


The score for as a telephone directory is a Kernel value of 2.923 , with a Minimum of 2.231 and a Maximum of 3.692 . The Kernel (most likely) value may be interpreted as close to sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for as a telephone directory.

Planning Survey 1

all business tasks

Min	Kernel	Max
2.477	3.236	4.11

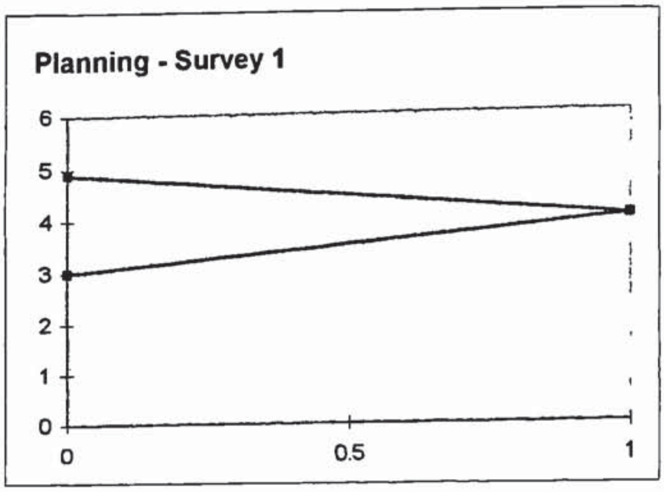


The score for all business tasks is a Kernel value of 3.236 , with a Minimum of 2.477 and a Maximum of 4.11 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
3	3.952	4.905	.... frequently employed for informal communications

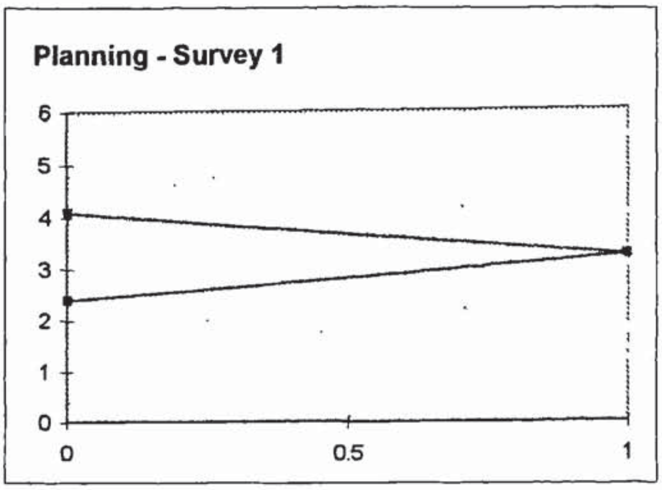


The score for informal communications is a Kernel value of 3.952 , with a Minimum of 3. and a Maximum of 4.905 . The Kernel (most likely) value may be interpreted as close to frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as close to almost always employed for informal communications.

co-ordination within teams

Emergent

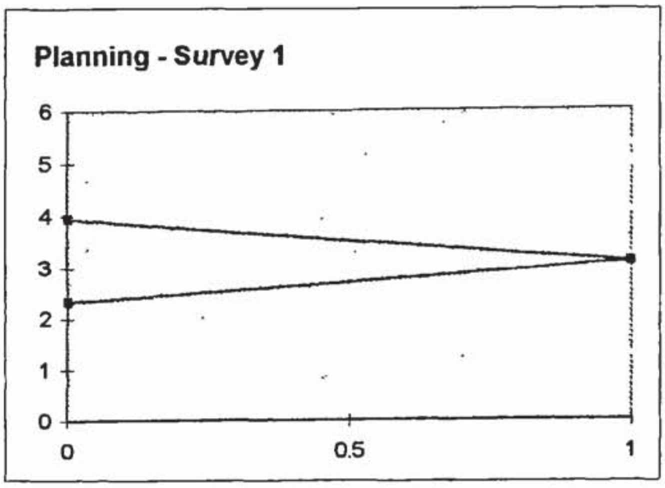
Min	Kernel	Max	Best supported hypothesis
2.4	3.2	4.1	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.2 , with a Minimum of 2.4 and a Maximum of 4.1 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as close to frequently employed for co-ordination within teams .

processing documents using mail attachments

Min	Kernel	Max	Best supported hypothesis
2.333	3.048	3.952	.... never employed for processing documents using mail attachments

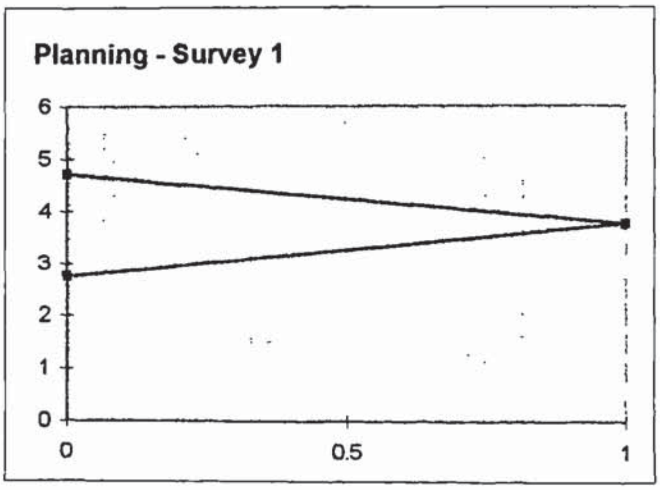


The score for processing documents using mail attachments is a Kernel value of 3.048 , with a Minimum of 2.333 and a Maximum of 3.952 . The Kernel (most likely) value may be interpreted as close to sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using mail

confirming delivery of communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.762	3.762	4.714	.... frequently employed for confirming delivery of communications

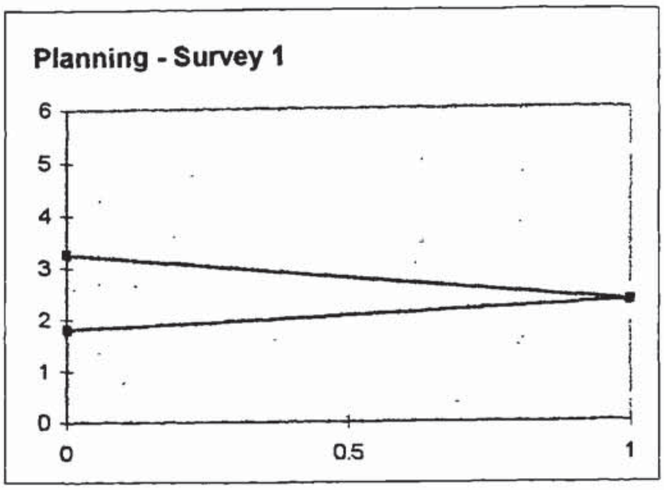


The score for confirming delivery of communications is a Kernel value of 3.762 , with a Minimum of 2.762 and a Maximum of 4.714 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for confirming delivery of communications.

managing a team task list

Emergent

Min	Kernel	Max	Best supported hypothesis
1.8	2.3	3.25	.... never employed for managing a team task list

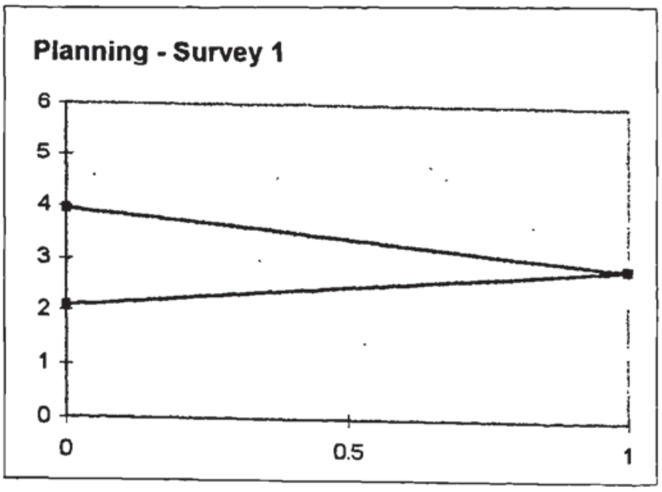


The score for managing a team task list is a Kernel value of 2.3 , with a Minimum of 1.8 and a Maximum of 3.25 . The Kernel (most likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for managing a team task list.

formal communications

Design

Min	*Kernel*	*Max*	***Best supported hypothesis***
2.095	**2.952**	**3.952**	.... frequently employed for formal communications

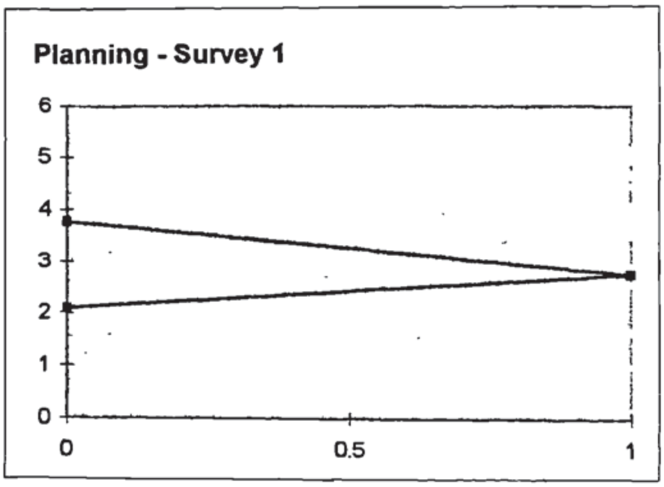


The score for formal communications is a Kernel value of 2.952 , with a Minimum of 2.095 and a Maximum of 3.952 . The Kernel (most likely) value may be interpreted as close to sometimes employed for formal communications. The Minimum (lowest likely) value may be interpreted as close to seldom employed for formal communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for formal communications.

recording messages

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
2.095	**2.81**	**3.762**	.... frequently employed for recording messages

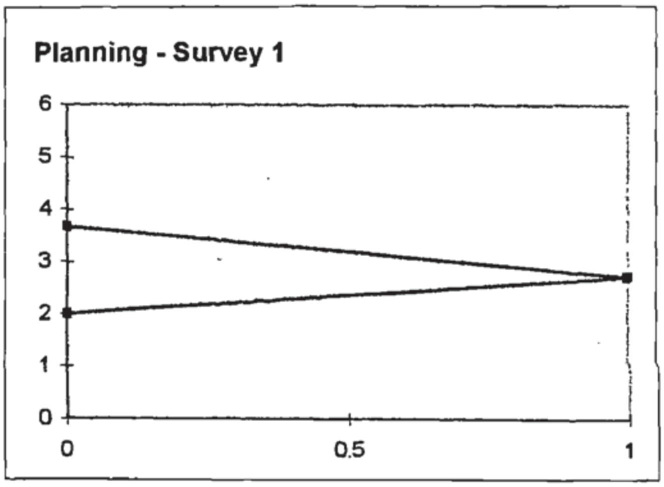


The score for recording messages is a Kernel value of 2.81 , with a Minimum of 2.095 and a Maximum of 3.762 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
2	**2.762**	**3.667**	.... never employed for managing a personal task list

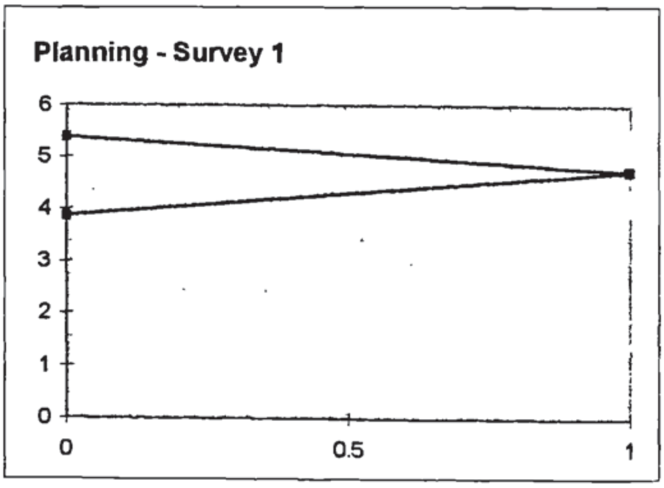


The score for managing a personal task list is a Kernel value of 2.762 , with a Minimum of 2. and a Maximum of 3.667 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
3.857	**4.762**	**5.381**	.... indispensible to task for maintaining a personal diary

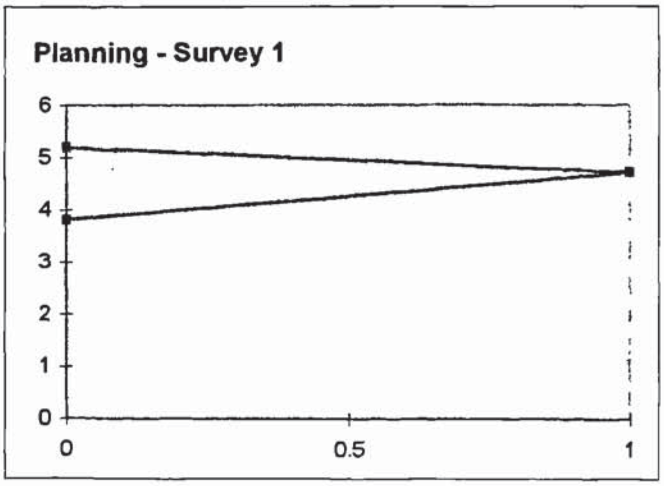


The score for maintaining a personal diary is a Kernel value of 4.762 , with a Minimum of 3.857 and a Maximum of 5.381 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.81	**4.714**	**5.19**	.... indispensible to task for scheduling meetings

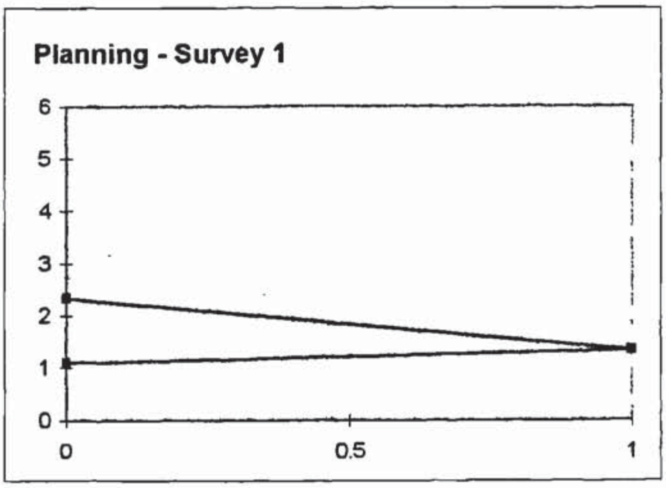


The score for scheduling meetings is a Kernel value of 4.714 , with a Minimum of 3.81 and a Maximum of 5.19 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.095	**1.333**	**2.333**	.... never employed for as a telephone directory

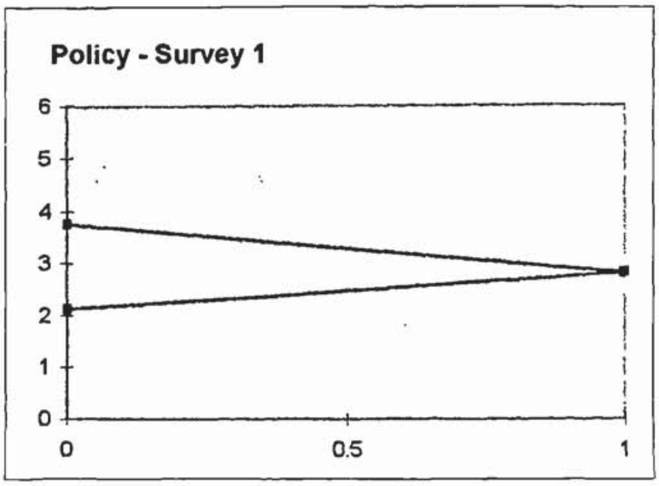


The score for as a telephone directory is a Kernel value of 1.333 , with a Minimum of 1.095 and a Maximum of 2.333 . The Kernel (most likely) value may be interpreted as somewhere between never employed and seldom employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as close to never employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as

Policy Survey 1

all business tasks

Min	Kernel	Max
2.124	2.809	3.754

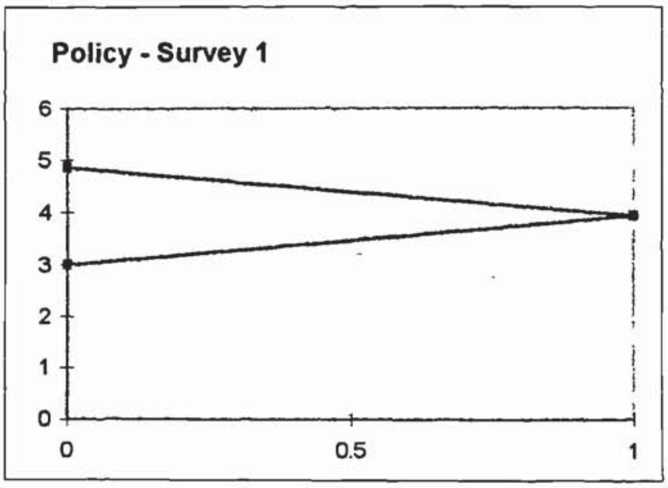


The score for all business tasks is a Kernel value of 2.809 , with a Minimum of 2.124 and a Maximum of 3.754 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
3	3.933	4.867	.... sometimes employed for informal communications

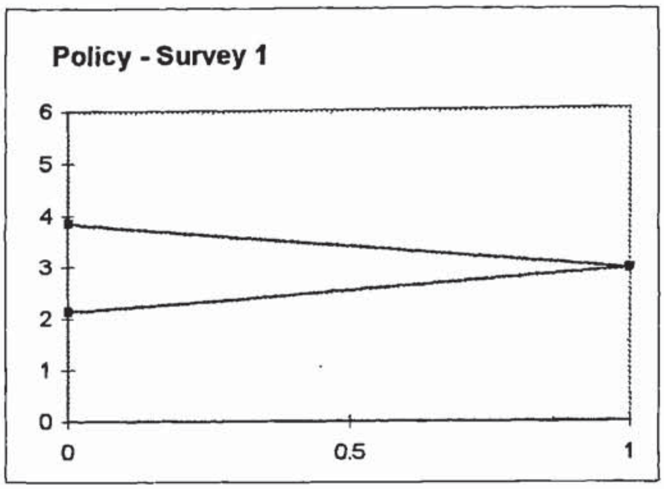


The score for informal communications is a Kernel value of 3.933 , with a Minimum of 3. and a Maximum of 4.867 . The Kernel (most likely) value may be interpreted as close to frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

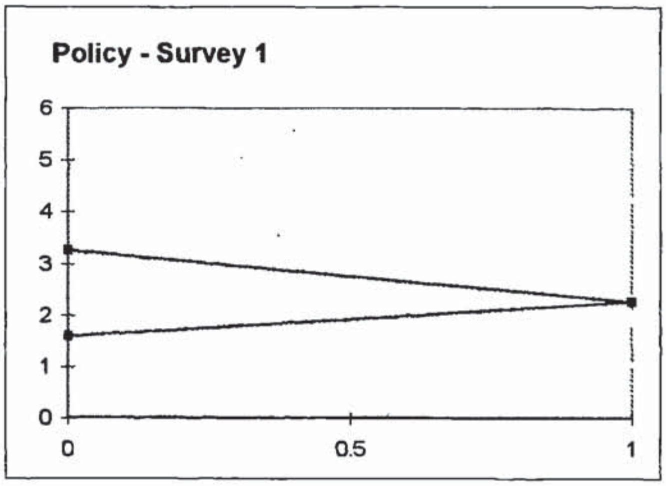
Min	Kernel	Max	Best supported hypothesis
2.133	2.933	3.867	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 2.933 , with a Minimum of 2.133 and a Maximum of 3.867 . The Kernel (most likely) value may be interpreted as close to sometimes employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for co-ordination within teams .

processing documents using mail attachments

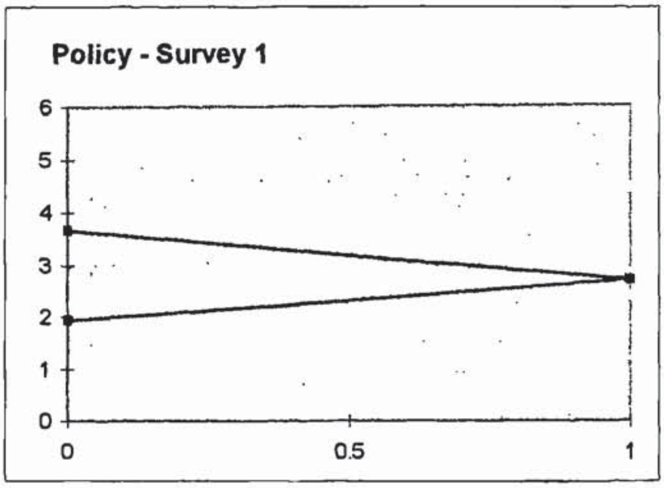
Min	Kernel	Max	Best supported hypothesis
1.6	2.267	3.267	.... seldom employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 2.267 , with a Minimum of 1.6 and a Maximum of 3.267 . The Kernel (most likely) value may be interpreted as somewhat more than seldom employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail

confirming delivery of communications **Emergent**

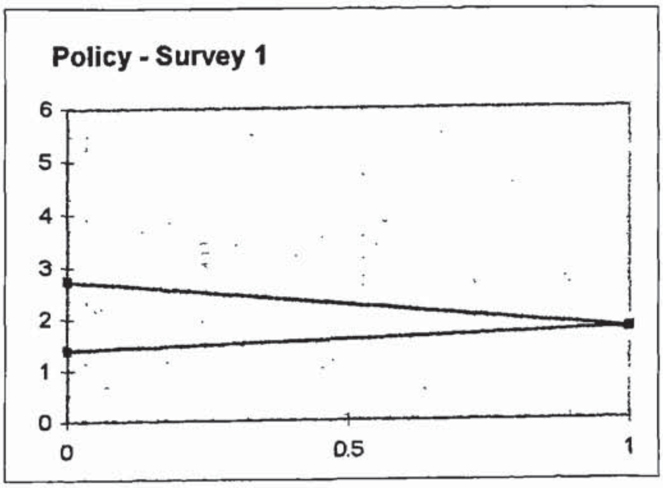
Min	Kernel	Max	Best supported hypothesis
1.933	**2.667**	**3.667**	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 2.667 , with a Minimum of 1.933 and a Maximum of 3.667 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as close to seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

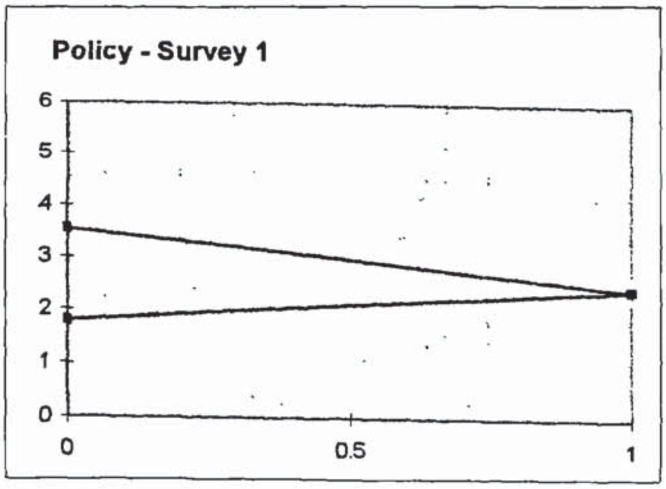
Min	Kernel	Max	Best supported hypothesis
1.4	**1.733**	**2.733**	.... never employed for managing a team task list



The score for managing a team task list is a Kernel value of 1.733 , with a Minimum of 1.4 and a Maximum of 2.733 . The Kernel (most likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat less than sometimes employed for managing a team task list

formal communications

Min	Kernel	Max	Best supported hypothesis
1.8	2.533	3.533	.... frequently employed for formal communications

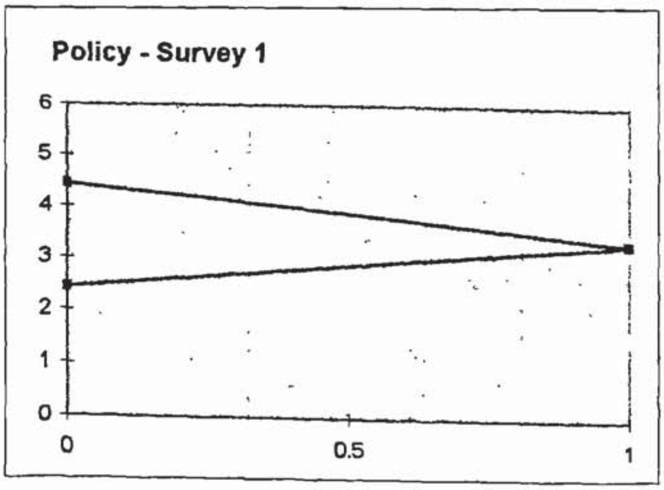


The score for formal communications is a Kernel value of 2.533 , with a Minimum of 1.8 and a Maximum of 3.533 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications.

Design

recording messages

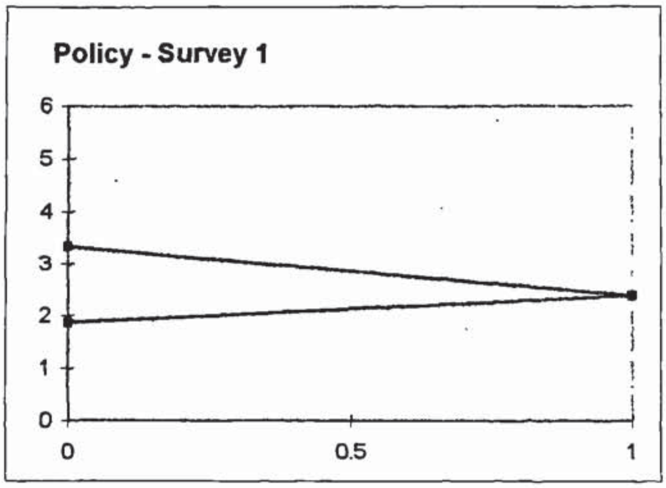
Min	Kernel	Max	Best supported hypothesis
2.429	3.429	4.429	.... sometimes employed for recording messages



The score for recording messages is a Kernel value of 3.429 , with a Minimum of 2.429 and a Maximum of 4.429 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between frequently

managing a personal task list **Design**

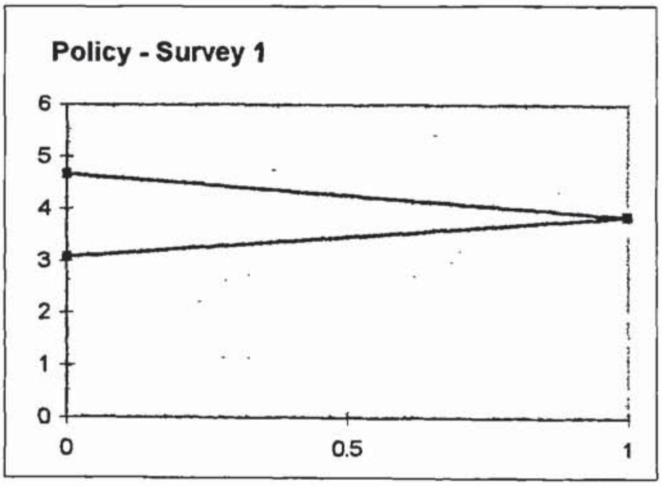
Min	Kernel	Max	Best supported hypothesis
1.867	2.4	3.333	.... never employed for managing a personal task list



The score for managing a personal task list is a Kernel value of 2.4 , with a Minimum of 1.867 and a Maximum of 3.333 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a personal task list.

maintaining a personal diary **Design**

Min	Kernel	Max	Best supported hypothesis
3.067	3.867	4.667	.... indispensible to task for maintaining a personal diary

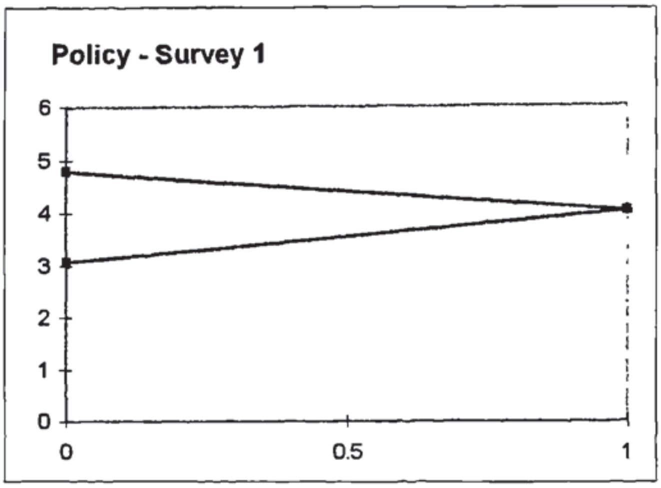


The score for maintaining a personal diary is a Kernel value of 3.867 , with a Minimum of 3.067 and a Maximum of 4.667 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.067	4	4.8	.... indispensible to task for scheduling meetings

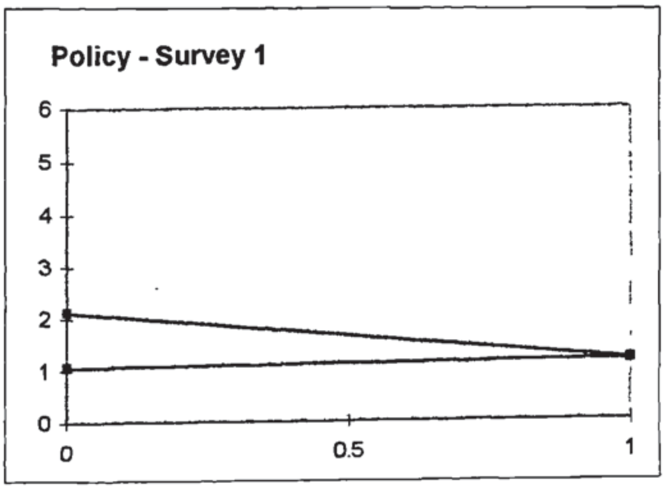


The score for scheduling meetings is a Kernel value of 4. , with a Minimum of 3.067 and a Maximum of 4.8 . The Kernel (most likely) value may be interpreted as close to frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.067	1.133	2.133	.... never employed for as a telephone directory

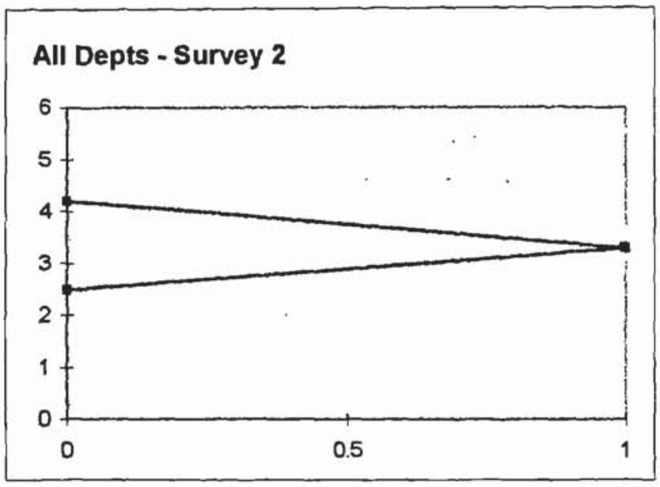


The score for as a telephone directory is a Kernel value of 1.133 , with a Minimum of 1.067 and a Maximum of 2.133 . The Kernel (most likely) value may be interpreted as somewhat more than never employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as close to never employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhat more than seldom employed for as a telephone directory.

All Departments Survey 2

all business tasks

Min	Kernel	Max
2.491	3.305	4.195

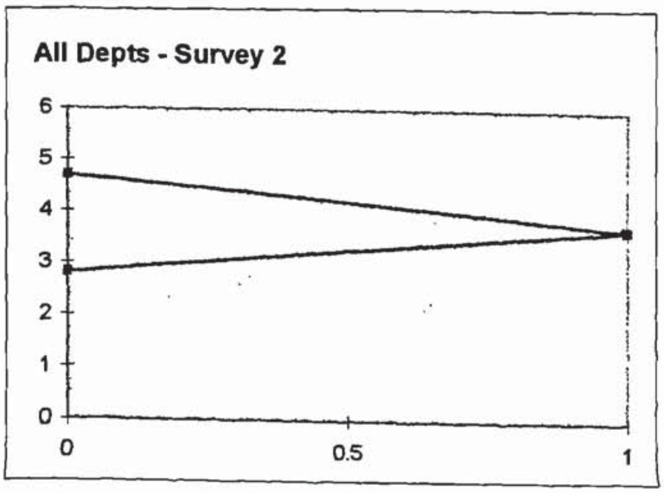


The score for all business tasks is a Kernel value of 3.305 , with a Minimum of 2.491 and a Maximum of 4.195 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.805	3.754	4.703	.... sometimes employed for informal communications

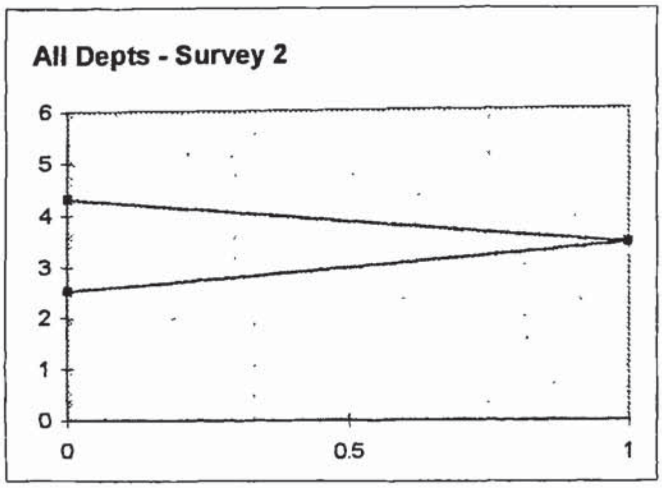


The score for informal communications is a Kernel value of 3.754 , with a Minimum of 2.805 and a Maximum of 4.703 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

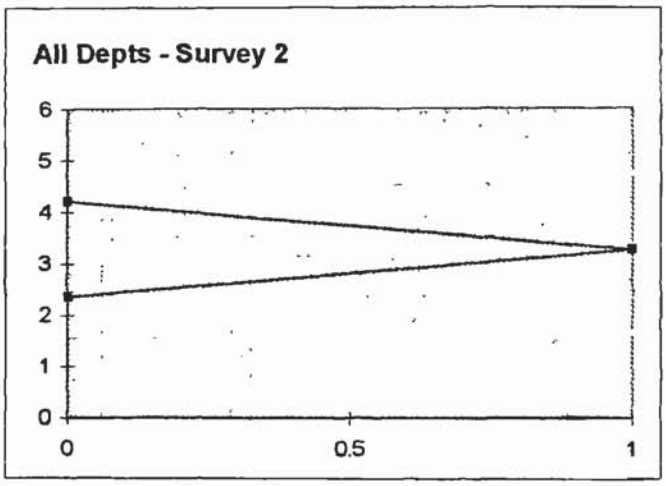
Min	Kernel	Max	Best supported hypothesis
2.534	3.415	4.331	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.415 , with a Minimum of 2.534 and a Maximum of 4.331 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for co-ordination within teams .

processing documents using mail attachments

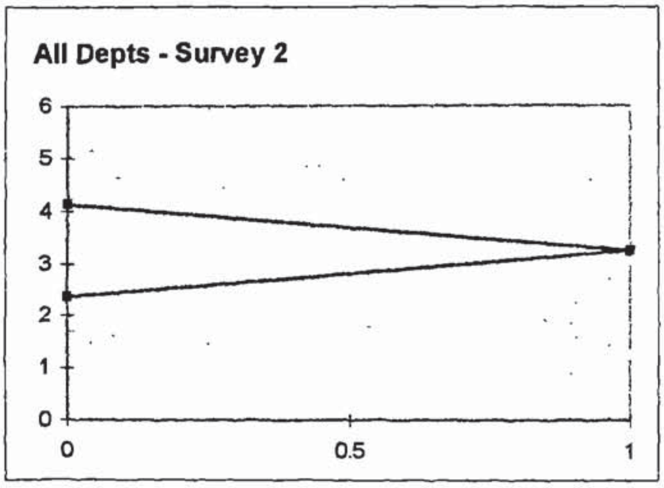
Min	Kernel	Max	Best supported hypothesis
2.359	3.265	4.222	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.265 , with a Minimum of 2.359 and a Maximum of 4.222 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for processing

confirming delivery of communications **Emergent**

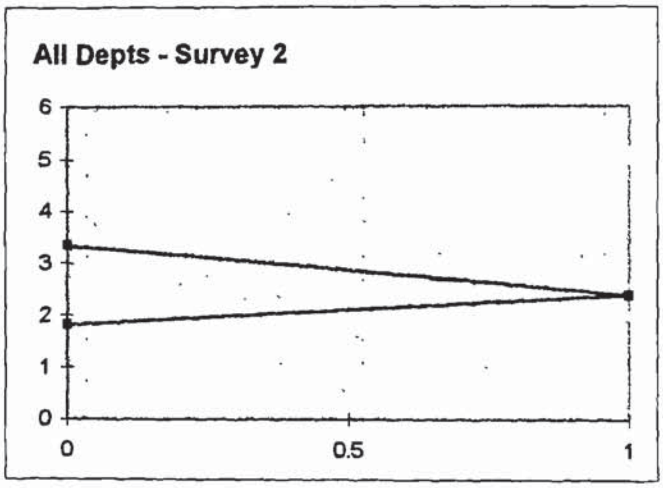
Min	Kernel	Max	Best supported hypothesis
2.364	3.246	4.136	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.246 , with a Minimum of 2.364 and a Maximum of 4.136 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.819	2.379	3.336	.... never employed for managing a team task list

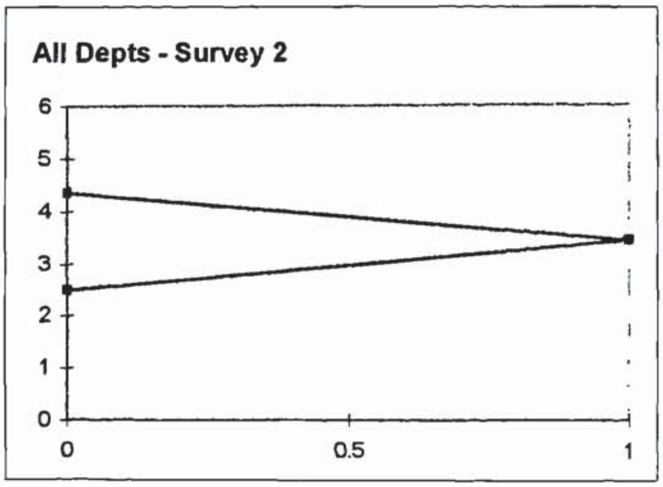


The score for managing a team task list is a Kernel value of 2.379 , with a Minimum of 1.819 and a Maximum of 3.336 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.504	**3.41**	**4.359**	.... frequently employed for formal communications

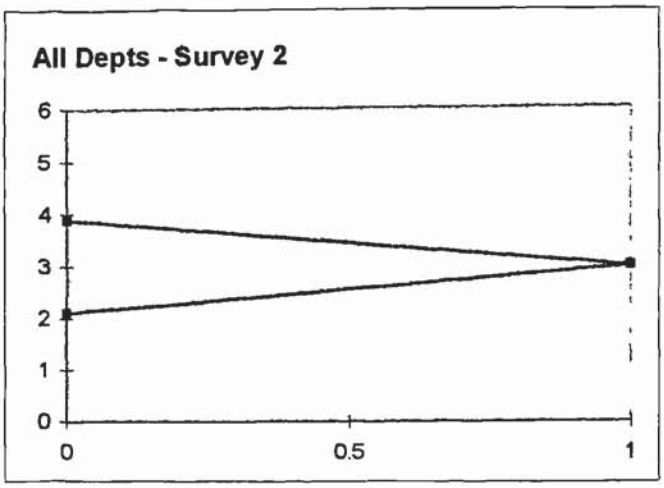


The score for formal communications is a Kernel value of 3.41 , with a Minimum of 2.504 and a Maximum of 4.359 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.104	**2.939**	**3.887**	.... sometimes employed for recording messages

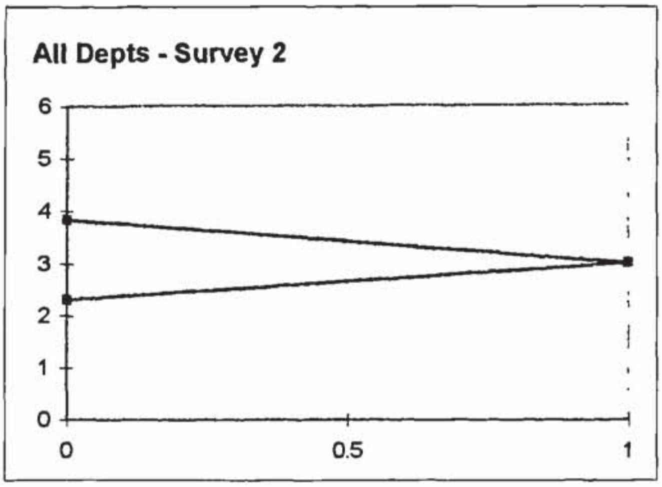


The score for recording messages is a Kernel value of 2.939 , with a Minimum of 2.104 and a Maximum of 3.887 . The Kernel (most likely) value may be interpreted as close to sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.316	**2.991**	**3.829**	.... never employed for managing a personal task list

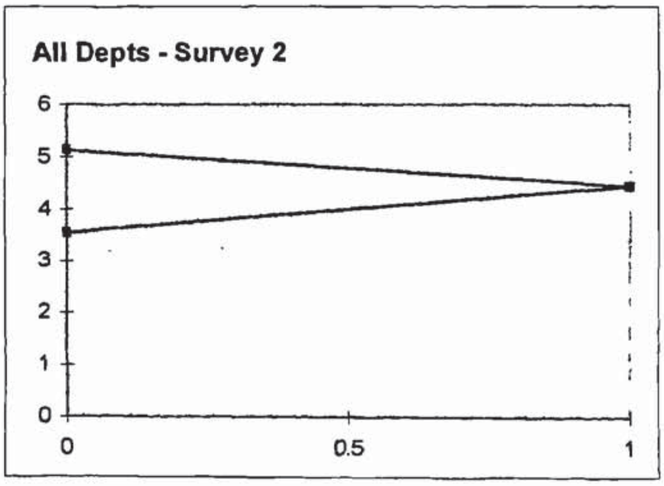


The score for managing a personal task list is a Kernel value of 2.991 , with a Minimum of 2.316 and a Maximum of 3.829 . The Kernel (most likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.539	**4.452**	**5.13**	.... indispensible to task for maintaining a personal diary

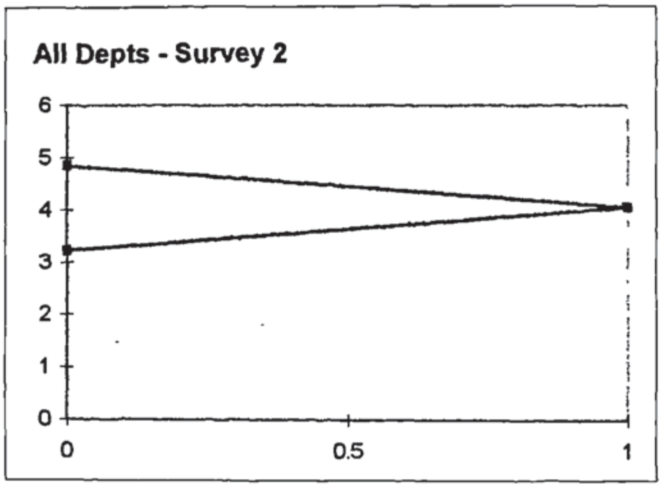


The score for maintaining a personal diary is a Kernel value of 4.452 , with a Minimum of 3.539 and a Maximum of 5.13 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.217	**4.078**	**4.852**	.... indispensible to task for scheduling meetings

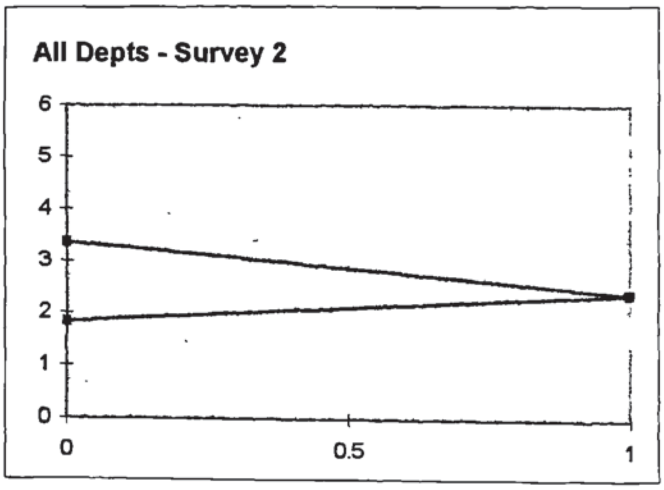


The score for scheduling meetings is a Kernel value of 4.078 , with a Minimum of 3.217 and a Maximum of 4.852 . The Kernel (most likely) value may be interpreted as close to frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.835	**2.426**	**3.357**	.... never employed for as a telephone directory

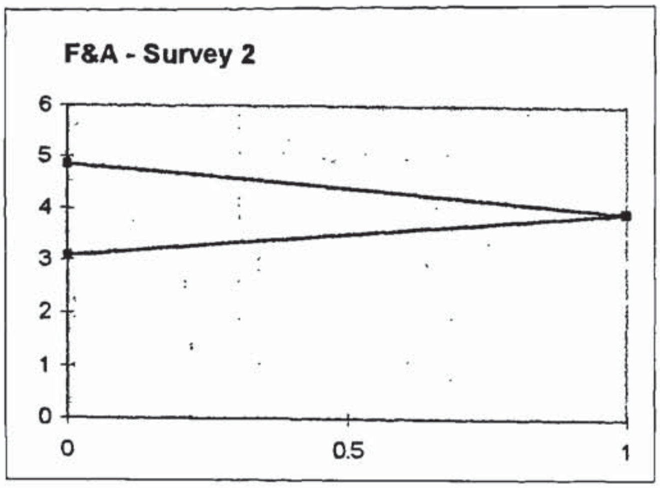


The score for as a telephone directory is a Kernel value of 2.426 , with a Minimum of 1.835 and a Maximum of 3.357 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently

Finance and Admin Survey 2

all business tasks

Min	Kernel	Max
3.07	4.007	4.86

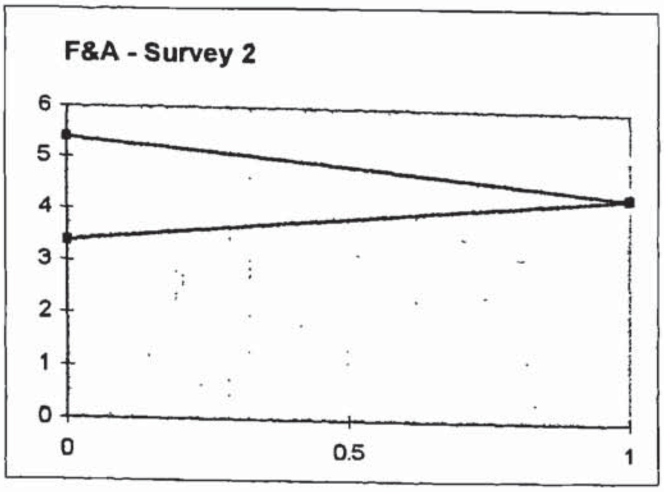


The score for all business tasks is a Kernel value of 4.007 , with a Minimum of 3.07 and a Maximum of 4.86 . The Kernel (most likely) value may be interpreted as close to frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
3.385	4.385	5.385	.... frequently employed for informal communications

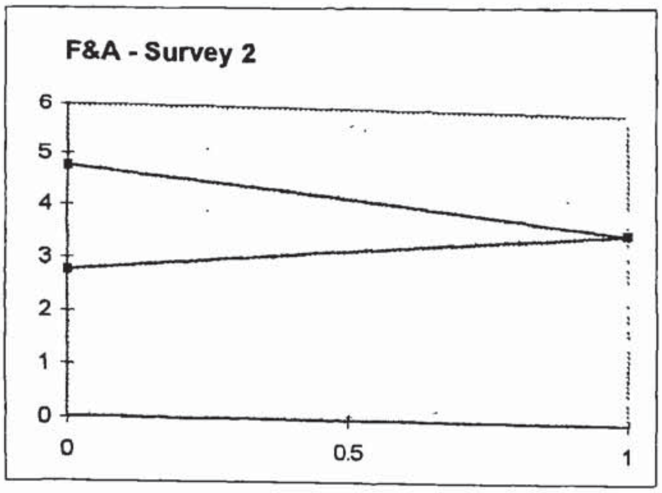


The score for informal communications is a Kernel value of 4.385 , with a Minimum of 3.385 and a Maximum of 5.385 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhere between

co-ordination within teams

Emergent

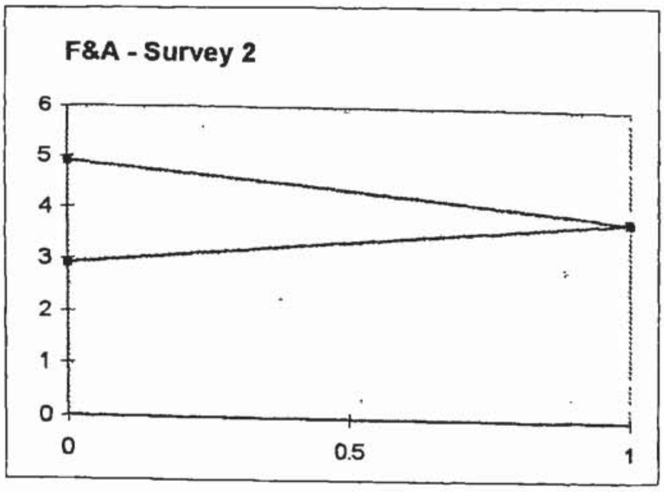
Min	Kernel	Max	Best supported hypothesis
2.769	3.769	4.769	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.769 , with a Minimum of 2.769 and a Maximum of 4.769 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for co-ordination within teams .

processing documents using mail attachments

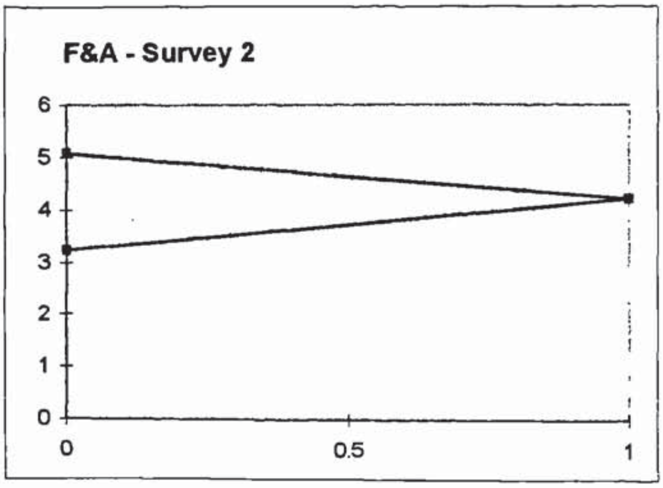
Min	Kernel	Max	Best supported hypothesis
2.923	3.923	4.923	.... frequently employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.923 , with a Minimum of 2.923 and a Maximum of 4.923 . The Kernel (most likely) value may be interpreted as close to frequently employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to almost always employed for processing documents using mail attachments.

confirming delivery of communications **Emergent**

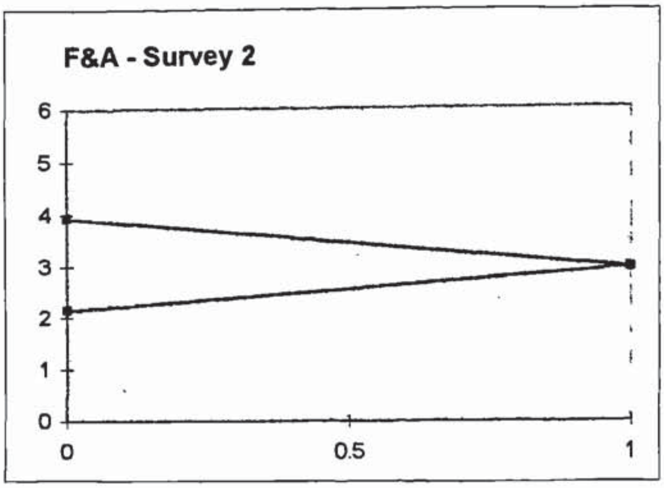
Min	Kernel	Max	Best supported hypothesis
3.231	4.231	5.077	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 4.231 , with a Minimum of 3.231 and a Maximum of 5.077 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to almost always employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
2.154	2.923	3.923	.... never employed for managing a team task list

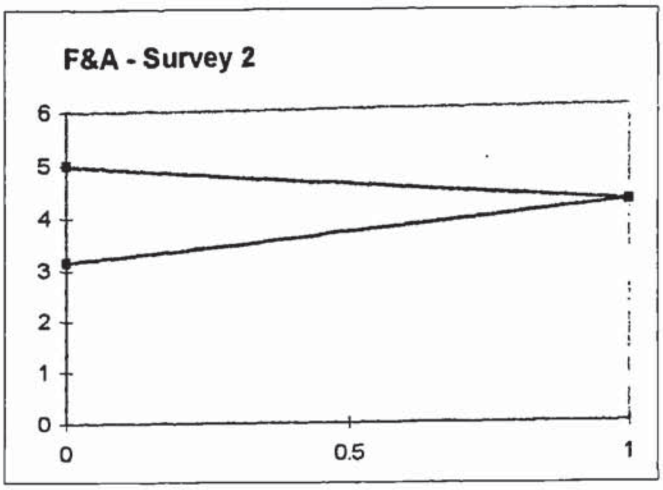


The score for managing a team task list is a Kernel value of 2.923 , with a Minimum of 2.154 and a Maximum of 3.923 . The Kernel (most likely) value may be interpreted as close to sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
3.154	4.154	5	.... frequently employed for formal communications

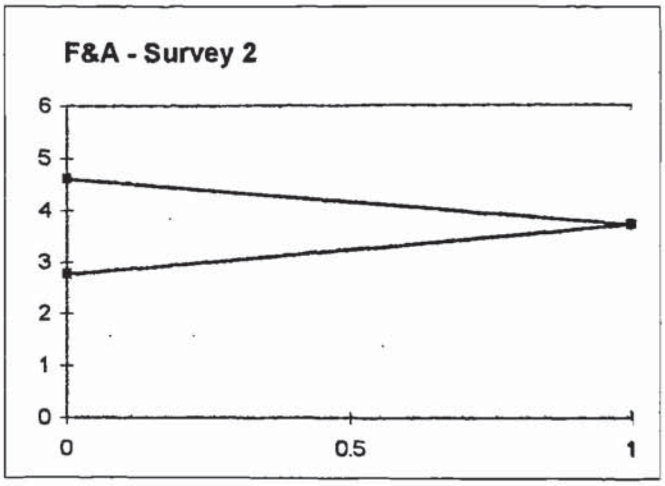


The score for formal communications is a Kernel value of 4.154 , with a Minimum of 3.154 and a Maximum of 5. . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as close to almost always employed for formal communications.

recording messages

Design

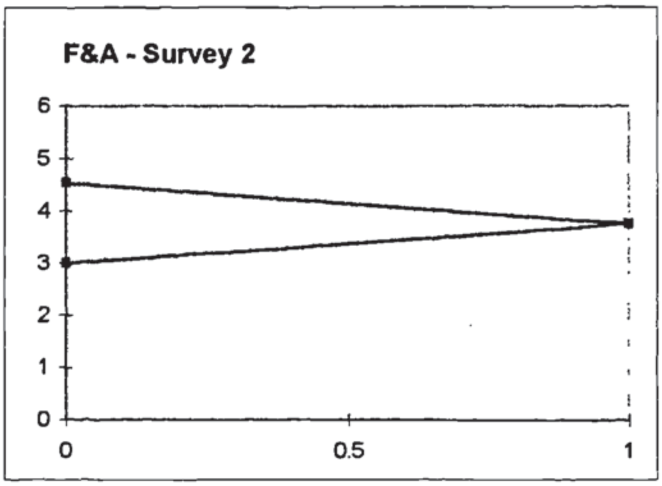
Min	Kernel	Max	Best supported hypothesis
2.769	3.692	4.615	.... frequently employed for recording messages



The score for recording messages is a Kernel value of 3.692 , with a Minimum of 2.769 and a Maximum of 4.615 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for recording

managing a personal task list **Design**

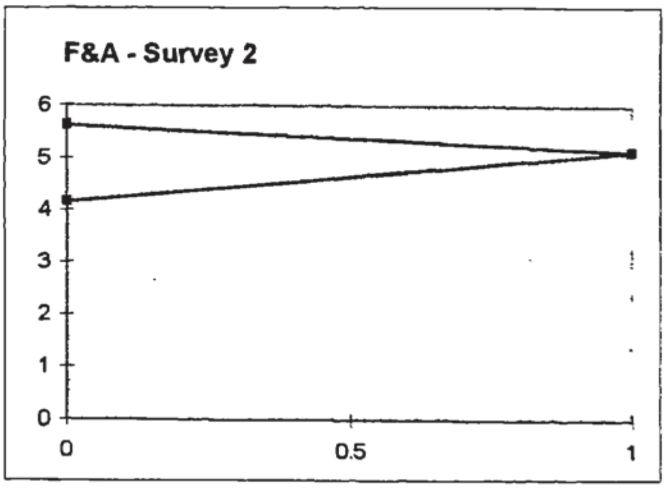
Min	Kernel	Max	Best supported hypothesis
3	3.769	4.538	.... indispensible to task for managing a personal task list



The score for managing a personal task list is a Kernel value of 3.769 , with a Minimum of 3. and a Maximum of 4.538 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for managing a personal task list.

maintaining a personal diary **Design**

Min	Kernel	Max	Best supported hypothesis
4.154	5.154	5.615	.... indispensible to task for maintaining a personal diary

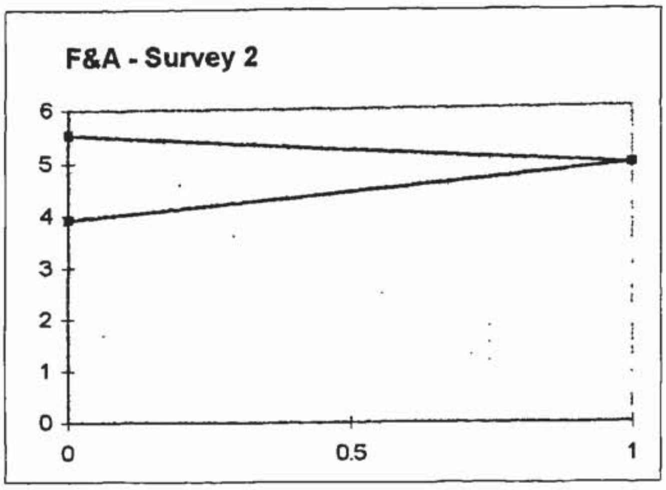


The score for maintaining a personal diary is a Kernel value of 5.154 , with a Minimum of 4.154 and a Maximum of 5.615 . The Kernel (most likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat more than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.923	4.923	5.538	.... indispensible to task for scheduling meetings

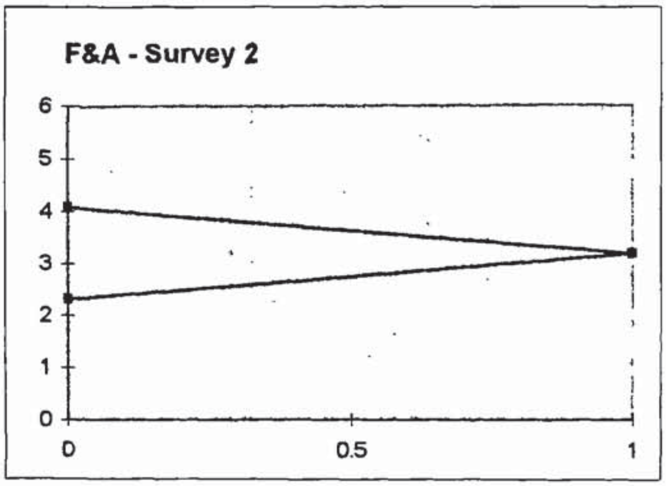


The score for scheduling meetings is a Kernel value of 4.923 , with a Minimum of 3.923 and a Maximum of 5.538 . The Kernel (most likely) value may be interpreted as close to almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between almost always employed and indispensible to task for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.308	3.154	4.077	.... sometimes employed for as a telephone directory

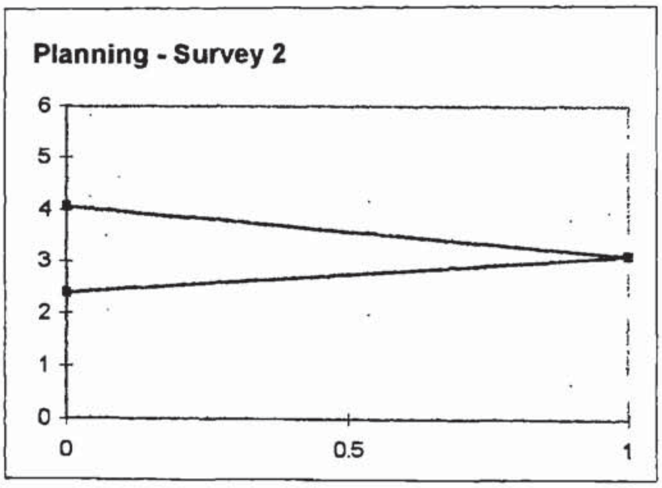


The score for as a telephone directory is a Kernel value of 3.154 , with a Minimum of 2.308 and a Maximum of 4.077 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to frequently employed for as a telephone directory.

Planning Survey 2

all business tasks

Min	Kernel	Max
2.403	3.168	4.052

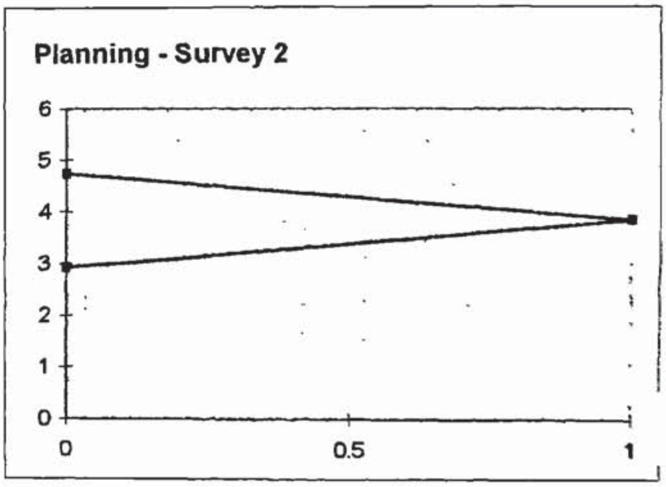


The score for all business tasks is a Kernel value of 3.168 , with a Minimum of 2.403 and a Maximum of 4.052 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as close to frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.913	3.87	4.739	.... seldom employed for informal communications

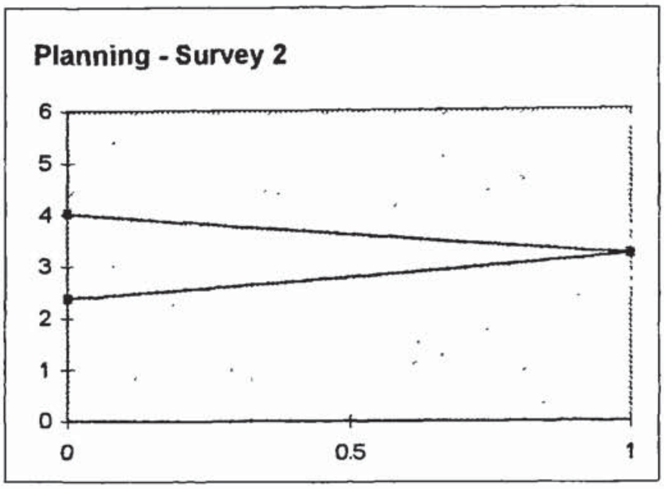


The score for informal communications is a Kernel value of 3.87 , with a Minimum of 2.913 and a Maximum of 4.739 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

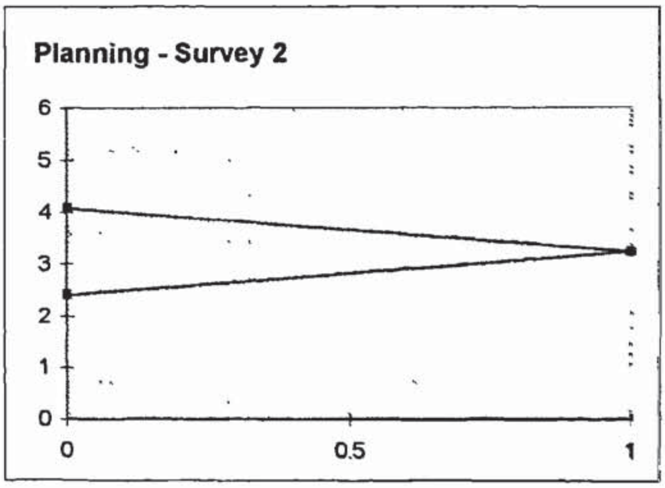
Min	Kernel	Max	Best supported hypothesis
2.391	3.217	4.043	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.217 , with a Minimum of 2.391 and a Maximum of 4.043 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as close to frequently employed for co-ordination within teams .

processing documents using mail attachments

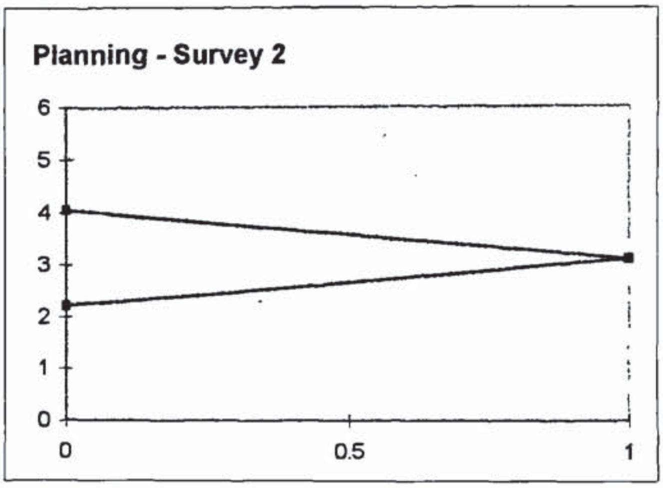
Min	Kernel	Max	Best supported hypothesis
2.409	3.227	4.091	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.227 , with a Minimum of 2.409 and a Maximum of 4.091 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using

confirming delivery of communications **Emergent**

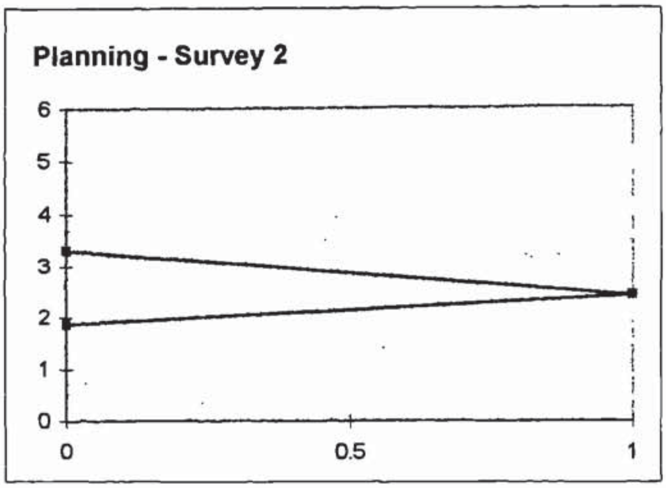
Min	Kernel	Max	Best supported hypothesis
2.217	**3.087**	**4.043**	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.087 , with a Minimum of 2.217 and a Maximum of 4.043 . The Kernel (most likely) value may be interpreted as close to sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.87	**2.391**	**3.304**	.... never employed for managing a team task list

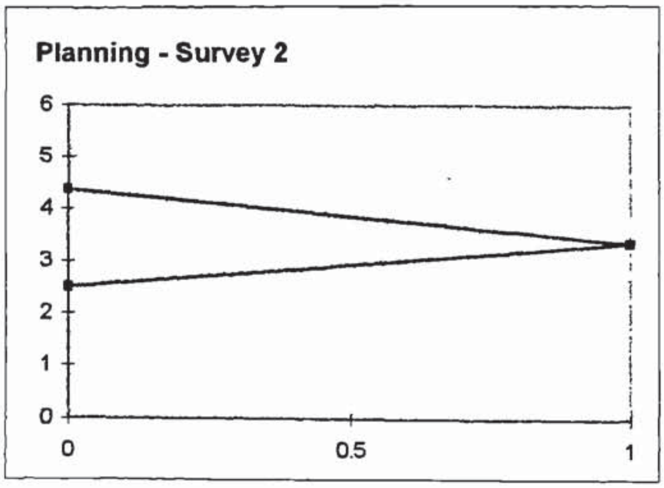


The score for managing a team task list is a Kernel value of 2.391 , with a Minimum of 1.87 and a Maximum of 3.304 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for managing a team task list

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.5	**3.409**	**4.364**	.... frequently employed for formal communications

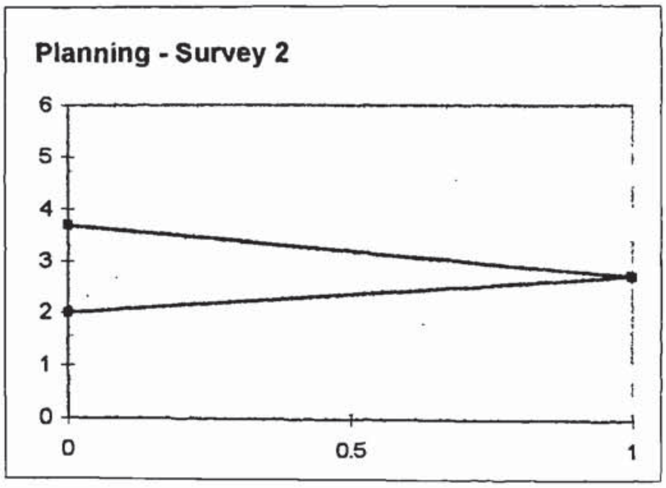


The score for formal communications is a Kernel value of 3.409 , with a Minimum of 2.5 and a Maximum of 4.364 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2	**2.773**	**3.682**	.... seldom employed for recording messages

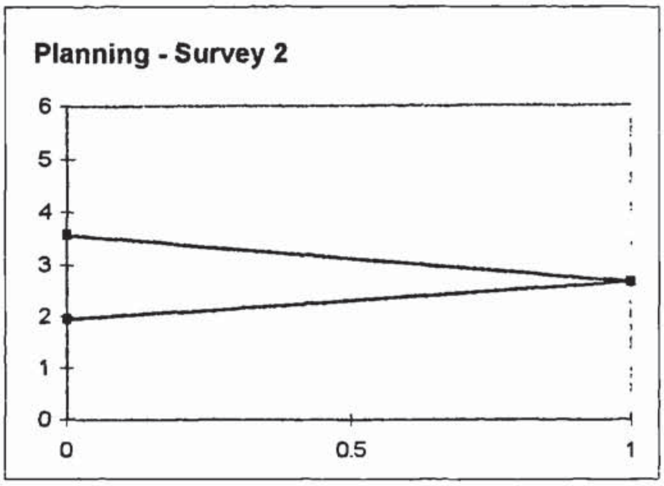


The score for recording messages is a Kernel value of 2.773 , with a Minimum of 2. and a Maximum of 3.682 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
1.957	**2.652**	**3.565**	.... never employed for managing a personal task list

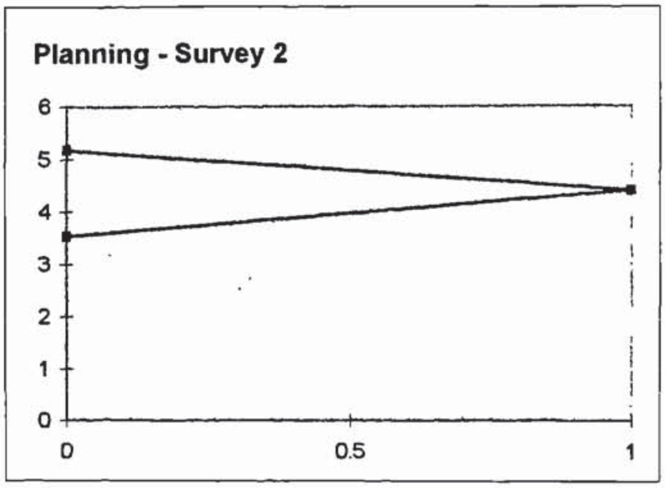


The score for managing a personal task list is a Kernel value of 2.652 , with a Minimum of 1.957 and a Maximum of 3.565 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.522	**4.391**	**5.174**	.... indispensible to task for maintaining a personal diary

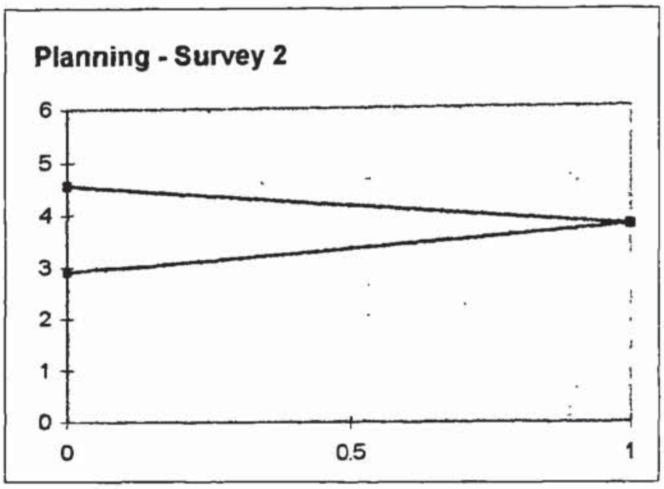


The score for maintaining a personal diary is a Kernel value of 4.391 , with a Minimum of 3.522 and a Maximum of 5.174 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
2.913	3.739	4.565	.... almost always employed for scheduling meetings

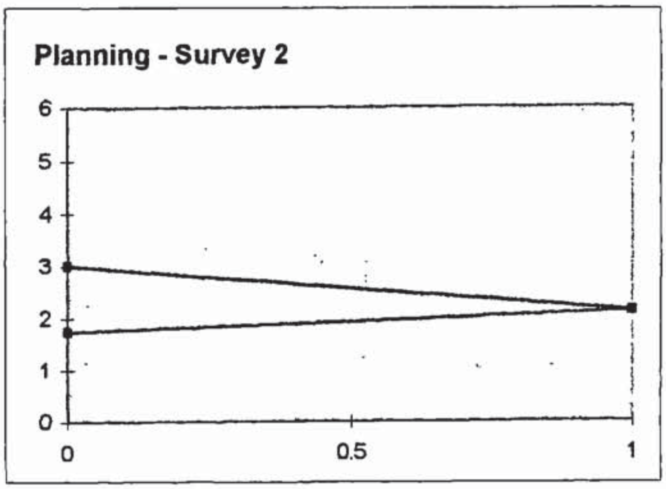


The score for scheduling meetings is a Kernel value of 3.739 , with a Minimum of 2.913 and a Maximum of 4.565 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.739	2.087	3	.... never employed for as a telephone directory

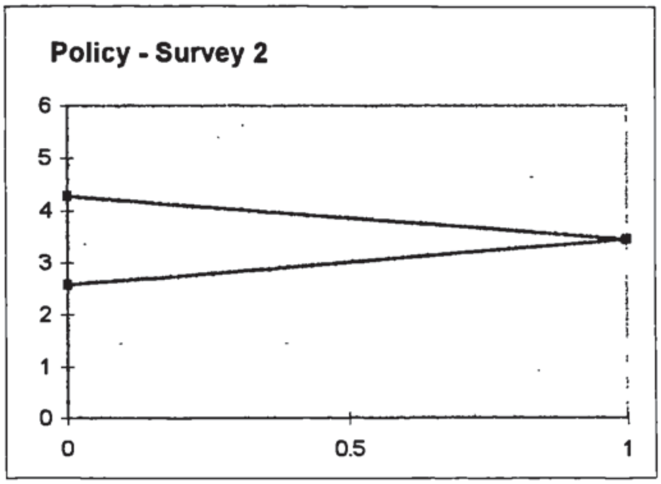


The score for as a telephone directory is a Kernel value of 2.087 , with a Minimum of 1.739 and a Maximum of 3. . The Kernel (most likely) value may be interpreted as close to seldom employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to sometimes employed for as a telephone directory.

Policy Survey 2

all business tasks

Min	Kernel	Max
2.576	3.429	4.283

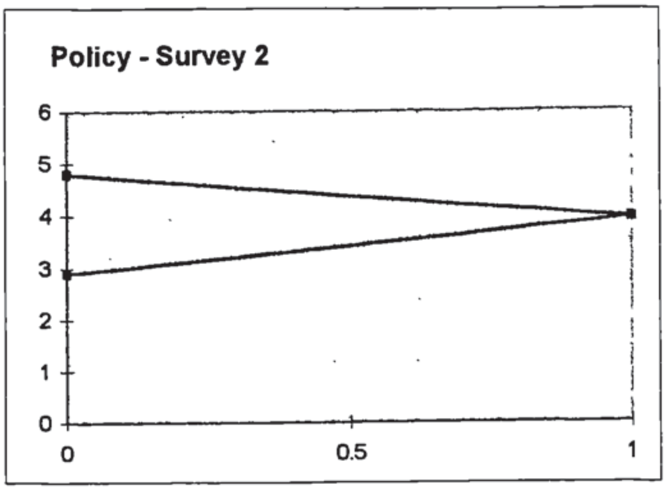


The score for all business tasks is a Kernel value of 3.429 , with a Minimum of 2.576 and a Maximum of 4.283 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.9	3.9	4.8	.... almost always employed for informal communications

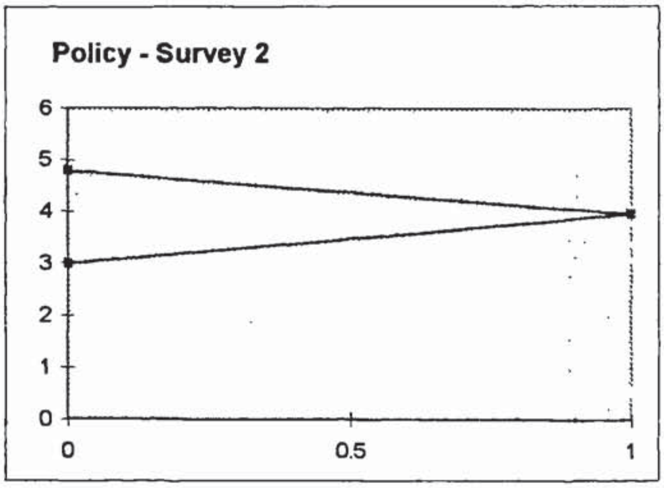


The score for informal communications is a Kernel value of 3.9 , with a Minimum of 2.9 and a Maximum of 4.8 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

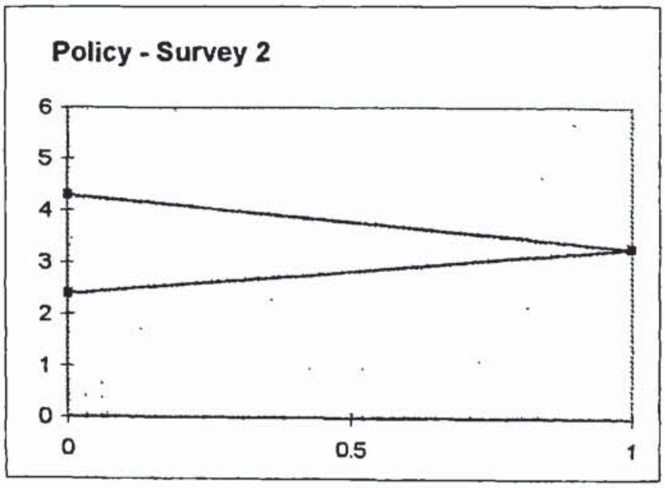
Min	Kernel	Max	Best supported hypothesis
3	4	4.8	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kemel value of 4. , with a Minimum of 3. and a Maximum of 4.8 . The Kemel (most likely) value may be interpreted as close to frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as close to sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for co-ordination within teams .

processing documents using mail attachments

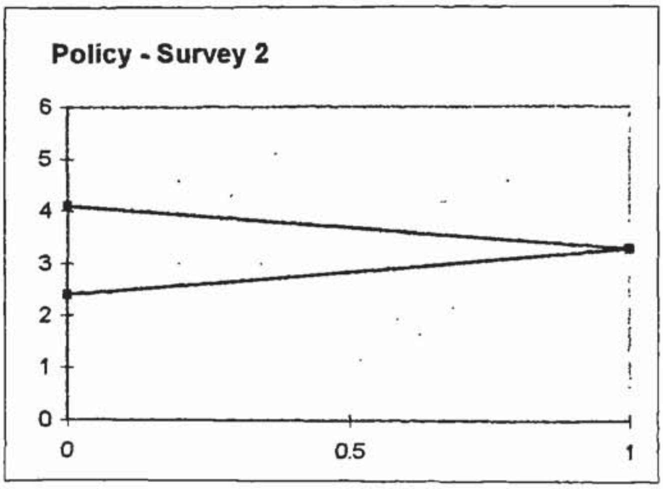
Min	Kernel	Max	Best supported hypothesis
2.4	3.3	4.3	.... frequently employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kemel value of 3.3 , with a Minimum of 2.4 and a Maximum of 4.3 . The Kemel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for processing documents

confirming delivery of communications **Emergent**

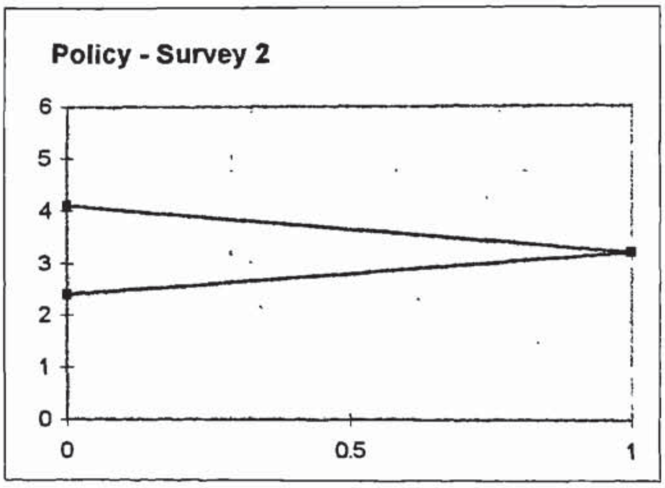
Min	Kernel	Max	Best supported hypothesis
2.4	3.3	4.1	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.3 , with a Minimum of 2.4 and a Maximum of 4.1 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
2.4	3.2	4.1	.... frequently employed for managing a team task list

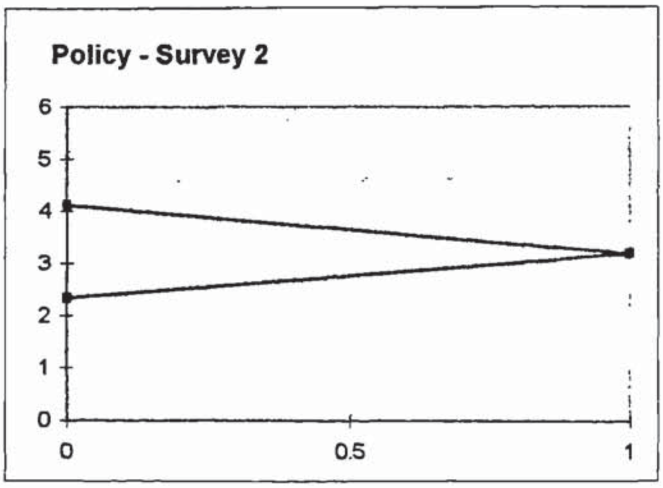


The score for managing a team task list is a Kernel value of 3.2 , with a Minimum of 2.4 and a Maximum of 4.1 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.333	**3.222**	**4.111**	.... frequently employed for formal communications

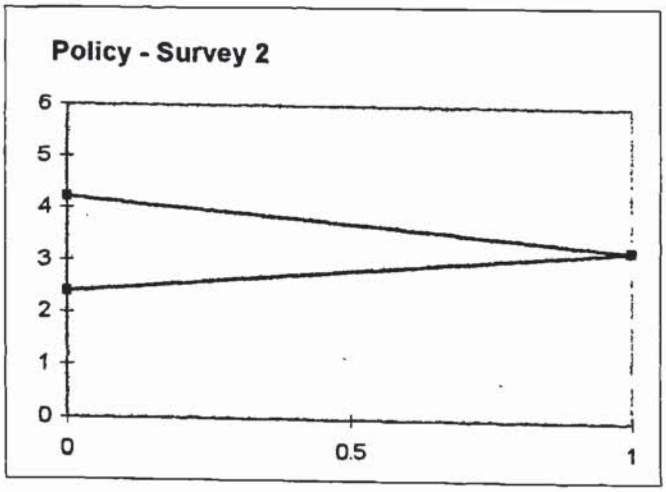


The score for formal communications is a Kernel value of 3.222 , with a Minimum of 2.333 and a Maximum of 4.111 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.4	**3.3**	**4.2**	.... almost always employed for recording messages

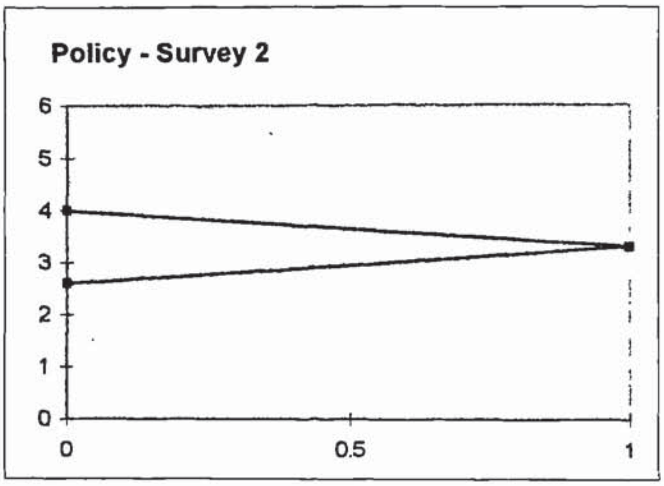


The score for recording messages is a Kernel value of 3.3 , with a Minimum of 2.4 and a Maximum of 4.2 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.6	3.3	4	.... never employed for managing a personal task list

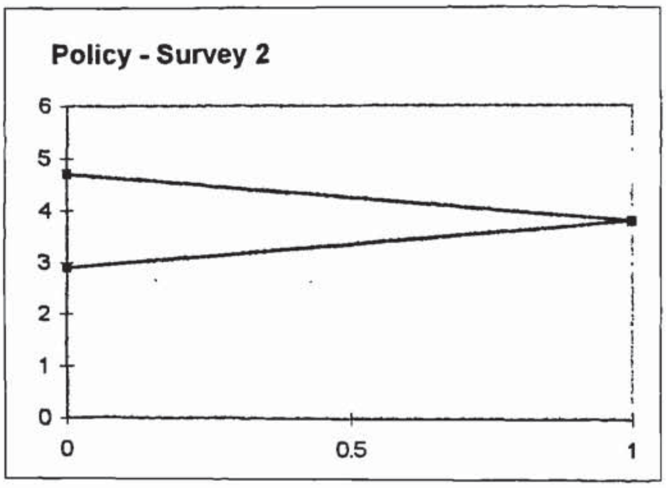


The score for managing a personal task list is a Kernel value of 3.3 , with a Minimum of 2.6 and a Maximum of 4. . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
2.9	3.8	4.7	.... almost always employed for maintaining a personal diary

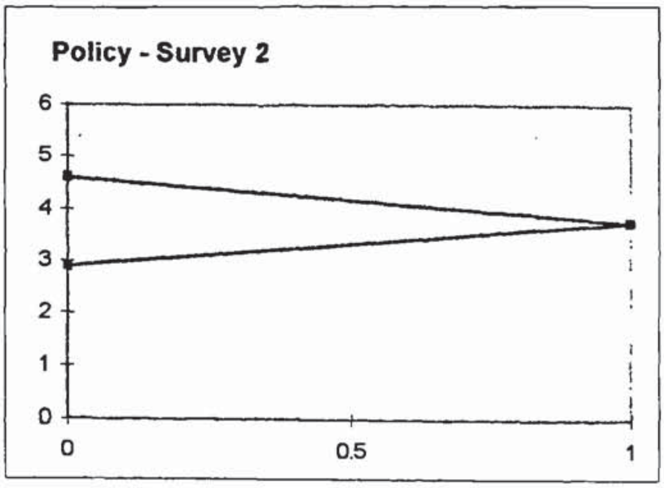


The score for maintaining a personal diary is a Kernel value of 3.8 , with a Minimum of 2.9 and a Maximum of 4.7 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
2.9	3.8	4.6	.... indispensible to task for scheduling meetings

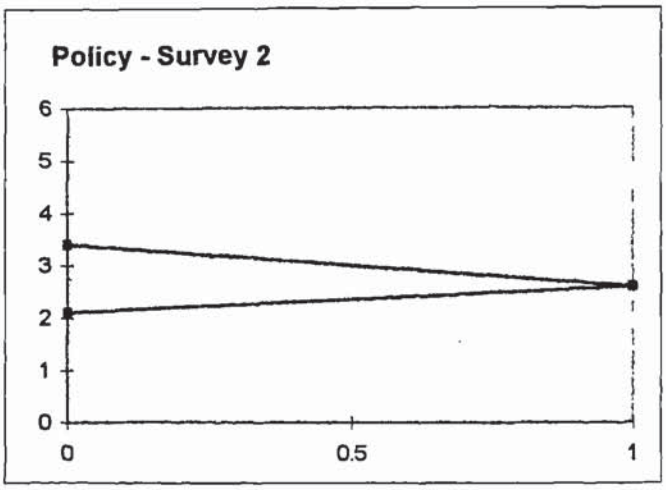


The score for scheduling meetings is a Kernel value of 3.8 , with a Minimum of 2.9 and a Maximum of 4.6 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.1	2.6	3.4	.... never employed for as a telephone directory

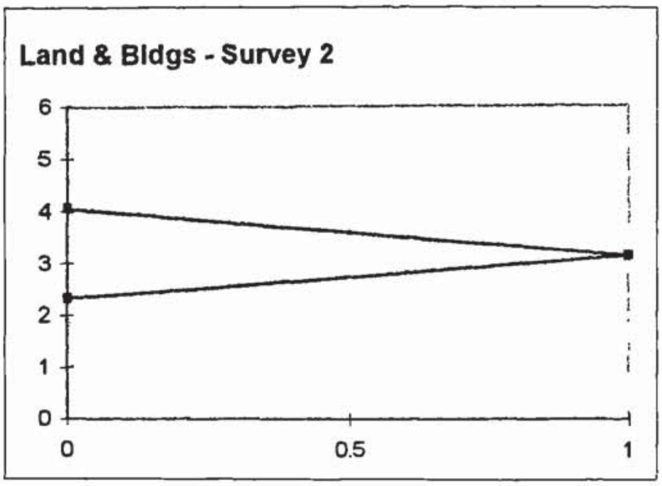


The score for as a telephone directory is a Kernel value of 2.6 , with a Minimum of 2.1 and a Maximum of 3.4 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as close to seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for

Land and Buildings Survey 2

all business tasks

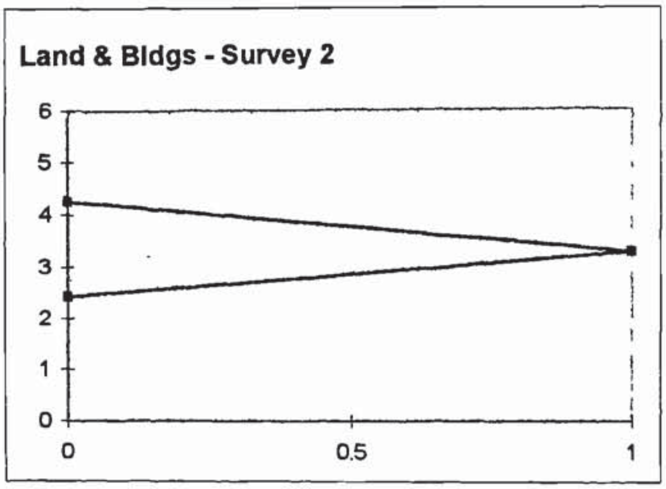
Min	Kernel	Max
2.33	3.127	4.056



The score for all business tasks is a Kernel value of 3.127 , with a Minimum of 2.33 and a Maximum of 4.056 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for all business tasks. The Maximum (greatest likely) value may be interpreted as close to frequently employed for all business tasks.

informal communications **Emergent**

Min	Kernel	Max	Best supported hypothesis
2.417	3.25	4.25	.... sometimes employed for informal communications

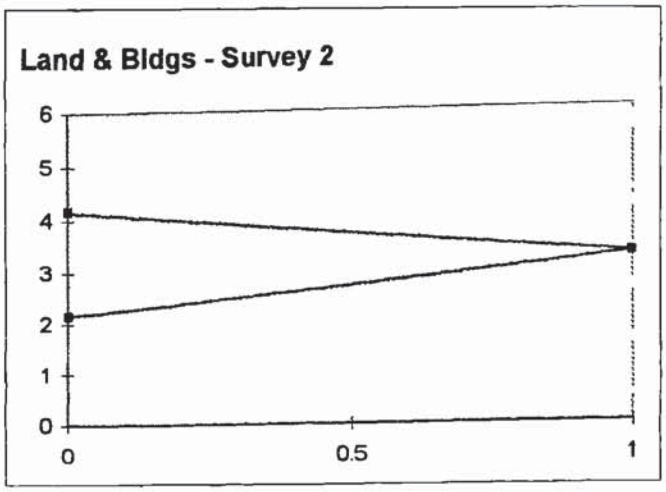


The score for informal communications is a Kernel value of 3.25 , with a Minimum of 2.417 and a Maximum of 4.25 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently

co-ordination within teams

Emergent

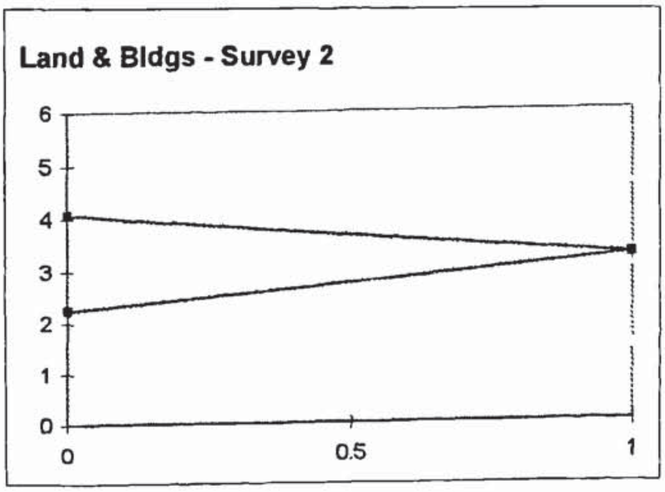
Min	Kernel	Max	Best supported hypothesis
2.167	**3.167**	**4.167**	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.167 , with a Minimum of 2.167 and a Maximum of 4.167 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for co-ordination within teams .

processing documents using mail attachments

Min	Kernel	Max	Best supported hypothesis
2.25	**3.167**	**4.083**	.... sometimes employed for processing documents using mail attachments

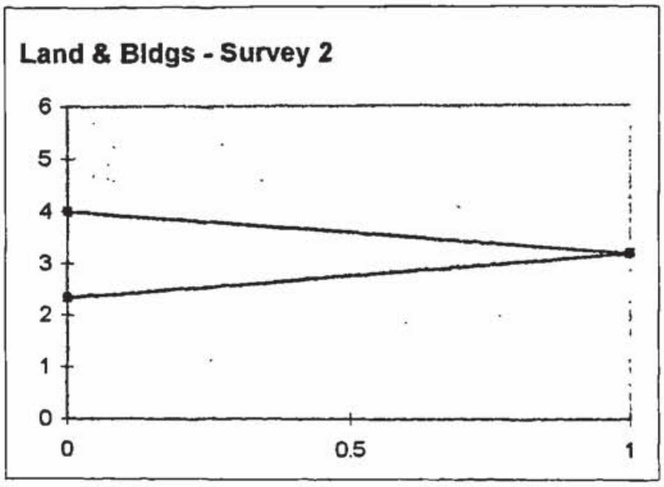


The score for processing documents using mail attachments is a Kernel value of 3.167 , with a Minimum of 2.25 and a Maximum of 4.083 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using mail attachments.

confirming delivery of communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.333	3.167	4	.... frequently employed for confirming delivery of communications

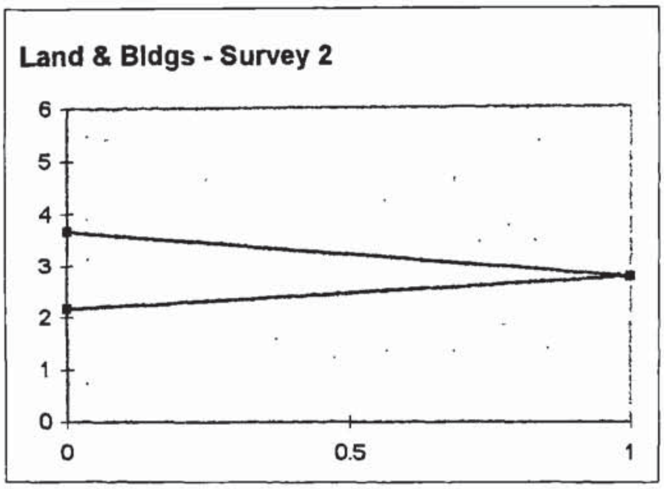


The score for confirming delivery of communications is a Kernel value of 3.167 , with a Minimum of 2.333 and a Maximum of 4. . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list

Emergent

Min	Kernel	Max	Best supported hypothesis
2.167	2.75	3.667	.... never employed for managing a team task list

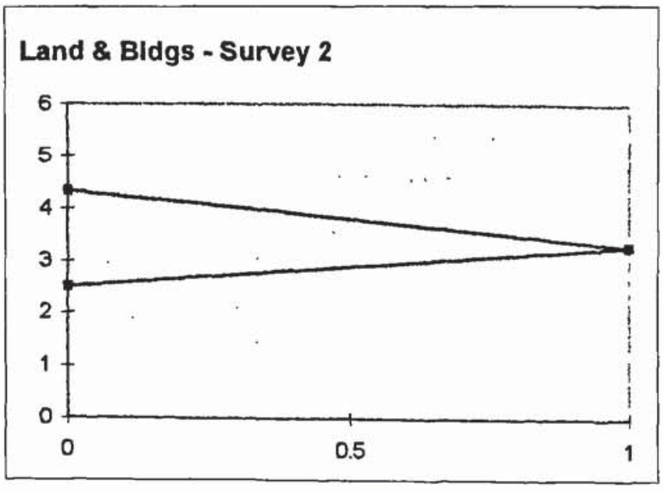


The score for managing a team task list is a Kernel value of 2.75 , with a Minimum of 2.167 and a Maximum of 3.667 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.5	3.333	4.333	.... frequently employed for formal communications

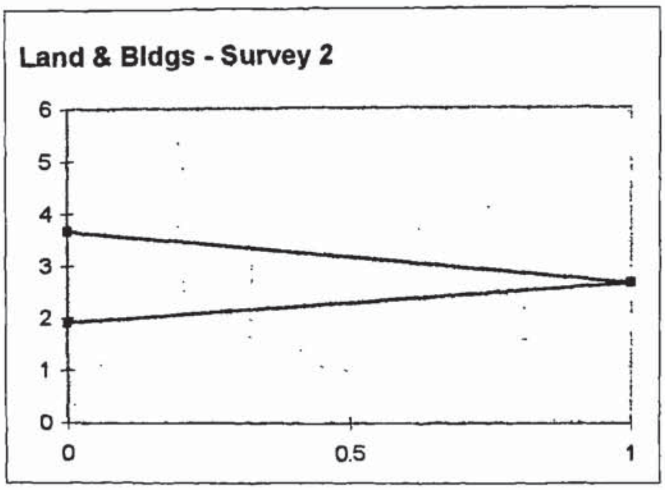


The score for formal communications is a Kernel value of 3.333 , with a Minimum of 2.5 and a Maximum of 4.333 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
1.917	2.667	3.667	.... sometimes employed for recording messages

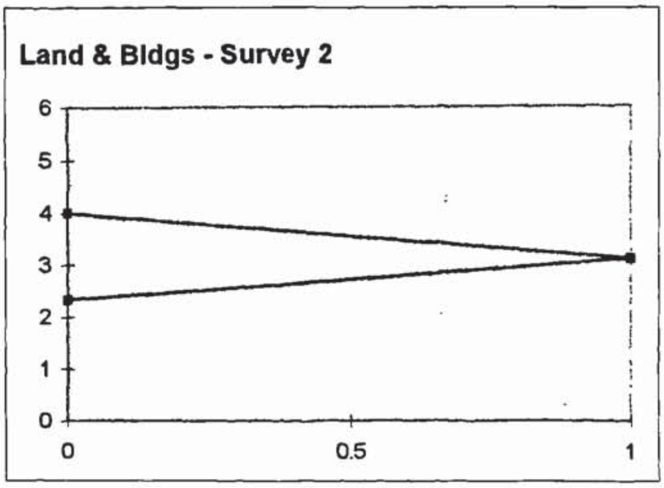


The score for recording messages is a Kernel value of 2.667 , with a Minimum of 1.917 and a Maximum of 3.667 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.333	3.083	4	.... never employed for managing a personal task list

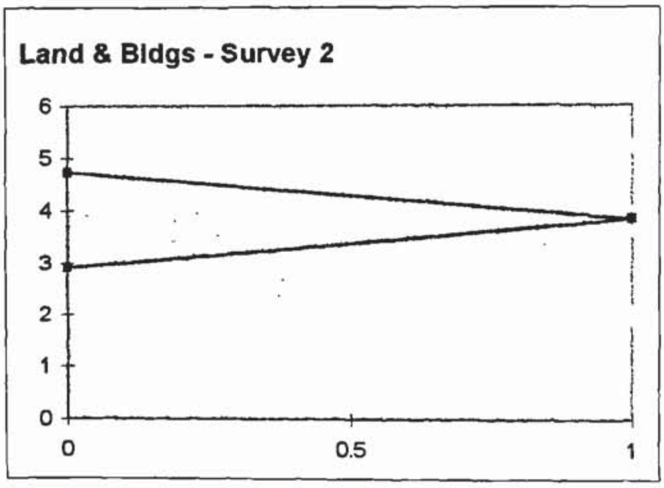


The score for managing a personal task list is a Kemel value of 3.083 , with a Minimum of 2.333 and a Maximum of 4. . The Kemel (most likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as close to frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
2.909	3.818	4.727	.... almost always employed for maintaining a personal diary

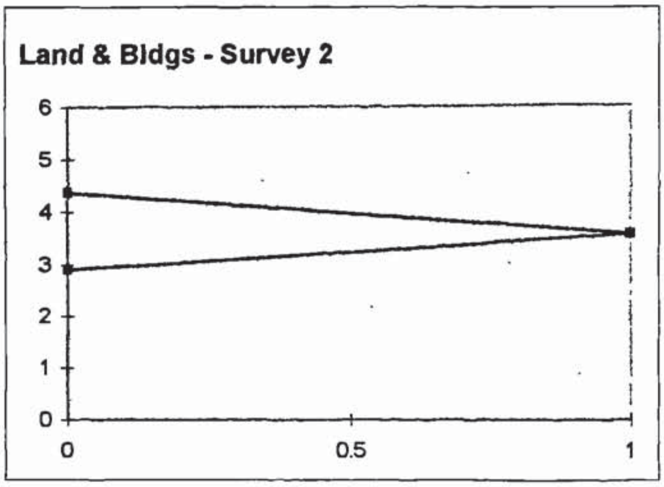


The score for maintaining a personal diary is a Kemel value of 3.818 , with a Minimum of 2.909 and a Maximum of 4.727 . The Kemel (most likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
2.909	3.545	4.364	.... indispensible to task for scheduling meetings

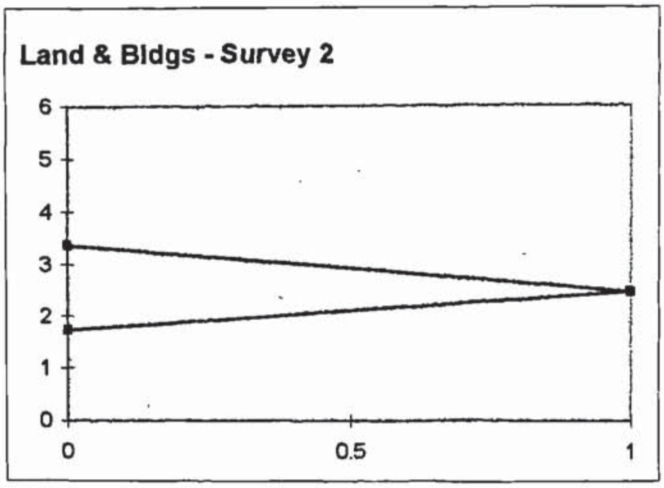


The score for scheduling meetings is a Kemel value of 3.545 , with a Minimum of 2.909 and a Maximum of 4.364 . The Kemel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
1.727	2.455	3.364	.... never employed for as a telephone directory

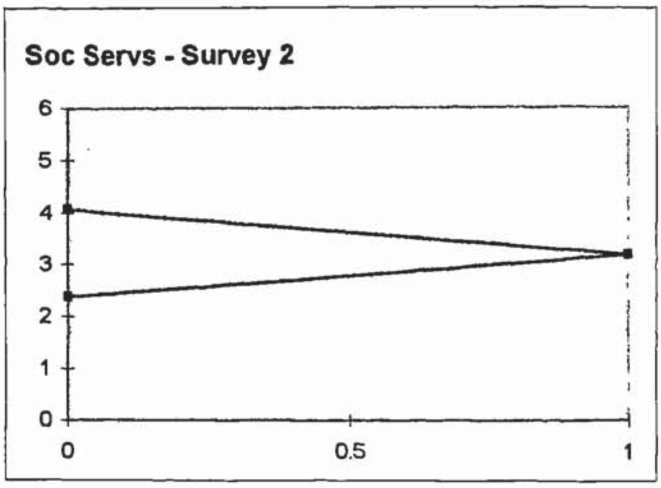


The score for as a telephone directory is a Kemel value of 2.455 , with a Minimum of 1.727 and a Maximum of 3.364 . The Kemel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently

Social Services Survey 2

all business tasks

Min	Kernel	Max
2.373	3.17	4.065

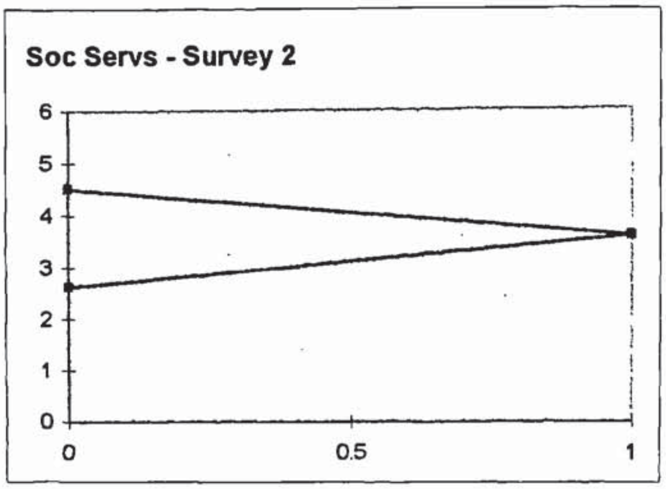


The score for all business tasks is a Kernel value of 3.17 , with a Minimum of 2.373 and a Maximum of 4.065 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as close to frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.622	3.556	4.511	.... frequently employed for informal communications

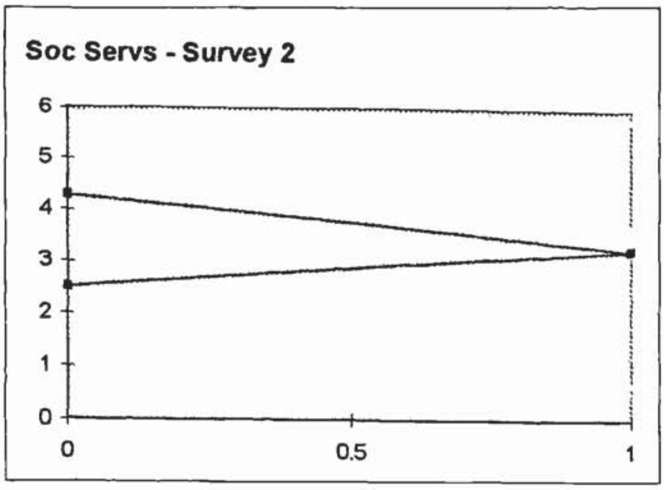


The score for informal communications is a Kernel value of 3.556 , with a Minimum of 2.622 and a Maximum of 4.511 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhere between

co-ordination within teams

Emergent

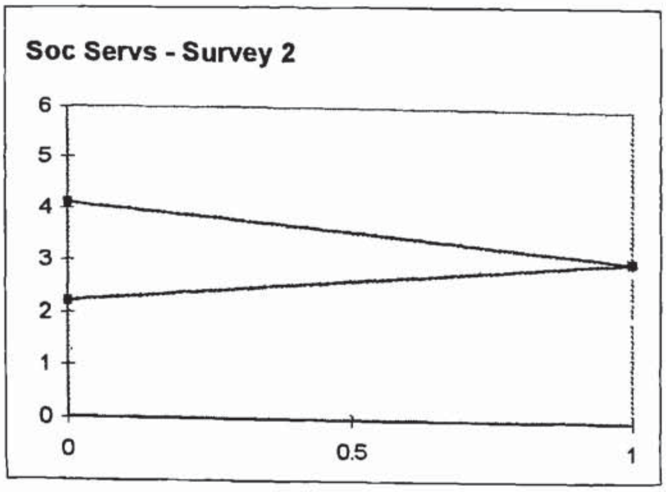
Min	Kernel	Max	Best supported hypothesis
2.511	**3.356**	**4.289**	.... sometimes employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.356 , with a Minimum of 2.511 and a Maximum of 4.289 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for co-ordination within teams .

processing documents using mail attachments

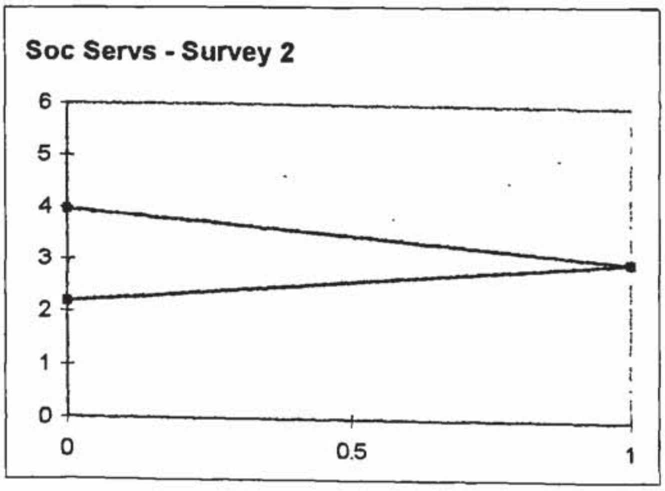
Min	Kernel	Max	Best supported hypothesis
2.222	**3.133**	**4.111**	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.133 , with a Minimum of 2.222 and a Maximum of 4.111 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for processing documents using mail

confirming delivery of communications **Emergent**

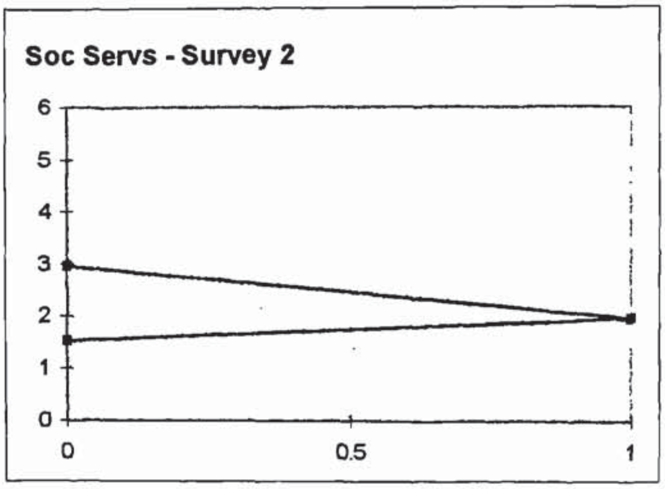
Min	Kernel	Max	Best supported hypothesis
2.182	3.068	3.955	.... sometimes employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.068 , with a Minimum of 2.182 and a Maximum of 3.955 . The Kernel (most likely) value may be interpreted as close to sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.523	1.977	2.955	.... never employed for managing a team task list

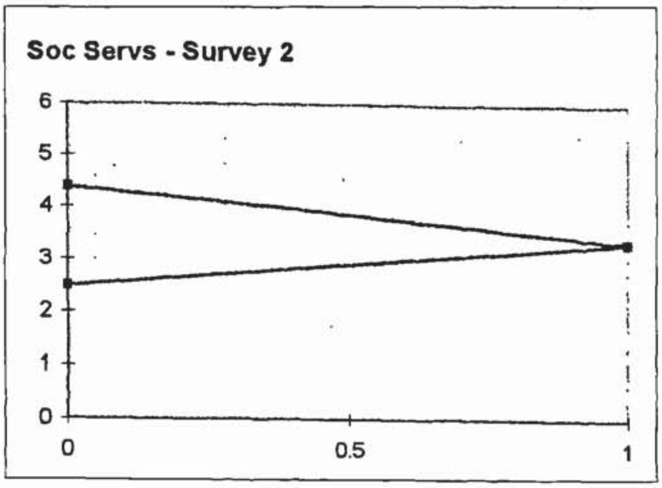


The score for managing a team task list is a Kernel value of 1.977 , with a Minimum of 1.523 and a Maximum of 2.955 . The Kernel (most likely) value may be interpreted as close to seldom employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhere between never employed and seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as close to sometimes employed for managing a team task list.

formal communications

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
2.489	**3.422**	**4.378**	.... sometimes employed for formal communications

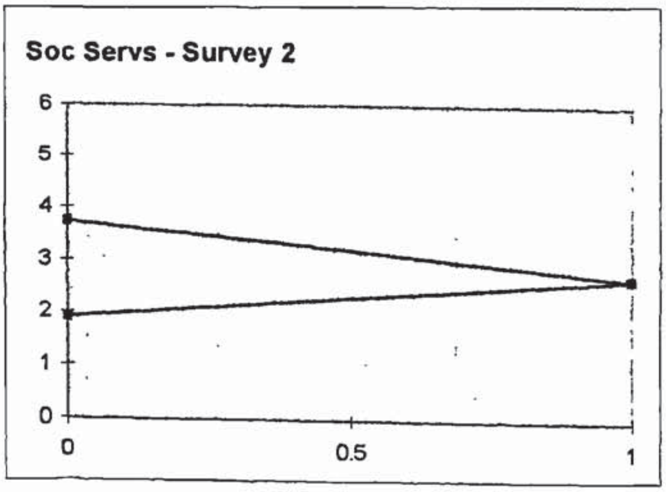


The score for formal communications is a Kernel value of 3.422 , with a Minimum of 2.489 and a Maximum of 4.378 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
1.907	**2.767**	**3.721**	.... frequently employed for recording messages

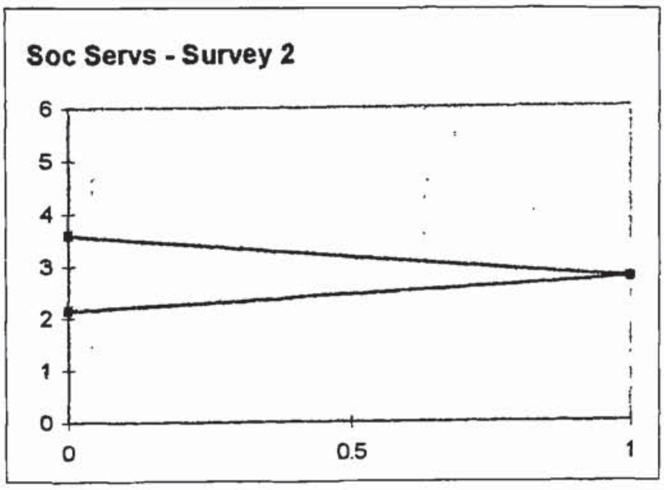


The score for recording messages is a Kernel value of 2.767 , with a Minimum of 1.907 and a Maximum of 3.721 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.136	2.727	3.591	.... never employed for managing a personal task list

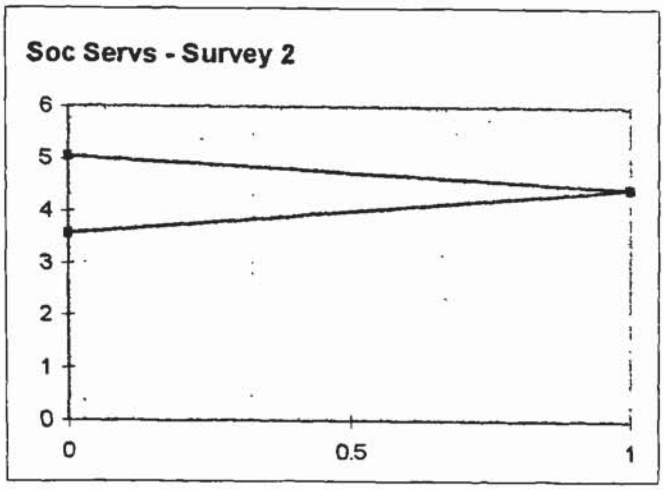


The score for managing a personal task list is a Kernel value of 2.727 , with a Minimum of 2.136 and a Maximum of 3.591 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.558	4.442	5.047	.... indispensible to task for maintaining a personal diary



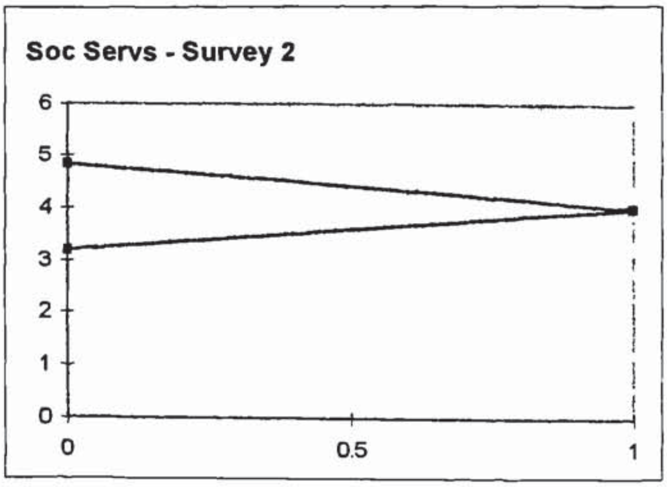
The score for maintaining a personal diary is a Kernel value of 4.442 , with a Minimum of 3.558 and a Maximum of 5.047 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as close to almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min Kernel Max Best supported hypothesis

3.186 4.047 4.837 .... indispensible to task for scheduling meetings



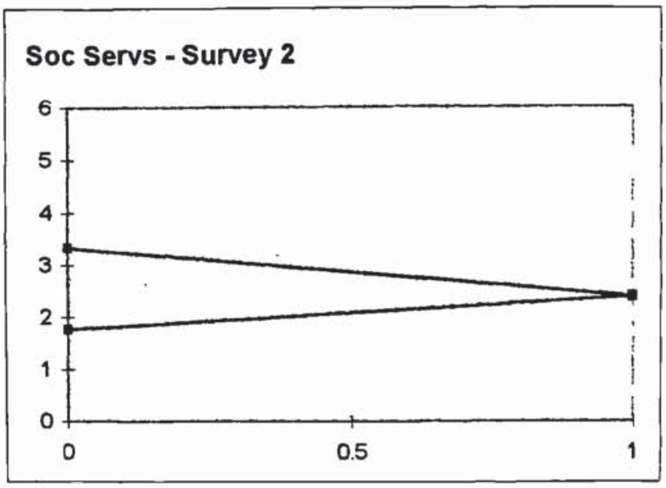
The score for scheduling meetings is a Kernel value of 4.047 , with a Minimum of 3.186 and a Maximum of 4.837 . The Kernel (most likely) value may be interpreted as close to frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings.

as a telephone directory

Design

Min Kernel Max Best supported hypothesis

1.767 2.372 3.326 .... never employed for as a telephone directory

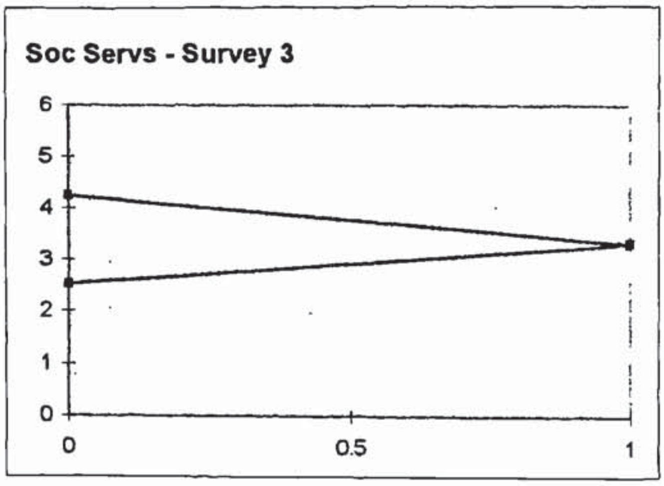


The score for as a telephone directory is a Kernel value of 2.372 , with a Minimum of 1.767 and a Maximum of 3.326 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhat more than sometimes employed for as a

Social Services Survey 3

all business tasks

Min	Kernel	Max
2.525	3.35	4.246

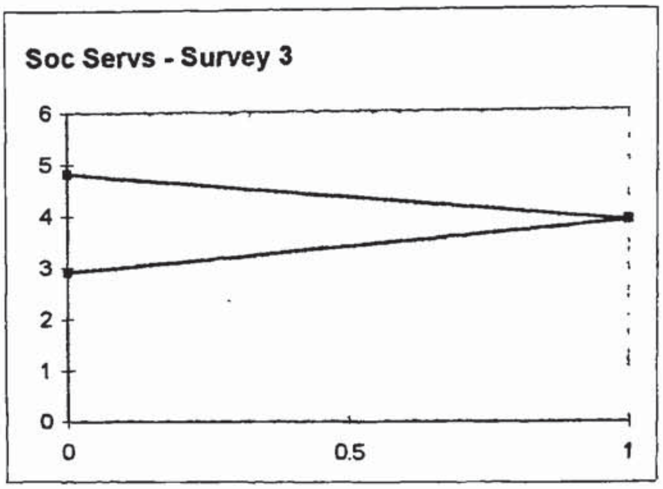


The score for all business tasks is a Kernel value of 3.35 , with a Minimum of 2.525 and a Maximum of 4.246 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.909	3.864	4.83	.... frequently employed for informal communications

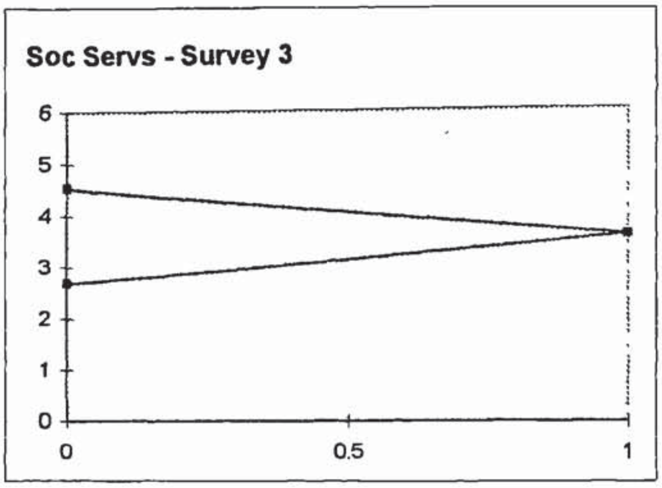


The score for informal communications is a Kernel value of 3.864 , with a Minimum of 2.909 and a Maximum of 4.83 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

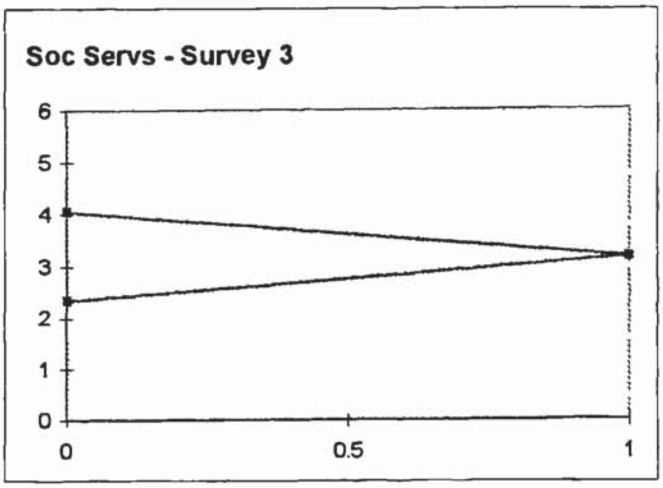
Min	Kernel	Max	Best supported hypothesis
2.682	**3.58**	**4.534**	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.58 , with a Minimum of 2.682 and a Maximum of 4.534 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for co-ordination within teams .

processing documents using mail attachments

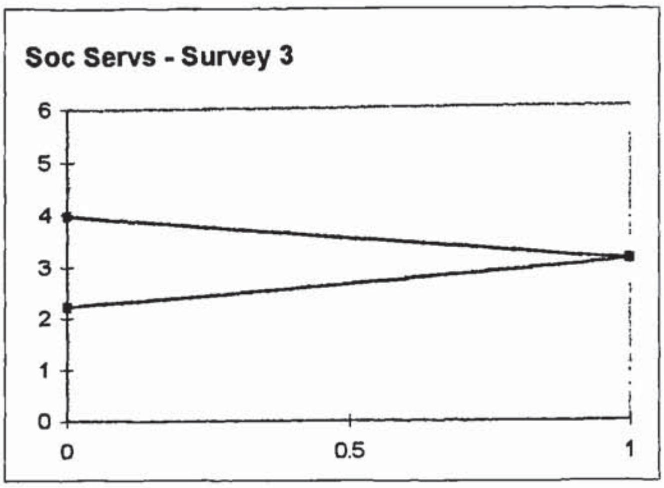
Min	Kernel	Max	Best supported hypothesis
2.341	**3.148**	**4.057**	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.148 , with a Minimum of 2.341 and a Maximum of 4.057 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using

confirming delivery of communications **Emergent**

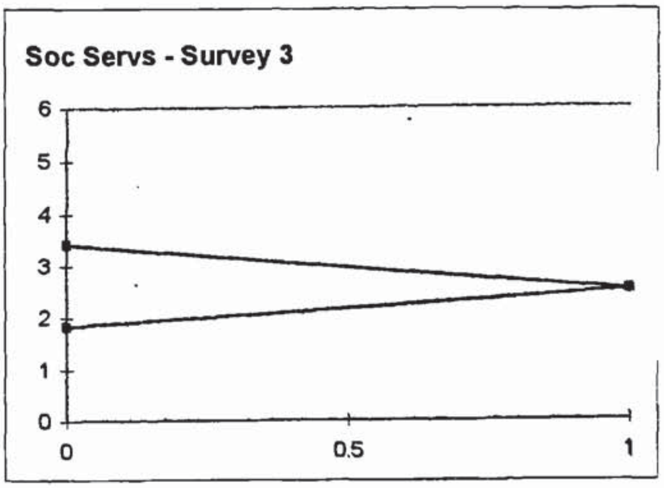
Min	Kernel	Max	Best supported hypothesis
2.227	3.045	3.966	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.045 , with a Minimum of 2.227 and a Maximum of 3.966 . The Kernel (most likely) value may be interpreted as close to sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.83	2.466	3.42	.... never employed for managing a team task list

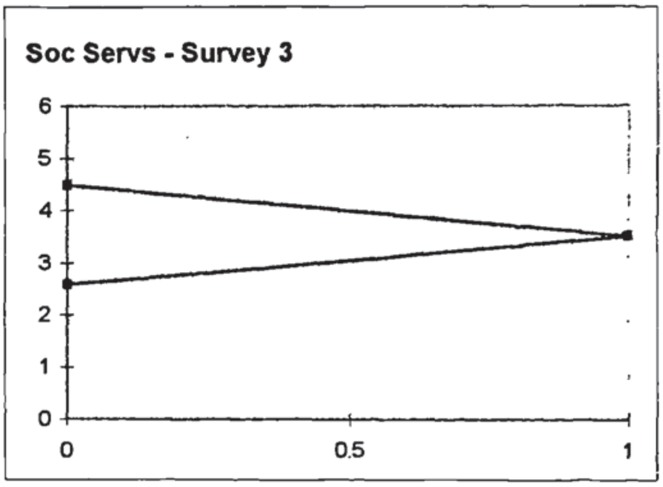


The score for managing a team task list is a Kernel value of 2.466 , with a Minimum of 1.83 and a Maximum of 3.42 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a team task list

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.58	**3.511**	**4.477**	.... frequently employed for formal communications

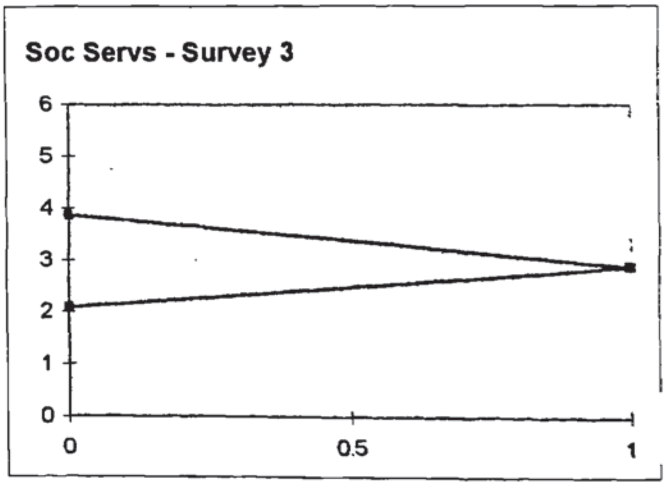


The score for formal communications is a Kernel value of 3.511 , with a Minimum of 2.58 and a Maximum of 4.477 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.08	**2.909**	**3.864**	.... frequently employed for recording messages

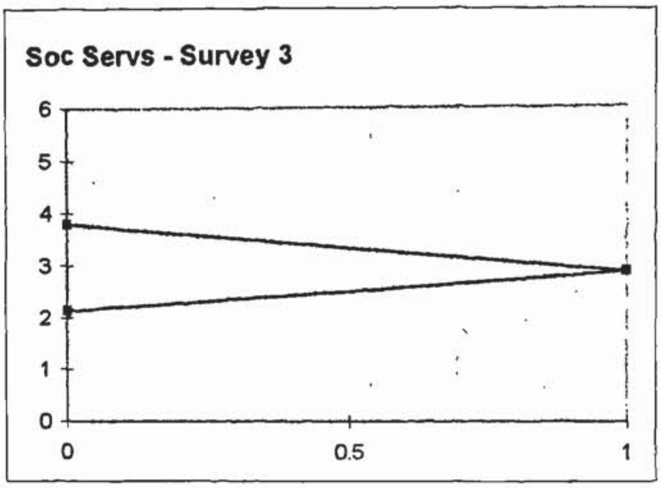


The score for recording messages is a Kernel value of 2.909 , with a Minimum of 2.08 and a Maximum of 3.864 . The Kernel (most likely) value may be interpreted as close to sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.136	2.864	3.784	.... never employed for managing a personal task list

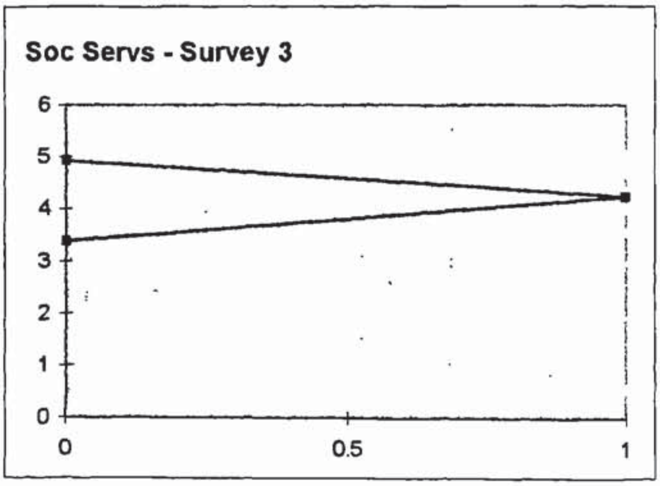


The score for managing a personal task list is a Kernel value of 2.864 , with a Minimum of 2.136 and a Maximum of 3.784 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.375	4.239	4.92	.... indispensible to task for maintaining a personal diary

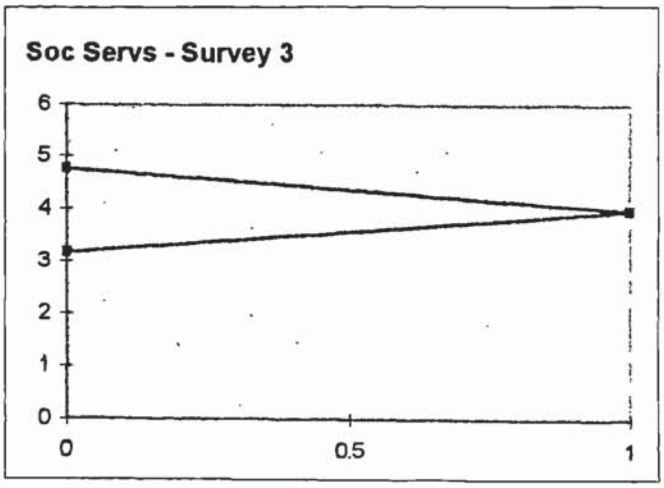


The score for maintaining a personal diary is a Kernel value of 4.239 , with a Minimum of 3.375 and a Maximum of 4.92 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as close to almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.17	4.011	4.761	.... indispensible to task for scheduling meetings

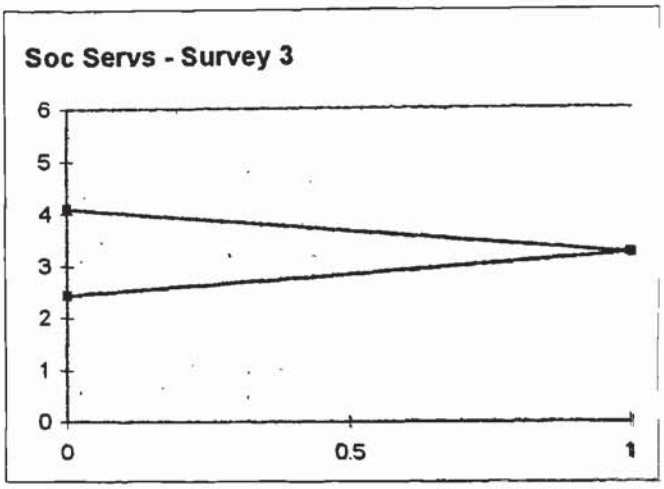


The score for scheduling meetings is a Kernel value of 4.011 , with a Minimum of 3.17 and a Maximum of 4.761 . The Kernel (most likely) value may be interpreted as close to frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.443	3.216	4.091	.... never employed for as a telephone directory

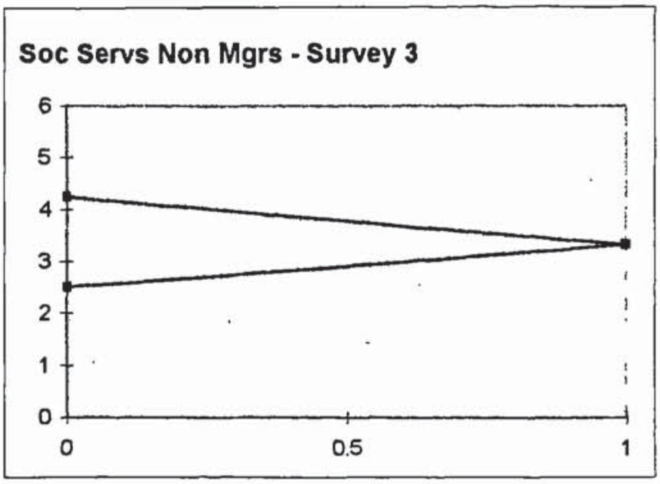


The score for as a telephone directory is a Kernel value of 3.216 , with a Minimum of 2.443 and a Maximum of 4.091 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to frequently employed for as a telephone directory.

Social Services Non Managers Survey 3

all business tasks

Min	Kernel	Max
2.498	3.332	4.242

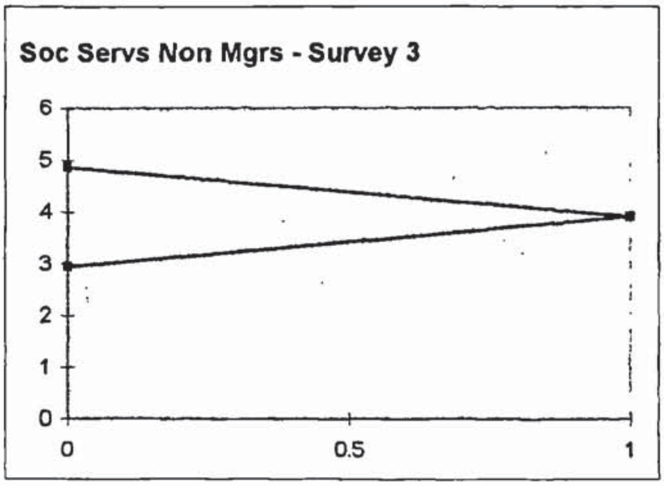


The score for all business tasks is a Kernel value of 3.332 , with a Minimum of 2.498 and a Maximum of 4.242 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.94	3.91	4.881	.... frequently employed for informal communications

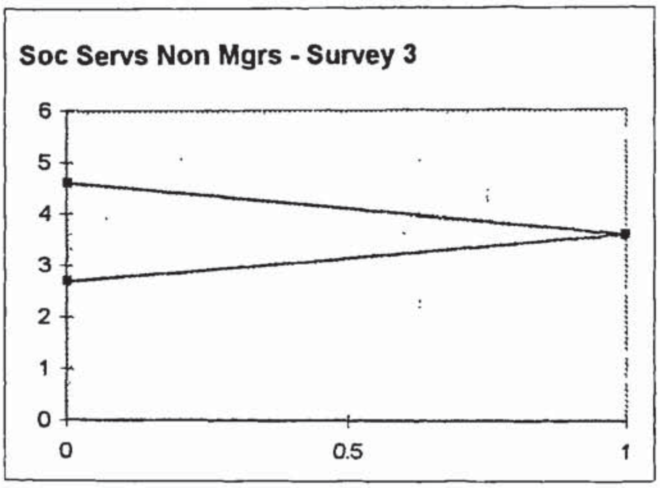


The score for informal communications is a Kernel value of 3.91 , with a Minimum of 2.94 and a Maximum of 4.881 . The Kernel (most likely) value may be interpreted as close to frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

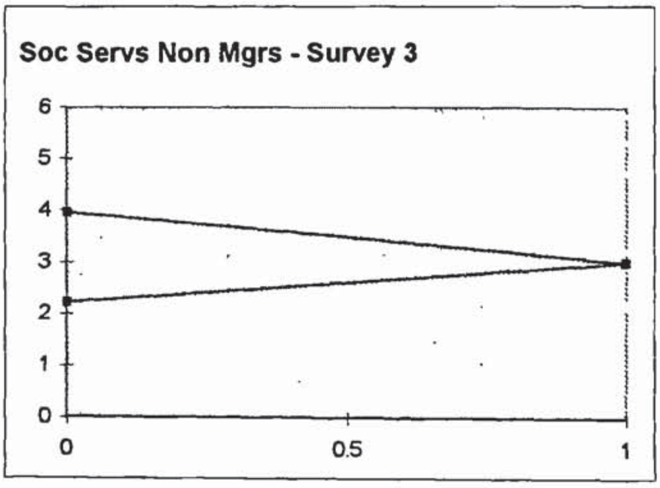
Min	Kernel	Max	Best supported hypothesis
2.701	**3.627**	**4.612**	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.627 , with a Minimum of 2.701 and a Maximum of 4.612 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for co-ordination within teams .

processing documents using mail attachments

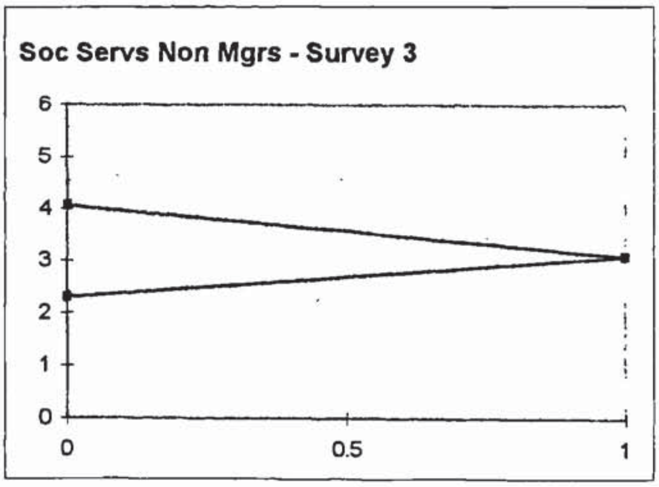
Min	Kernel	Max	Best supported hypothesis
2.224	**3.03**	**3.97**	.... sometimes employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.03 , with a Minimum of 2.224 and a Maximum of 3.97 . The Kernel (most likely) value may be interpreted as close to sometimes employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as close to frequently employed for processing documents using mail attachments.

confirming delivery of communications **Emergent**

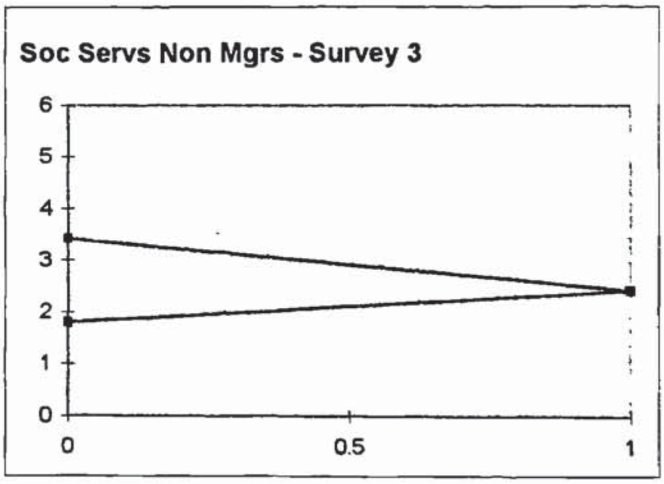
Min	Kernel	Max	Best supported hypothesis
2.299	3.134	4.06	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 3.134 , with a Minimum of 2.299 and a Maximum of 4.06 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as close to frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.806	2.448	3.418	.... never employed for managing *a team task list*

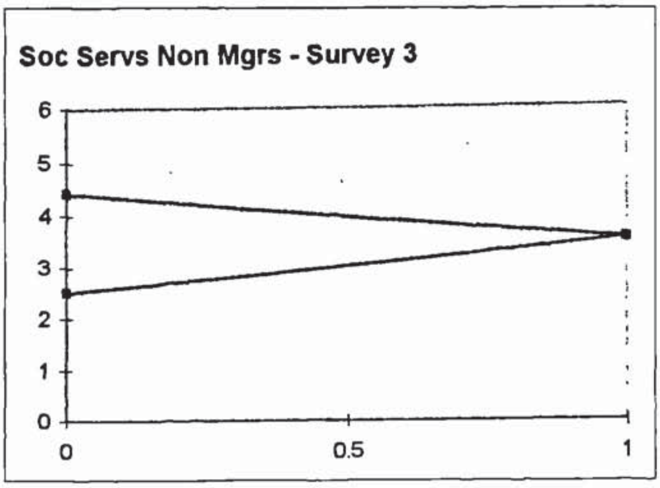


The score for managing a team task list is a Kernel value of 2.448 , with a Minimum of 1.806 and a Maximum of 3.418 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat less than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a team task list

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.507	**3.448**	**4.418**	.... frequently employed for formal communications

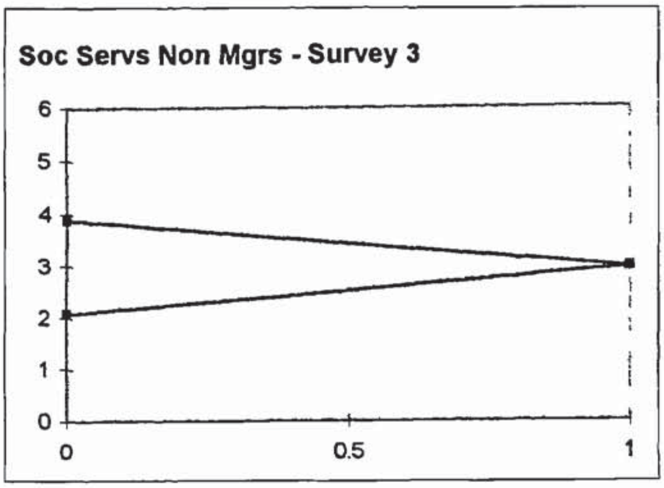


The score for formal communications is a Kernel value of 3.448 , with a Minimum of 2.507 and a Maximum of 4.418 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.075	**2.91**	**3.881**	.... frequently employed for recording messages

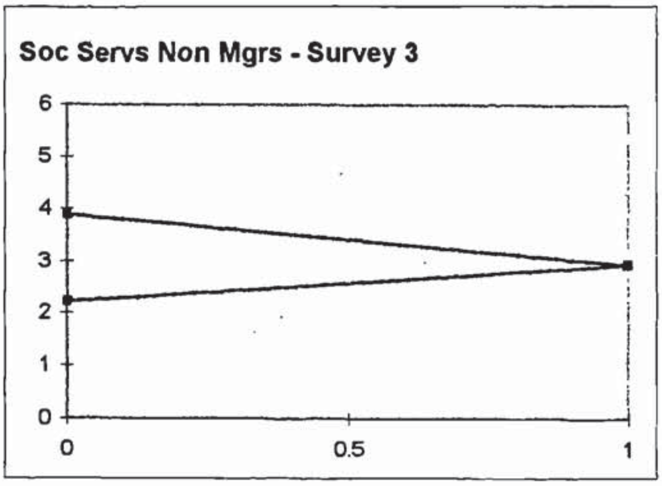


The score for recording messages is a Kernel value of 2.91 , with a Minimum of 2.075 and a Maximum of 3.881 . The Kernel (most likely) value may be interpreted as close to sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list **Design**

Min Kernel Max Best supported hypothesis

2.209 2.955 3.881 .... never employed for managing a personal task list

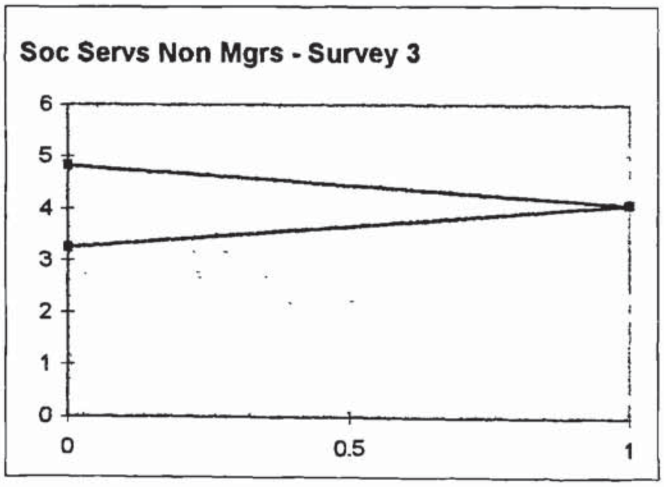


The score for managing a personal task list is a Kernel value of 2.955 , with a Minimum of 2.209 and a Maximum of 3.881 . The Kernel (most likely) value may be interpreted as close to sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a personal task list.

maintaining a personal diary **Design**

Min Kernel Max Best supported hypothesis

3.239 4.104 4.821 .... indispensible to task for maintaining a personal diary

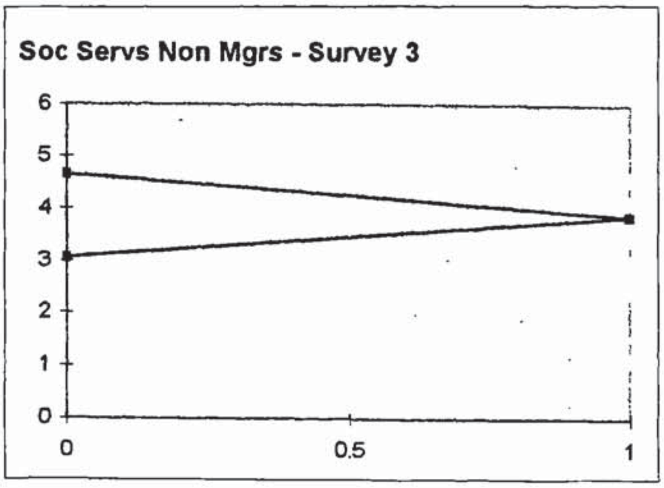


The score for maintaining a personal diary is a Kernel value of 4.104 , with a Minimum of 3.239 and a Maximum of 4.821 . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
3.06	**3.896**	**4.657**	.... indispensible to task for scheduling meetings

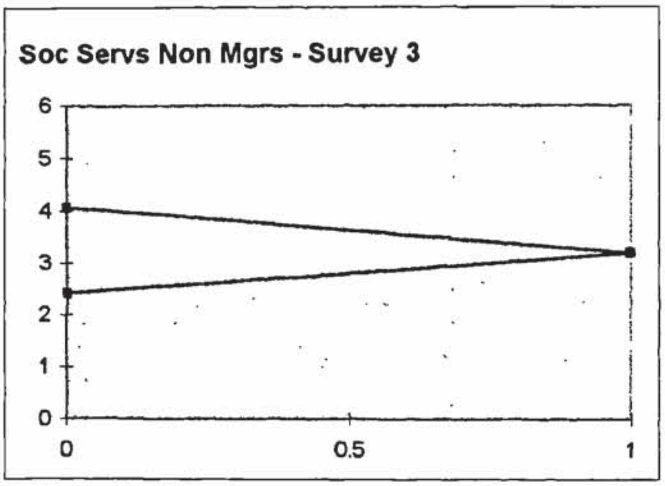


The score for scheduling meetings is a Kernel value of 3.896 , with a Minimum of 3.06 and a Maximum of 4.657 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as close to sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings.

as a telephone directory

Design

Min	**Kernel**	**Max**	**Best supported hypothesis**
2.418	**3.194**	**4.06**	.... never employed for as a telephone directory

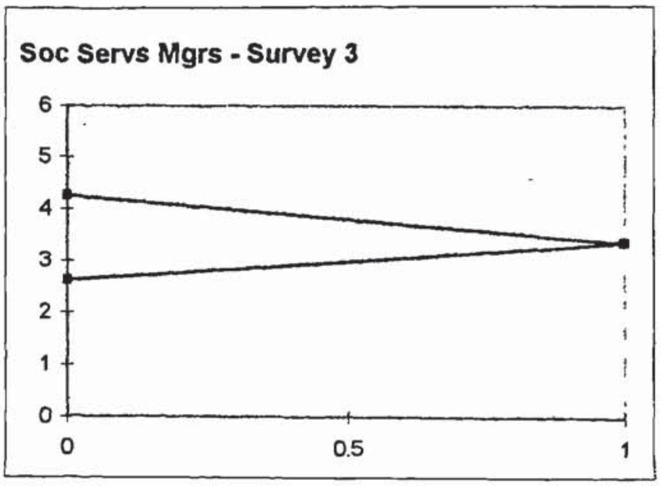


The score for as a telephone directory is a Kernel value of 3.194 , with a Minimum of 2.418 and a Maximum of 4.06 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to frequently employed for as a telephone directory.

Social Services Managers Survey 3

all business tasks

Min	Kernel	Max
2.61	3.407	4.26

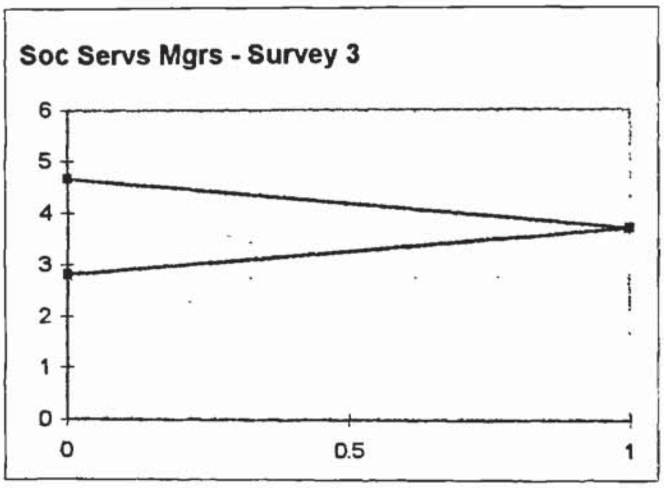


The score for all business tasks is a Kernel value of 3.407 , with a Minimum of 2.61 and a Maximum of 4.26 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min	Kernel	Max	Best supported hypothesis
2.81	3.714	4.667	.... frequently employed for informal communications

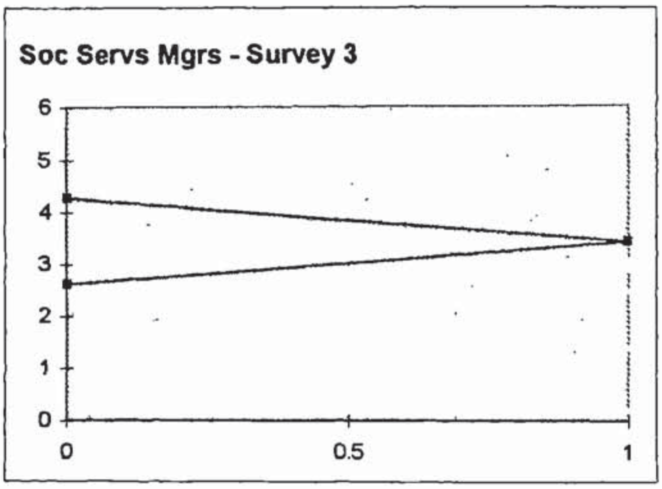


The score for informal communications is a Kernel value of 3.714 , with a Minimum of 2.81 and a Maximum of 4.667 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for informal communications.

co-ordination within teams

Emergent

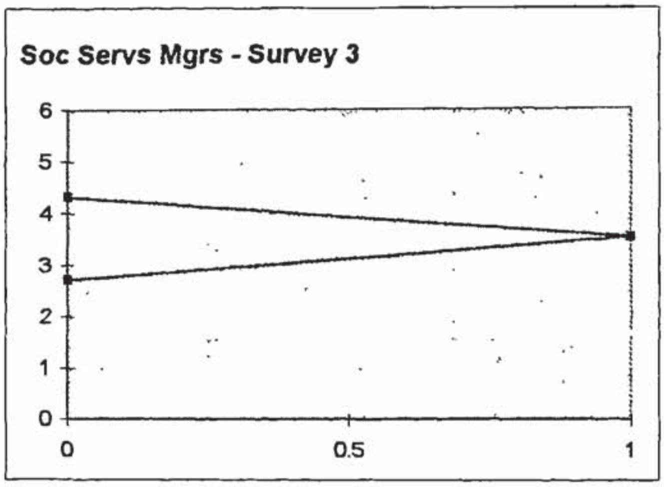
Min	Kernel	Max	Best supported hypothesis
2.619	3.429	4.286	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.429 , with a Minimum of 2.619 and a Maximum of 4.286 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for co-ordination within teams .

processing documents using mail attachments

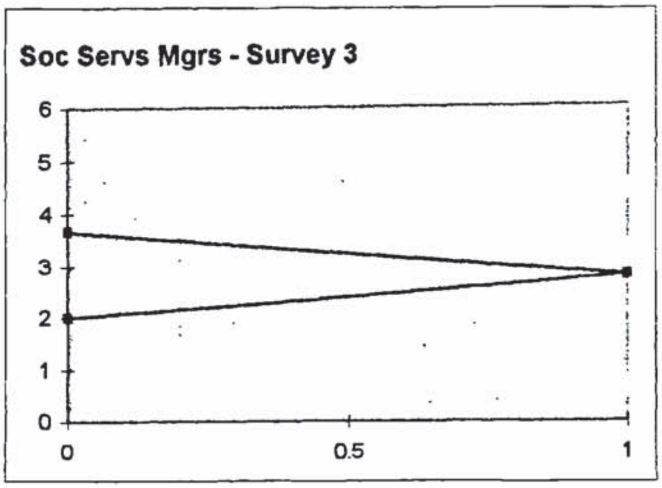
Min	Kernel	Max	Best supported hypothesis
2.714	3.524	4.333	.... frequently employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.524 , with a Minimum of 2.714 and a Maximum of 4.333 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always

confirming delivery of communications **Emergent**

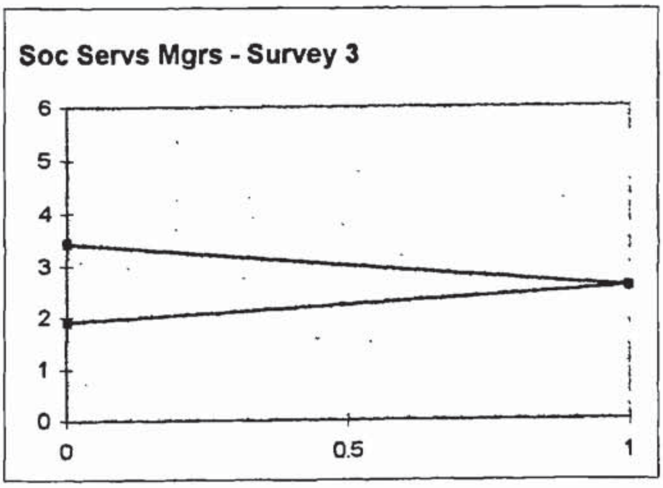
Min	Kernel	Max	Best supported hypothesis
2	2.762	3.667	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 2.762 , with a Minimum of 2. and a Maximum of 3.667 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as close to seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
1.905	2.524	3.429	.... never employed for managing a team task list

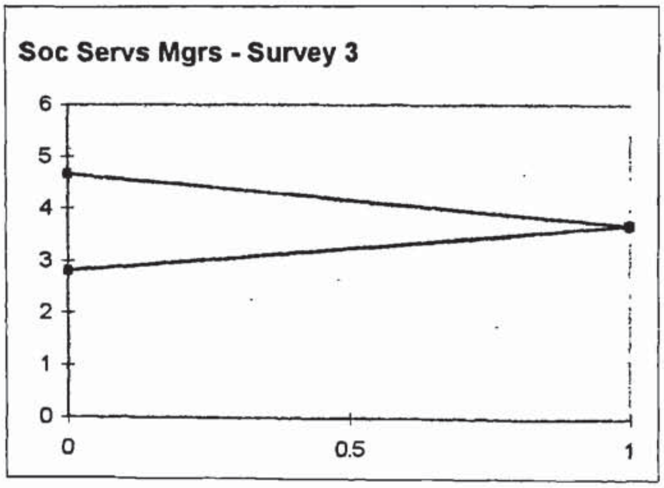


The score for managing a team task list is a Kernel value of 2.524 , with a Minimum of 1.905 and a Maximum of 3.429 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as close to seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a team task list

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.81	3.714	4.667	.... frequently employed for formal communications

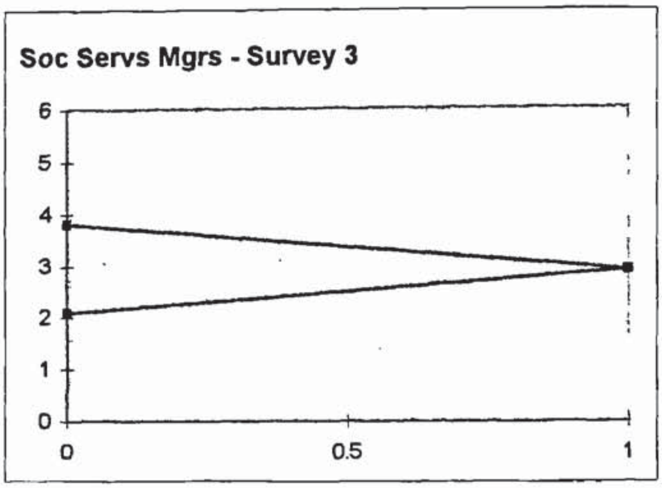


The score for formal communications is a Kernel value of 3.714 , with a Minimum of 2.81 and a Maximum of 4.667 . The Kernel (most likely) value may be interpreted as somewhat less than frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.095	2.905	3.81	.... frequently employed for recording messages

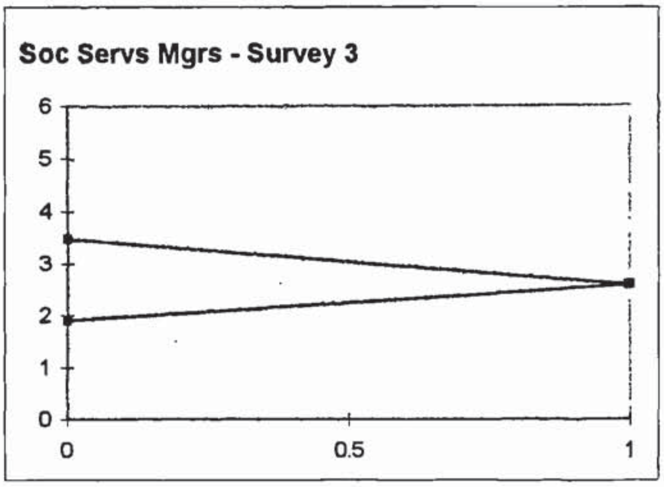


The score for recording messages is a Kernel value of 2.905 , with a Minimum of 2.095 and a Maximum of 3.81 . The Kernel (most likely) value may be interpreted as close to sometimes employed for recording messages. The Minimum (lowest likely) value may be interpreted as close to seldom employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for recording messages.

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
1.905	2.571	3.476	.... never employed for managing a personal task list

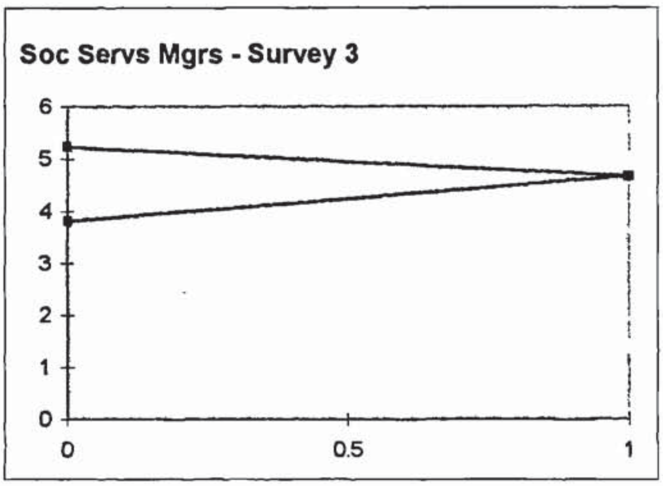


The score for managing a personal task list is a Kernel value of 2.571 , with a Minimum of 1.905 and a Maximum of 3.476 . The Kernel (most likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as close to seldom employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.81	4.667	5.238	.... indispensible to task for maintaining a personal diary

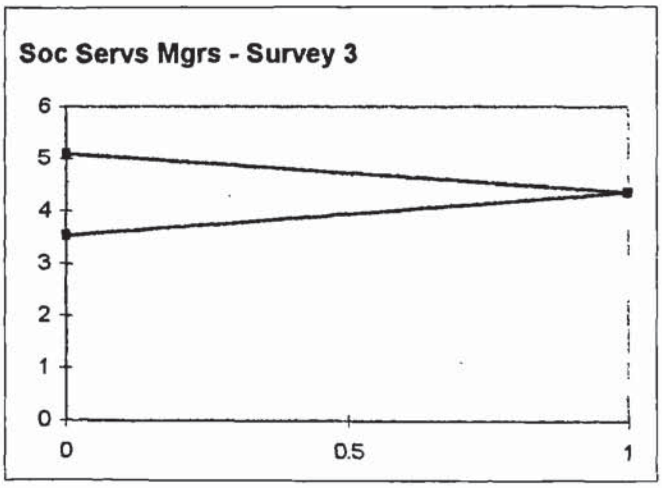


The score for maintaining a personal diary is a Kernel value of 4.667 , with a Minimum of 3.81 and a Maximum of 5.238 . The Kernel (most likely) value may be interpreted as somewhat less than almost always employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhat less than frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as somewhat more than almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.524	4.381	5.095	.... indispensible to task for scheduling meetings

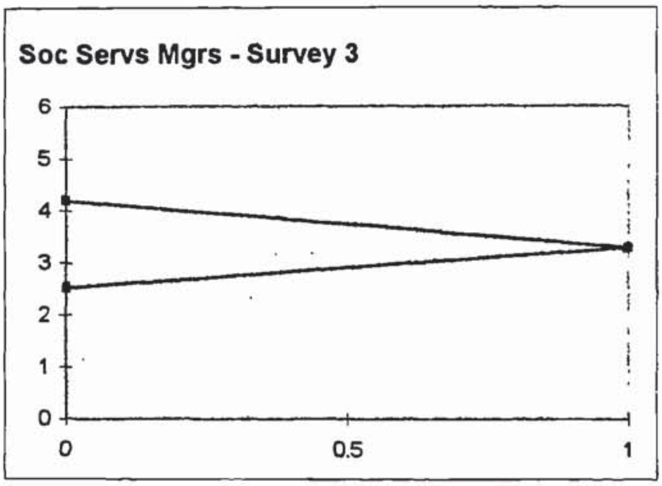


The score for scheduling meetings is a Kernel value of 4.381 , with a Minimum of 3.524 and a Maximum of 5.095 . The Kernel (most likely) value may be interpreted as somewhere between frequently employed and almost always employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as close to almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.524	3.286	4.19	.... never employed for as a telephone directory

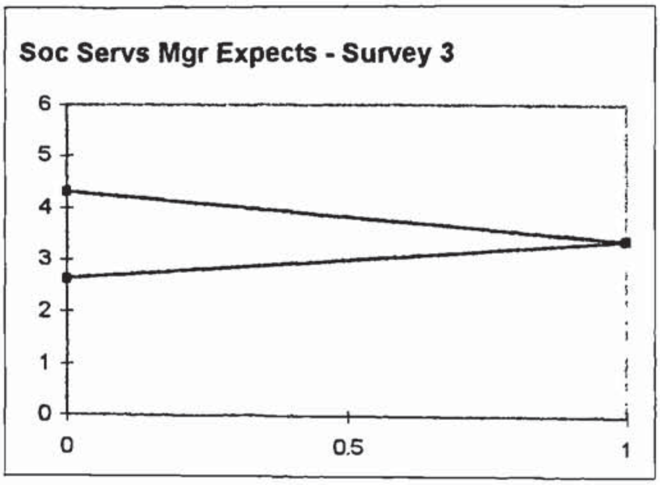


The score for as a telephone directory is a Kernel value of 3.286 , with a Minimum of 2.524 and a Maximum of 4.19 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for as a

Social Services Manager Expectations Survey 3

all business tasks

Min Kernel Max
2.628 3.42 4.303

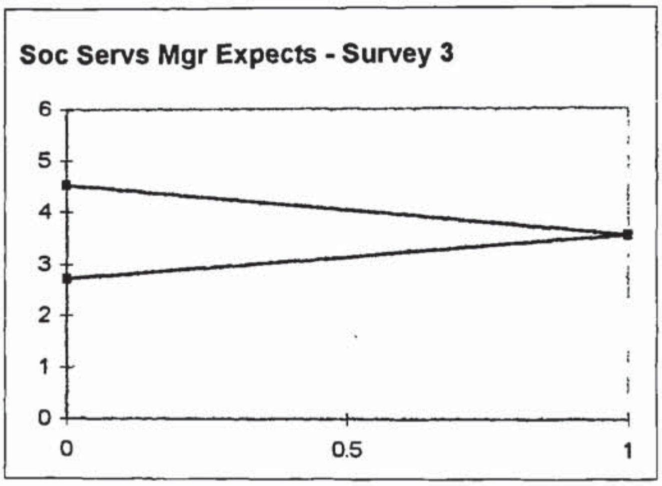


The score for all business tasks is a Kernel value of 3.42 , with a Minimum of 2.628 and a Maximum of 4.303 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for all business tasks. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for all business tasks. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for all business tasks.

informal communications

Emergent

Min Kernel Max **Best supported hypothesis**
2.714 3.571 4.524 .... frequently employed for informal communications

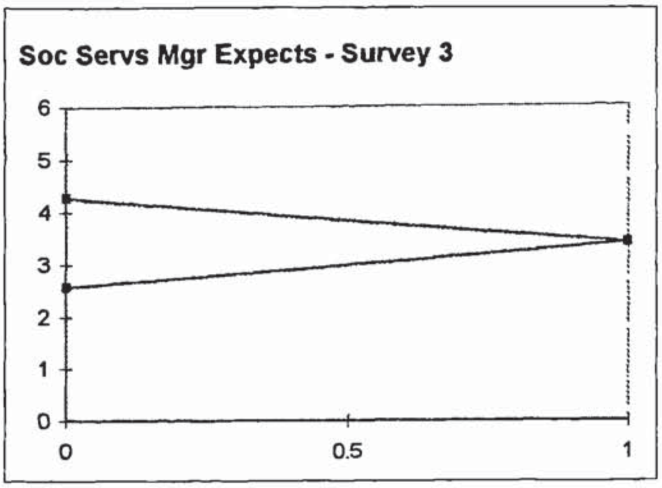


The score for informal communications is a Kernel value of 3.571 , with a Minimum of 2.714 and a Maximum of 4.524 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for informal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for informal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and

co-ordination within teams

Emergent

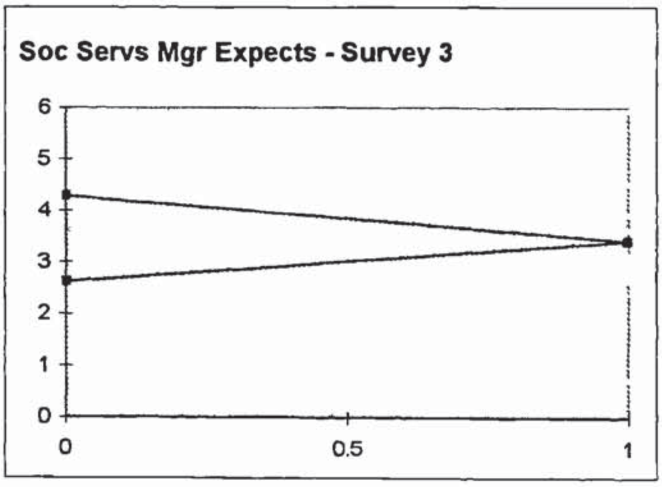
Min	Kernel	Max	Best supported hypothesis
2.571	**3.381**	**4.286**	.... frequently employed for co-ordination within teams



The score for co-ordination within teams is a Kernel value of 3.381 , with a Minimum of 2.571 and a Maximum of 4.286 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for co-ordination within teams . The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for co-ordination within teams . The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for co-ordination within teams .

processing documents using mail attachments

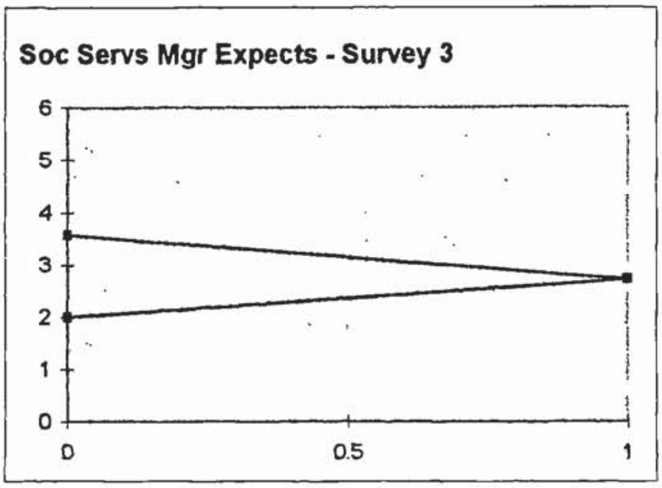
Min	Kernel	Max	Best supported hypothesis
2.619	**3.429**	**4.286**	.... frequently employed for processing documents using mail attachments



The score for processing documents using mail attachments is a Kernel value of 3.429 , with a Minimum of 2.619 and a Maximum of 4.286 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for processing documents using mail attachments. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for processing documents using mail attachments. The Maximum (greatest likely) value may be interpreted as somewhat more than

confirming delivery of communications **Emergent**

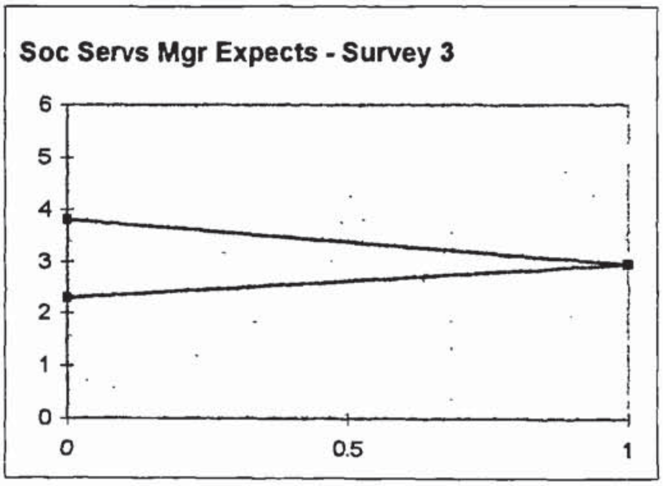
Min	Kernel	Max	Best supported hypothesis
2	2.714	3.571	.... frequently employed for confirming delivery of communications



The score for confirming delivery of communications is a Kernel value of 2.714 , with a Minimum of 2. and a Maximum of 3.571 . The Kernel (most likely) value may be interpreted as somewhat less than sometimes employed for confirming delivery of communications. The Minimum (lowest likely) value may be interpreted as close to seldom employed for confirming delivery of communications. The Maximum (greatest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for confirming delivery of communications.

managing a team task list **Emergent**

Min	Kernel	Max	Best supported hypothesis
2.286	2.952	3.81	.... never employed for managing a team task list

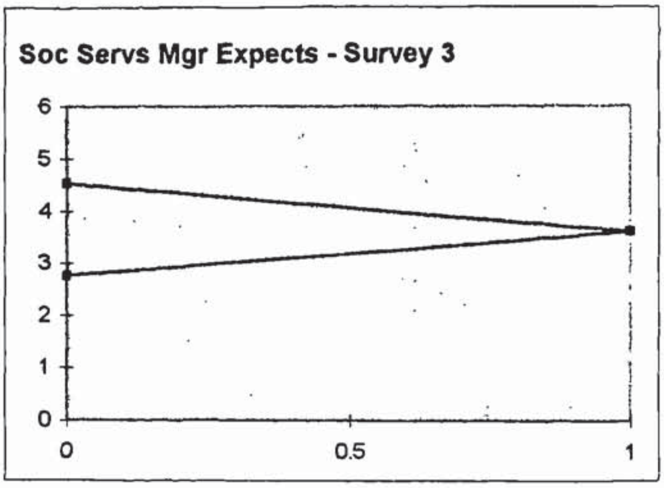


The score for managing a team task list is a Kernel value of 2.952 , with a Minimum of 2.286 and a Maximum of 3.81 . The Kernel (most likely) value may be interpreted as close to sometimes employed for managing a team task list. The Minimum (lowest likely) value may be interpreted as somewhat more than seldom employed for managing a team task list. The Maximum (greatest likely) value may be interpreted as somewhat less than frequently employed for managing a team task list.

formal communications

Design

Min	Kernel	Max	Best supported hypothesis
2.762	**3.619**	**4.524**	.... frequently employed for formal communications

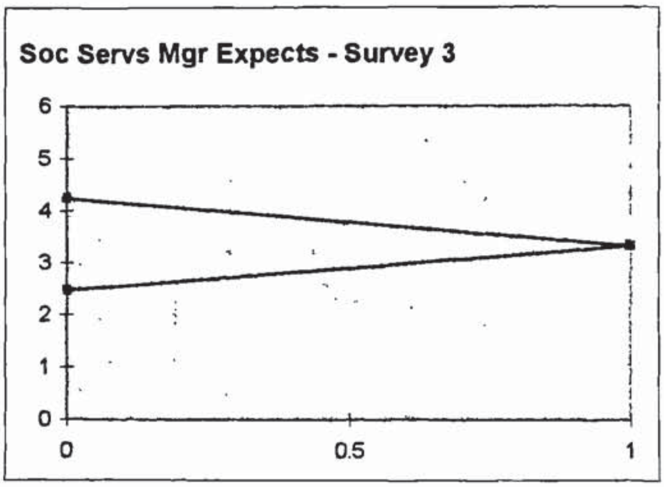


The score for formal communications is a Kernel value of 3.619 , with a Minimum of 2.762 and a Maximum of 4.524 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for formal communications. The Minimum (lowest likely) value may be interpreted as somewhat less than sometimes employed for formal communications. The Maximum (greatest likely) value may be interpreted as somewhere between frequently employed and almost always employed for formal communications.

recording messages

Design

Min	Kernel	Max	Best supported hypothesis
2.476	**3.333**	**4.238**	.... frequently employed for recording messages

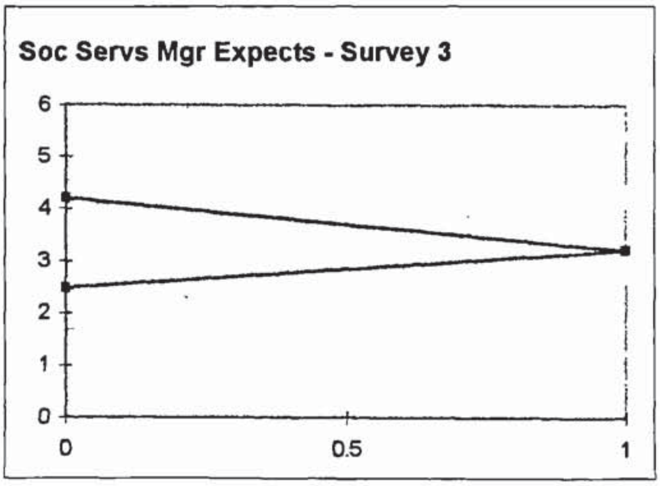


The score for recording messages is a Kernel value of 3.333 , with a Minimum of 2.476 and a Maximum of 4.238 . The Kernel (most likely) value may be interpreted as somewhere between sometimes employed and frequently employed for recording messages. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for recording messages. The Maximum (greatest likely) value may be interpreted as somewhat more than

managing a personal task list

Design

Min	Kernel	Max	Best supported hypothesis
2.476	3.238	4.19	.... frequently employed for managing a personal task list

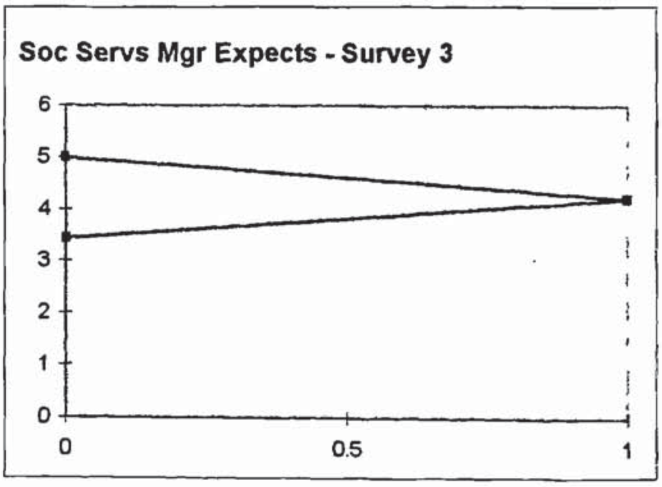


The score for managing a personal task list is a Kernel value of 3.238 , with a Minimum of 2.476 and a Maximum of 4.19 . The Kernel (most likely) value may be interpreted as somewhat more than sometimes employed for managing a personal task list. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for managing a personal task list. The Maximum (greatest likely) value may be interpreted as somewhat more than frequently employed for managing a personal task list.

maintaining a personal diary

Design

Min	Kernel	Max	Best supported hypothesis
3.429	4.238	5	.... indispensible to task for maintaining a personal diary

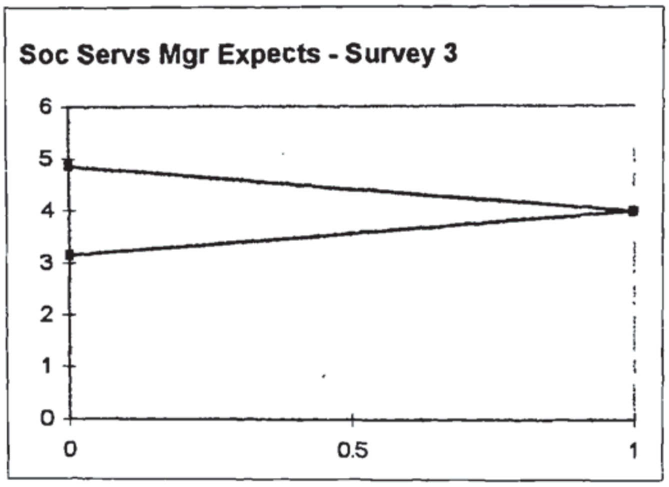


The score for maintaining a personal diary is a Kernel value of 4.238 , with a Minimum of 3.429 and a Maximum of 5. . The Kernel (most likely) value may be interpreted as somewhat more than frequently employed for maintaining a personal diary. The Minimum (lowest likely) value may be interpreted as somewhere between sometimes employed and frequently employed for maintaining a personal diary. The Maximum (greatest likely) value may be interpreted as close to almost always employed for maintaining a personal diary.

scheduling meetings

Design

Min	Kernel	Max	Best supported hypothesis
3.143	**4**	**4.857**	.... frequently employed for scheduling meetings

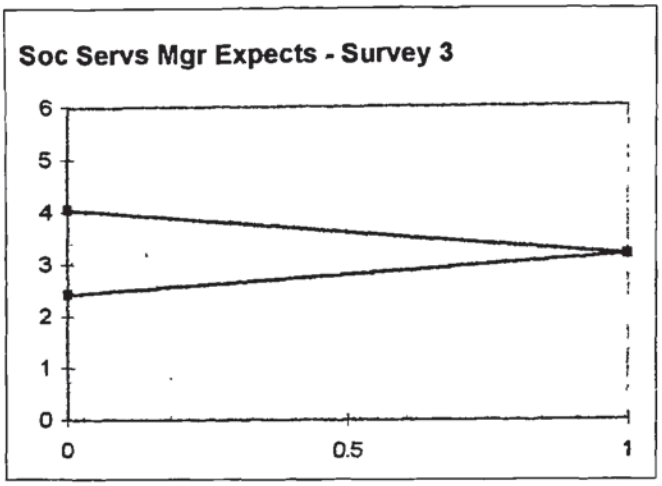


The score for scheduling meetings is a Kemel value of 4. , with a Minimum of 3.143 and a Maximum of 4.857 . The Kernel (most likely) value may be interpreted as close to frequently employed for scheduling meetings. The Minimum (lowest likely) value may be interpreted as somewhat more than sometimes employed for scheduling meetings. The Maximum (greatest likely) value may be interpreted as somewhat less than almost always employed for scheduling meetings.

as a telephone directory

Design

Min	Kernel	Max	Best supported hypothesis
2.429	**3.143**	**4.048**	.... never employed for as a telephone directory



The score for as a telephone directory is a Kemel value of 3.143 , with a Minimum of 2.429 and a Maximum of 4.048 . The Kemel (most likely) value may be interpreted as somewhat more than sometimes employed for as a telephone directory. The Minimum (lowest likely) value may be interpreted as somewhere between seldom employed and sometimes employed for as a telephone directory. The Maximum (greatest likely) value may be interpreted as close to frequently employed for as a telephone directory.