Understanding the use of forecasting systems:
an interpretive study in a supply-chain company

P. Goodwin, R. Fildes, W.Y. Lee, K.Nikolopoulos & M. Lawrence
University of Bath
School of Management
Working Paper Series
2007.14

UNIVERSITY OF BATH
SCHOOL OF MANAGEMENT

University of Bath School of Management
Working Paper Series

School of Management
Claverton Down
Bath
BA2 7AY
United Kingdom
Tel: +44 1225 826742
Fax: +44 1225 826473
http://www.bath.ac.uk/management/research/papers.htm

2007		
2007.01	Fotios Pasiouras	International evidence on the impact of regulations and supervision on banks' technical efficiency: an application of two-stage data envelopment analysis
2007.02	Richard Fairchild	Audit Tenure, Report Qualification, and Fraud
2007.03	Robert Heath & Paul Feldwick	50 Years using the wrong model of TV advertising
2007.04	Stephan C. Henneberg, Daniel Rohrmus & Carla Ramos	Sense-making and Cognition in Business Networks: Conceptualisation and Propositional Development
2007.05	Fotios Pasiouras, Sailesh Tanna & Constantin Zopounidis	Regulations, supervision and banks' cost and profit efficiency around the world: a stochastic frontier approach
2007.06	Johan Lindeque, Mark Lund & Steven McGuire	Non-Market Strategies, Corporate Political Activity and Organizational Social Capital: The US Anti-Dumping and Countervailing Duty Process
2007.07	Robert Heath	Emotional Persuasion in Advertising: A Hierarchy-of-Processing Model
2007.08	Joyce Yi-Hui Lee & Niki Panteli	A Framework for understanding Conflicts in Global Virtual Alliances
2007.09	Robert Heath	How do we predict advertising attention and engagement?
2007.10	Patchareeporn Pluempavarn & Niki Panteli	The Creation of Social Identity Through Weblogging

2007.11	Richard Fairchild	Managerial Overconfidence, Agency Problems, Financing Decisions and Firm Performance.
2007.12	Fotios Pasiouras, Emmanouil Sifodaskalakis & Constantin Zopounidis	Estimating and analysing the cost efficiency of Greek cooperative banks: an application of two-stage data envelopment analysis
2007.13	Fotios Pasiouras and Emmanouil Sifodaskalakis	Total Factor Productivity Change of Greek Cooperative Banks
2007.14	Paul Goodwin, Robert Fildes, Wing Yee Lee, Konstantinos Nikolopoulos & Michael Lawrence	Understanding the use of forecasting systems: an interpretive study in a supply-chain company

Understanding the use of forecasting systems: an interpretive study in a supply-chain company

Paul Goodwin *

The Management School, University of Bath, Bath, BA2 7AY, United Kingdom.

**Email:* mnspg@bath.ac.uk Tel: 44-1225-383594

Robert Fildes

Department of Management Science, Lancaster University Management School, LA1 4YX, United Kingdom.

Email: r.fildes@lancaster.ac.uk Tel: 44-1524-583879

Wing Yee Lee

The Management School, University of Bath, Bath, BA2 7AY, United Kingdom.

Email: mnpwyl@bath.ac.uk Tel: 44-1225-383594

Konstantinos Nikolopoulos

Decision Sciences and Operations Management Group, Manchester Business School, Booth Street East, Manchester, M15 6PB, United Kingdom.

Email: kostas.nikolopoulos@mbs.ac.uk Tel: 44 -161-275-6333

Michael Lawrence

School of Information Systems, Technology and Management, University of New South Wales, Sydney 2052, Australia

Email: Michael.Lawrence@unsw.edu.au Tel: 61-2 -9385-4417

August 2007

***Corresponding author**

Understanding the use of forecasting systems: an interpretive study in a supply-chain company

ABSTRACT

Managers in a supply-chain company believed that they were making extensive use of the demand forecasts generated by an expensive forecasting system that is marketed on the basis of the accuracy of its advanced statistical methods. Yet the majority of the forecasts were obtained by using the system's facility for judgmentally overriding the automatic statistical forecasts. These judgmental forecasts, ostensibly based on qualitative market intelligence, were then represented and understood as being the output of the system. Carrying out the judgmental interventions involved considerable management effort and time, yet in a large proportion of cases it served only to reduce forecast accuracy. This study uses observations of the forecasting process, semi-structured interviews with participants and data on the accuracy of forecasts to investigate the reasons underlying the managers' use of the system at two levels. First, it seeks to identify the psychological mechanisms which account for the way the system was perceived and used at the level of the individual manager. Secondly, it uses actor-network theory to explain how such patterns of use accorded with the aligned interests of the software vendors, senior and middle management and other participants in the forecasting process**.** The persistence and stability of the alliances negated any motivation to change the way in which the system was used, despite potential economic benefits and the company's change programme with its objective of improved forecasting accuracy.

INTRODUCTION

Several years ago a cost-conscious UK subsidiary of an American company, which prides itself on its application of modern management methods, paid out around $75,000 for a forecasting system to forecast the monthly demand for its products (the latest version of the system cost over $160,000 in 2005). The system consists of a data base and query language, various statistical forecasting algorithms, graphical facilities and an interactive component which permits the user to adjust the statistical forecast that the software has generated. Systems like this are marketed by vendors largely on the basis of the accuracy of their in-built *statistical* methods. However, when the system is actually used, the managers in the company generally use their judgment to override the statistical forecasts it produces to obtain forecasts that 'look right'. Their aim is to improve accuracy since forecast errors are viewed as extremely costly. Despite the fact that the system's statistical methods played little or no role in the forecasting process, the forecasts are largely perceived and presented by the managers as being the output of an advanced, modern system –indeed they are referred to as the 'System forecasts'. Carrying out the judgmental interventions involves considerable management effort and time, which can only be justified economically if they lead to improved accuracy. But the company forecasters instead rely on their beliefs that their interventions are valuable.

The paper seeks to explain why the automatic forecasts of the system are so often overridden by forecasts based on management judgment. Understanding this is important for a number of reasons. Accurate forecasts are crucial to the success of supply-chain companies and decisions relating to transportation, purchasing, inventory control, work-force scheduling, production planning and cash-flow planning are all dependent on them. Secondly, the manufacture and sale of statistical forecasting systems is big business, with the market achieving sales of $250m in 2001 in the US and UK alone. Yet designers of these systems have paid little attention to the role of judgmental interventions or the organisational environment within which their products are deployed. Thirdly, while the information systems literature contains many studies relating to the implementation of systems, relatively few papers have considered the on-going use of such tools (Auer, 1998; Bagchi, Kanungo, & Dasgupta, 2003).

To address our research question we need to understand the perspectives, beliefs and motives of the managers involved in the forecasting process because it is reasonable to assume that, according to these, the managers are behaving rationally as individuals (Kanter, 1977). Such an understanding is unlikely to be achieved through a 'traditional' survey device like a postal questionnaire, though to date this approach has been the predominant method for investigating forecasting practices in companies (e.g. Dalrymple, 1987; Klassen & Flores, 2001; Mady, 2000; Sanders & Manrodt, 1994). To try to explain the situation we needed to investigate the forecasting process at two levels –first at the level of the individual forecaster and then at the level of the network of all the participants in the process. Our research also required a methodology that could reveal a deep understanding of reasons for the managers' behavior and of the social and organizational context in which they operate. We therefore used an interpretive approach (Walsham, 1995; Nandhakumar & Jones, 1997; Easterby-Smith, Thorpe, & Low, 2002) based on observations of the forecasting process and semi-structured interviews with participants, but we also triangulated this with statistical data relating to the forecasts. From this we developed a psychological explanation of the way that individual managers used and perceived the system. We also used actor-network theory (ANT) (Latour, 1987; Callon, 1991; Akrich, 1992; Vidgen & McMaster, 1996; Walsham & Sahay, 1999; McGrath, 2002) to explain how these individual psychological factors were combined with other forces that existed both within and outside the organisation so that any pressures to change the existing use of the system would be likely to be nullified.

Although we have observed similar behaviour to that described at the start of this paper in several companies, in common with many other interpretive studies we decided to focus on one company - the UK branch of a leading US pharmaceutical company. There are a number of advantages to this case study approach (Walsham, 1995). In particular, it allows a situation to be studied in depth and, as Alexander (2004) argues, the social unit can be studied systemically.

The rest of the paper is organised as follows. First we declare our beliefs and preconceptions as researchers so that our interpretations can be seen against that context. Then we outline the theoretical background to our research, including existing psychological theories relating to the use of support systems and why we chose to use actor-network theory. The next section describes the company, its decision to purchase the forecasting system and the way in which the software is currently being used. Statistical evidence is used to present an additional perspective. Then we interpret our results to provide explanations of why the system is used as it is. Finally, we present our conclusions, together with the practical implications of our results.

OUR BELIEFS AND PRECONCEPTIONS AS RESEARCHERS

Before describing the company's forecasting process it is important to declare our own beliefs and inevitable preconceptions as researchers, especially given our direct interaction with the forecasters (Klein & Myers, 1999). Our belief, based on extensive research, is that, in general, the optimum approach to forecasting is to allow *appropriate* statistical forecasting methods to identify regular patterns in data (assuming that sufficient data is available for this purpose) (Goodwin, 2002). Failure to do this can lead to forecasters reading false patterns into the noise that appears in time series (O'Connor, Remus, & Griggs, 1993). Judgmental interventions should only be applied to statistical forecasts when the forecaster has important information about forthcoming events that is not available to the statistical method. (Sanders & Ritzman, 2001;

Fildes, Goodwin, & Lawrence, 2006). Further, the size of these adjustments should be accounted for and their rationale recorded (Goodwin, 2002) and they should, in general, be true adjustments to statistical forecasts –accounting only for the extra information- rather than replacements of these forecasts (Goodwin & Fildes, 1999). Finally, any choice of method, or any decision on what length of series history to employ should be informed, as far as possible, by empirical evidence. As we will show, the forecasting process employed by this company deviated significantly from this 'normative' approach.

THE INDIVIDUAL'S USE OF A SUPPORT SYSTEM: EXISTING VIEWS

Why might forecasters be motivated to change statistical forecasts that have automatically generated by an expensive and advanced forecasting system? Clearly, some interventions are easy to justify. As we have indicated, these will be where the forecaster has information, not available to the statistical system, about future events that are highly likely to have a large impact on demand. However, as we shall see, forecasters in the pharmaceutical company made adjustments even when they did not apparently possess this extra information. The work of Payne, Bettman, and Johnson (1993) suggests that people seek to balance cognitive effort with accuracy considerations when making judgments and decisions. Making an adjustment involves more effort than the simple acceptance of a statistical forecast so a forecaster making judgmental interventions must perceive that there are benefits to be gained through this extra effort. In many cases these benefits will be political in that forecasters may deliberately bias their forecasts to try to gain advantage in the organisation (Fildes & Hastings, 1994; Galbraith & Merrill, 1996). However, accounting for changes where there is a genuine desire to achieve forecast accuracy requires a more elaborate explanation.

Kleinmuntz (1990) has suggested that one reason why people prefer to use their heads (i.e. judgment) rather than formulae, is ‘deluded self confidence’, which he defines as confidence that you will beat the odds because you have real expertise in a domain. Kleinmuntz concludes that ‘people are indeed not a good as they think they are at using their heads’. Related to this is what Dawes (1979) refers to as ‘cognitive conceit’. People suffer from the illusion that the world is more predictable than it really is. In particular, there is much evidence that humans have a poor conception of randomness (e.g. Falk & Konold, 1997). When confronted with randomness, they have a tendency to perceive patterns and causes (Siegrist, Cvetkovich, & Gutscher, 2001). This leads to the belief that greater mental effort will improve the accuracy of forecasts (Davis & Kottemann, 1994).

The belief that mental effort, rather than greater reliance on the support system, is the key to greater accuracy occurs because people are aware that the support system is imperfect in that its forecasts will inevitably not be perfectly accurate. This imperfection is overemphasised because the environment is assumed to be largely predictable. Indeed, Kaplan, Reneau, and Whitecotton (2001) found that people were more likely to rely on a support system when its accuracy was not disclosed.

The psychological literature on advice-taking suggests another reason why the imperfection of a support system might be exaggerated in the eyes of users. This research suggests that the weight attached to advice is dependent on the reputation of the adviser, but negative information about an adviser is perceived to be more diagnostic than positive (Yaniv & Kleinberger, 2000). If we regard a statistical forecast as a form of advice, albeit from a machine, then errors arising from noise and special events will diminish the system’s reputation.

Another factor which influences the acceptance of a support system is the extent to which users are allowed to manipulate aspects of the task, for example by performing ‘what if’ analyses. Greater involvement with the task is likely to be associated with greater acceptance of the system, but it can also lead to an illusion of control, which leads to further overconfidence (Davis & Kottemann, 1994). Illusion of control occurs when factors that are usually associated with good performance in skilled situations are found in tasks where the outcome is largely or wholly governed by chance. This increased confidence and acceptability is not, however, necessarily associated with greater accuracy. The manipulations that the user is permitted to perform, (such as the choice of forecasting method or parameter values) might substantially reduce the accuracy of the system's recommendations, when compared to the advice it would have produced automatically (Lawrence et al, 2002).

In summary, forecasters are likely to use a forecasting system inefficiently because of the organisational advantage that might accrue, their over-confidence in their supposed expertise, their propensity to see patterns and causes when none exist, their exaggerated distrust of a system known to be imperfect and their need to control the outcome

ACTOR NETWORK THEORY AND ITS APPLICATION TO THE USE OF FORECASTING SUPPORT SYSTEMS

Individual forecasters in organizations do not work in isolation. Their job requires that they interact with other people from both inside and outside the organization in order to acquire information or to explain their forecasts. As a result, it is also important to consider the potential effects of political, social and other influences on the way that they use forecasting support systems.

A range of models have been developed to try to explain how the interplay between the technology itself and these social interactions determines the way in which technology is used (Orlikowski,1992). These models vary in the relative importance that they place on the role of humans and technology in influencing each other and in shaping working practices. For example, at one extreme, the technological imperative model (e.g., Siegel, Dubrovsky, Kierler, & McGuire, 1986) implies that technology is an exogenous influence on human behaviour and organisational attributes. This view discounts the actions of humans in developing, appropriating and changing technology and assumes that people operate and behave like machines. Under this assumption, forecasters would 'compliantly carry out the orders and commands they received, making efficient and effective use of all information and all technologies available to them' (Davis, Lee, Nickles, Chatterjee, Harthung, & Wu, 1992).

This can be contrasted with models which adopt a 'social construction of technology' perspective. These models would recognise that forecasting is carried out within a complex social context, that the forecasting system will be understood differently by different individuals and that the meaning attached to the forecasting system will be determined by a shared understanding arising from social interaction. In this perspective the design and shaping of a forecasting system would be seen as resulting from political actions and negotiations between a multiplicity of stakeholders (Orlikowski, 1992; McGovern & Hicks, 2004). While this perspective acknowledges that there is duality in that people and technology interact reciprocally it has been criticised for understating the role of technology and its characteristics in this process (Hanseth, 2004).

Actor-network theory (ANT) (Latour, 2005; Callon, 1991; Akrich, 1992) avoids the dichotomy between human and non-human entities by using the concept of an actor (or actant). An actor is any element which has the power to initiate action and can be either a human, a collection of humans or an item such as a heavy hotel key (which causes a guest to return it to reception) or a forecasting system. Actors all have interests and they try to enrol other actors in order to create an alignment of the other actors' interests with their own. The result of successful enrolment is an actor network. This network relates, not to the static relationships between the actors, but to the processes in which they are involved (Zackariasson & Wilson, 2004).

Three key concepts associated with ANT are inscription, translation and irreversibility. When a technical artefact, such as a forecasting system, is created by an actor certain functions are inscribed into it that are designed to protect the actor's interests. This process of inscribing involves the designer anticipating how future actors might use the artefact. In this process, designers define artefacts with 'specific tastes, competencies, motives, aspirations, political prejudices and the rest' (Akrich, 1992). Translation refers to the process of interacting with other actors 'to build heterogeneous networks of human and non-human actors forming alliances and mobilising resources to convert an idea to reality' (McGrath, 2002).

In ANT the inscription of an artefact is an embodiment of the designer's view of how the system will be used. However, users will also translate the system in relation to the tasks they are performing and the context within which they are operating (Monteiro, 2000). Once inscribed the technology itself becomes an actor by influencing its users to follow its program of action. There is, however, no guarantee that users will follow the prescribed pattern of use and the technology may be deployed in ways not anticipated by the designer. The possibility of deviation from these anticipated patterns depends upon the strength of the inscription. For example, an inscription for a forecasting system may take the form of a training course that shows the novice user but experienced forecaster how the features of a new system can be used. But , if the training course does not cover the key features of the forecaster's job the system will be by-passed, the inscription has proved to be too weak. Stronger forms could be employed such as restrictions on the use of judgemental interventions within the program itself (Monteiro, 2000). The strength of inscriptions (whether they must be followed or can be varied) is related to the irreversibility of the actor-network. Irreversibility is the degree to which it is subsequently impossible to return to a point where alternative possibilities exist (Walsham, 1997). Actor-networks with high irreversibility have accumulated a resistance to change so it is very difficult, if not impossible, for alternative translations to be made.

ANT has been applied in a number of information systems research projects. For example, Vidgen and McMaster (1996) used it to examine an automated car parking system, Zackariasson and Wilson (2004) used it understand the role of IT in an after-sales organisation while Hanseth and Braa (2000) looked at the role of SAP in influencing change in a company. However, ANT's symmetrical treatment of humans and non-humans is not without its critics. While Hanseth and Braa described the technology they studied as 'a powerful actor.. and an ally', others argue that distinctions between humans and non-humans are necessary. For example, Rose and Jones (2005) argue that 'Human agents have purposes and forms of awareness that machines do not'.

Despite these criticisms, ANT would appear to have a number of features that have the potential to illuminate the forecasting process at the pharmaceutical company. Its symmetry means that it will not downplay the role of technologies, such as the forecasting system, in the formation and continued existence of the complex process of interactions that lead to a set of forecasts. Moreover, by considering the mutual interaction of all of the actors, it guides the researcher towards an assessment of their interests and how these might be aligned. It may also help to explain how these alliances ensure various organisational - technological processes endure.

DATA GATHERING

The research study involved visits to the company's headquarters by either two or three researchers over period of around six months. The initial visit included a presentation by the company's managers, followed by a general question and answer session. The researchers also observed two meetings where the forecasts were finalised and they conducted semi-structured interviews with the main participants in the forecasting process: two Logistics Managers, a Product Manager, a Marketing Manager, a Finance Manager, a placement student who was acting as a Commercial Manager, and a Stock Replenishment Planner. Independent sets of notes were taken by each of the researchers at all meetings and interviews, which were also tape recorded. The research team sent a summary of their understanding of the organisation and its forecasting process to the company for validation and any necessary corrections. In addition, members of the team attended two user conferences run by the company which produced the forecasting system and also interviewed two of their software developers. Note that, while our approach is predominantly interpretive, we have also had access to statistical evidence and have used this to triangulate and strengthen our findings (Nardulli, 1978; Benbasat, Goldstein, & Mead, 1987). This consisted of a sample of 3264 forecasts that were supplied by the company and for which the actual outcomes were known.

THE COMPANY AND ITS FORECASTING PROCESS

Background

The organization we studied is a pharmaceutical sales and marketing company. supplying products for treating both animals and humans (aspects of this organization have been disguised for reasons of confidentiality, both organizational and personal). Within the company there are three logistics managers who produce the initial forecasts for around 350 stock keep units (SKUs) and manage the inventory. The forecasting process also involves fifteen product managers, who look after the sales of groups of products, and financial and marketing managers.

At the time of the study a placement student had also been recruited and he was spending a year using the system to produce forecasts for products with 'well behaved' demand patterns.

Three years before our study, the company had adopted the Six Sigma approach to managing (Six Sigma is a data driven method for eliminating defects in any process – including those used in manufacturing and service industries). Two logistics managers had achieved 'green belt' status, while another manager was in the process of becoming a 'black belt'. This indicates that they had achieved a proficiency in the application of statistical tools to management problems, although they had no training in statistical forecasting methods and minimal training in the use of the system (the manual had been lost a long time ago). One of the Six Sigma projects that coincided with our study concerned the company's forecasting process.

Forecasting had been selected for the Six Sigma treatment because, i) in the words of one manager: "it took an enormous amount of time, effort and resources and pain to produce the various forecasts" and ii) there were concerns about forecast accuracy. At a rough estimate, forecasting was taking around 80 person-hours of managers' time each month in meetings alone (see later) and the managers clearly wanted to see this effort rewarded with higher levels of accuracy. Because of this the forecasting improvement project was regarded as "a big strategic project".

Purchase of the forecasting system

This forecasting system had been in use for seven years at the time of the study. It was bought 'off-the-shelf' (as opposed to being an in-house development), with some 'personalised' settings tailored to the company by the supplier based on an analysis of the company's sales data. At the time of the purchase it was thought that a forecasting system was needed "to do the job properly", as one logistics manager explained. Before this, individuals had made their own forecasts, often using a ruler to fit a line to paper copies of sales graphs. The system was chosen by a group of middle managers over two alternatives (including an Enterprise Resource Planning (ERP) system) with a 9 to 1 vote in its favour. The choice was primarily driven by the perceived 'user-friendliness' of the system and the marketing and sales people commented that they particularly liked the ease with which the forecasts could be changed to reflect managerial judgment. Interestingly, the marketing and sales staff took a keen interest in the forecasts for their products, which contrasted with the attitude of staff in some other companies visited by the research team. In these other companies sales personnel apparently saw their objectives as maintaining customer relationships and making deals and, in consequence, had little interest in numbers, forecasts and computer systems.

The system was now perceived as being "fairly extensively used" [in the words of one logistics manager] in producing forecasts. Its use was regarded as a big improvement on the previous approach and managers felt that forecasting accuracy had also improved –though no empirical data existed to support this. The system was regarded as "the best available" [this quote is from the same logistics manager] and, while some users had complaints about particular facilities, most were generally satisfied with it. Its perceived central role in the forecasting process was never questioned and no one, in the meetings we had with participants, suggested switching to an alternative system or making other fundamental changes to the existing forecasting process.

How the system was used

Forecasts of demand were needed looking forward two months, reflecting the production planning requirements of the company's manufacturers. In *theory*, the derivation of the forecasts involved two main stages. First, a logistics manager cleaned the sales history to remove the effects of stockouts (these are known from data on orders) so that the series represented the level of demand. They then used the system to produce the 'base-line' forecasts. These are forecasts which take no account of market intelligence (MI) and are simply based on an extrapolation of past demand patterns. Secondly, these base forecasts were presented at a forecast review meeting where they were judgmentally adjusted for MI to produce the final forecast. As we will show, the actual practice of producing the forecasts involved some blurring of these stages. MI was sometime used in setting the baseline forecasts at stage 1, while recent past patterns in the demand were sometimes used as a reason for adjustment at review meetings rather than MI.

A particular difficulty in producing accurate forecasts arose because of the effects of cross border trade (CBT) where customers buy the company's products from overseas subsidiaries, usually at a lower price. This resulted in many unforeseen fluctuations in the demand data that were used when producing the forecasts. The degree to which CBT had impacted on the most recent observations was also difficult to ascertain as it took time to obtain information on the level of this activity. Apart from CBT, there were many other uncertainties in the market, such as the outcomes of tenders, competitors' actions and consumers' behaviour. For example, with animal medicines, farmers may switch brands when the drug ceases to be effective because bacteria have become resistant to its effects.

Stage 1 Obtaining the baseline forecasts

The patterns of the demand history varied according to the product types. However, the forecasters explained that most products had a life cycle which caused their underlying trend to have a non-linear shape (see fig 1). In the early years of a product's life it took time for demand to build up as doctors needed to be persuaded to prescribe the drug. Following this, the product experienced a mature phase of demand, before finally losing its patent protection. This caused sales to decline as generic products were marketed at a lower price.

Insert figure 1 about here

Despite the existence of the product life cycle, the statistical methods embedded in the system were designed to extrapolate linear trends. One forecaster explained that, to try to adapt the system's automatic extrapolations so that they matched the perceived life-cycle pattern, they proceeded as follows.

a) They selected an 'appropriate' length of demand history, for a given product so that the system generated a trend line that gave the best fit to the selected data, using the least squares criterion. Usually, two year's of past data were used, but it could be much less (e.g. six months) and by manipulating the length of the demand history, a more acceptable trend line could often be obtained. The two-month ahead forecasts were then calculated from an extrapolation of this trend line.

b) To further improve the apparent fit of the trend line to the past data and also to obtain forecasts that "looked right", the forecasters often used their judgment to override the forecasts obtained in (a). This could be simply achieved by using a mouse to reposition the the trend line on the graph. Thus the forecasters were ostensibly trying to model the non-linear trends resulting from the perceived product life-cycle by fitting and adjusting linear trends to relatively short sequences of past data. (We will discuss later whether the perception, that linear extrapolations were inadequate for short-term forecasts, was correct or, indeed, whether this was merely a pretext for intervention.)

Stage 2 Incorporating the effects of market intelligence (MI)

The system's displays of the forecasts resulting from Stage 1 were presented on a large screen at one of 17 monthly product group review meetings. As mentioned above, the main purpose of these meetings was officially to allow the forecast to take into account market intelligence (MI). The attendees at the forecast review meetings were the relevant product manager, whose role was to adjust the forecast for MI, the relevant forecaster, who might challenge these adjustments, and representatives of the market research, finance and commercial functions. One of the logistics managers said "years ago we [Logistics] owned the [forecasting] process; [Marketing] owned the forecasts". Since then, senior management had insisted that all parties at the review meetings had to jointly own and agree the forecasts.

The review meetings that were observed differed in character. For example, the first meeting concerned forecasts for animal products. Here, the forecasts that were agreed were based almost exclusively on the product manager's intimate knowledge of his market. These were never challenged. A meeting to forecast the demand for a human medicine had a number of contrasting characteristics. In particular, there was great emphasis on very recent demand history. As stated earlier, the forecast initially presented usually were based on, at most, two year's past data because "further back the trends tend to be different" [Quote from a Logistics Manager]. The appropriateness of this forecast was then assessed in a forensic discussion of very recent demand patterns, with particular emphasis on the last three months. An explanation was sought for every movement in the graph over these months, though reasons for these movements were usually unknown or highly speculative (e.g. "Why was October low and November high?" Answer: "…November is normally part of the wholesaler's build …. We always do better in November. Having said that we didn't last year, did we?") [Quotes are taken directly from tape recordings of the meeting].

The actual forecasting process can thus be summarised as:

Automatic statistical baseline forecast

→ Replacement with judgmentally derived baseline forecast

→ Further judgmental adjustment at Review Meeting to obtain final forecast.

The accuracy of the judgemental interventions

To investigate the effect of the judgmental interventions on forecast accuracy we carried out an analysis of a sample of 3264 forecasts that were supplied by the company. Because managers had kept no record of the original automatic statistical baseline forecasts that would have been generated by their system and because we had restricted access to this software we simulated these forecasts by applying the *Forecast Pro* forecasting system (Stellwagen & Goodrich, 1994), in automatic mode to 24 consecutive months of past demand data. We are confident that our simulated forecasts provided accurate estimates of the automatic statistical baseline forecasts as they are based on a similar algorithm. However, because only 24 months of past data was made available to us, we may have underestimated the system's ability to produce accurate baseline forecasts.

First, what was the effect of replacing the system's automatic statistical baseline forecasts with judgmental baseline forecasts? Clearly, it is not possible to answer this question for baseline forecasts that were subsequently adjusted for market intelligence. We cannot tell whether a different baseline would have resulted in a different adjustment. However, 47.7% of the baseline forecasts were left unadjusted when MI was considered. For *these* forecasts, the company's judgmental baseline forecasts were, on average, slightly less accurate than those automatically supplied, despite the extra effort entailed in producing them - their median absolute percentage error (MdAPE) was 12.0%, while the MdAPE for the automatic forecasts was 11.7%. Thus it appears that the cost of ignoring the system's recommendations was primarily one of wasted management effort and time rather than serious damage to forecasting accuracy.

62.3% of all of the baseline forecasts were themselves judgmentally adjusted, ostensibly for MI. Did *these* adjustments lead to improved accuracy? Analysis of the sample indicated that moderate improvements were sometimes achieved: the MdAPE of the baseline forecasts was 17.3%, while that of the adjusted forecasts was 14.3%. However, only 51.3% of forecasts were improved through MI adjustment and the most successful adjustments tended to be larger. Less than 45% of the smallest adjustments (below the first quartile) improved accuracy while over 58% of the largest adjustments (above the third quartile) resulted in improvements. The size of the adjustment is a measure of the strength of the market intelligence possessed by the members of the review meeting. It seems therefore that only when the proposed adjustment is substantial is the effort of making the judgmental adjustment worthwhile.

Summary: The Organisation's Forecasting Process

How did managers perceive the quality of their forecasting process? The perception of one of the logistics managers was that they were "good on reporting error levels, but not good on using the data that they have to improve forecast accuracy" (e.g. stock level data that were available for some customers were not used). In particular, this manager thought that there was potential for improving their ability to learn from past forecast errors. However, managers saw little need for fundamental changes in their process or in their use of the statistical system that they had purchased.

EXPLAINING THE USE OF THE SYSTEM FROM AN INDIVIDUAL PSYCHOLOGICAL PERSPECTIVE

The statistical forecasting system used in this company is designed to filter out the random noise that is associated with demand time series in order to identify the underlying systematic patterns so that this could be extrapolated into the future. However, the managers exhibited an intolerance of randomness and, consistent with Dawes (1979), they appeared to believe that almost every movement in their graphs had a predictable cause. As Kaplan, Reneau, and Whitecotton (2001) have suggested, the inevitable errors of the forecasts automatically produced by the system will have served to diminish its value in the eyes of the managers. This tendency to see causes and explanations for random changes was apparently exacerbated when individual managers were regarded as experts in the factors that underlay the behaviour of a time series. For example, it was clearly difficult for a marketing manager to admit he they could not account for all of the month-to-month increases or decreases in the demand for a product, even though many of these movements were probably inherently unpredictable. In addition, in seeking to explain these movements, hindsight bias (Fischhoff, 1975) is likely to increase the belief that the random movements could have been predicted.

As we have indicated, the facility in the forecasting system that allowed the judgmental manipulation of the base-line forecasts using a mouse was highly regarded by the forecasters and, consistent with studies on participatory design, was a major factor in the acceptability of the system. However, as we discussed earlier, such participation is associated with an illusion of control which would further enhance belief in the predictability of demand.

In this company the devaluing of the automatic forecasts was exacerbated by the fact that some of the movements in the time series, which a statistical method will discount as noise, could be foreseen, at least in part. These movements were caused by special events for which there may have been little or no past data, thereby precluding statistical estimation. In these circumstances, the human forecaster, who is aware of the impending event, will usually improve on the statistical forecast by intervening (Goodwin & Fildes, 1999). However, the observable deficiency of the statistical forecast on these occasions apparently contaminated belief in the automatic forecasts on other occasions, when its errors were genuinely unpredictable (Goodwin & Fildes, 1999).

This belief that all or much of the variation in time series is explainable appeared to have another important effect. While a statistical method will usually characterise a time series as having a relatively simple systematic pattern overlaid with noise, the managers seemed to perceive the series as a set of individually explainable outcomes. This is associated with a propensity to use epistemic logic (where the focus is on the underlying causes of an *individual* event) rather than aleatoric logic (where the focus is on the *set* of observations and element specific information is ignored (Beach, Christensen-Szalanaski, & Barnes, 1987)). This emphasis on case-specific information meant that 'base-rate' information, like long term trends, was underweighted (Tversky & Kahneman, 1974; Hoch & Schkade, 1996). It also meant that the forecasters' interest was usually confined to recent observations which were perceived as being the result of current ongoing or recently concluded events. Their attempts to get the statistical forecasts to provide as close a fit as possible to the few recent observations was symptomatic of this. In any case, recalling the many events and circumstances that were perceived to have shaped the past history would have put too great a load on memory so there was a natural bias towards recency. Against this background, the automatic forecasts of a statistical time series method were bound to be regarded with scepticism. The focus on recent patterns and individual outcomes meant that the system's ability to detect longer term systematic underlying movements was grossly undervalued.

The psychological literature on accepting advice also provides insights into why the automatic statistical forecasts were often changed. Research by Yaniv and Kleinberger (2000) suggests that people are more likely to trust their own beliefs, rather than the advice because they have greater access to the rationale for these beliefs. The statistical forecasting system did not provide an explanation for its forecasts and the advice it provided was therefore mute and unsupported.

EXPLAINING THE SYSTEM USE FROM AN ACTOR-NETWORK PERSPECTIVE

The individual cognitive perspective that we have just adopted does not provide a complete explanation for the way that the forecasting system was used. For example, why were managers apparently happy with a system that was unable to explain movements in time series that they judged to be largely predictable and which produced only linear extrapolations when they perceived the underlying trends in demand to be non-linear? Also, there were pressures in the organisation to improve forecast accuracy, through for example the Six Sigma initiative, so why were the fundamental aspects of the forecasting process and the way the system was used never questioned? In this section we seek to use actor network theory to explain these apparent paradoxes.

In seeking to identify the actor network which had created the forecasting process we chose to distinguish between stakeholders (those who have an interest in the process) and actors. Actors not only have an interest in the process, they also have to have the ability to influence the process "to bend space around themselves" (Sidorova & Sarka, 2002). Table 1 lists the actors we identified.

** Please insert Table 1 about here**

.

We then set about classifying the interests of the actors that had become apparent during our field work, using a method suggested by Vidgen and McMaster (1996). This method is based on Mitroff and Linstone's (1993) multiple perspectives approach and considers interests from three perspectives: rational, organisational and personal. The rational perspective is concerned with a scientific world view and considers actors' interests from a viewpoint which is objective, logical and rational. The organisational perspective considers interests from the perspective of 'social entities, politics and the establishment of shared understandings'. Finally, the personal perspective focuses on individual factors 'such as power, influence, prestige, learning, values and experience'. Vidgen and McMaster argue that no single perspective will, by itself, be sufficient to gain insights into complex situations. Table 1 shows our interpretation of the actors' interests using this structure.

For the purpose of understanding the networked forces that create stability, it is useful to start with the perspective of a single actor who has an interest in changing the status quo. This actor will be referred to as the 'focal actor' and we will aim to show how other actors' alignment with the focal actor's interests leads to the formation of the network (Sidorova & Sarka, 2002) through a process of enrolment. In our case, we will designate the software vendor as the focal actor, though we could have taken the perspective of another actor as our starting point and we would still have derived the same rationale for the formation of the network.

The vendor is interested in obtaining sales of the system. This interest is served by advertising the accuracy and sophistication of the system's inbuilt statistical methods and its facilities for incorporating judgmental intervention, together with the system's ease of use (evidence for the highlighting of these attributes can be found on the software company's web site). The vendor will also want to maximise the profit on the sale. This will be achieved by selling a system containing a *standard* (rather than a customised) set of statistical forecasting methods in order to spread the system's development costs. In the words of one software developer: "We live in a commercial reality, you see, and the customer will come along and say I would like something [a new facility] and you say I can't do this unless you co-fund the development" [this quote has been slightly re-worded to improve clarity]. Inscription of the system with easy-to-use facilities for judgmental intervention will thus serve the vendor's interests in a second way because it will effectively place the costs of any local adaptation (or customisation) of the *forecasts* upon the user. This will also reduce the chances of the system being blamed for forecast errors, so ensuring continued use. Continued use is in the vendor's interests because users will pay for the maintenance of the system and will attend user conferences and purchase upgrades. Also, the existence of an active body of existing users is likely to attract new customers.

However, the provision of an easy-to-use facility for judgmental intervention is also in the interests of the company's middle managers. They can be seen to be using an advanced system containing reportedly sophisticated and accurate statistical methods, while at the same time being able easily to control the forecasts. The existence of these facilities for intervention has been particularly useful in the enrolment of the product managers whose participation in forecasting is seen as crucial because of their market intelligence. It allows them to derive prestige by demonstrating their expertise on their markets at forecast review meetings and gives them the opportunity of attempting to push the forecasts in directions that suit the balance of their interests. For example, one product manager, commenting on the system, said: "It's there, it's useful, but it needs to be managed since no way can it have the market intelligence".

The fact that system produces linear extrapolations, when the managers perceive the underlying trends to be non-linear, is paradoxically a factor assists in securing its acceptance. It provides a pretext for interventions, allowing users to make adjustments for other reasons. To maintain their own standing, the logistics managers need to produce baseline forecasts which look credible at review meetings where colleagues have an intolerance of noise in the time series. To achieve this they can use the intervention facilities to fit and refit past trends to different lengths of past history until a close fitting trend is achieved. One logistics manager described the system as being "quite good" because it allowed the graphical fit of the trend line to be easily assessed as judgmental changes were made to it and the length of the demand history.

It is in senior managers' interests to receive timely forecasts that they perceive to be from an advanced, modern forecasting process yielding baseline forecasts that are as accurate as possible, given current technology. It is also in their interests to ensure the inclusion of all relevant middle managers in the process. The system serves these interests because, when coupled with a projector, it produces graphical and tabular displays that can be used in review meetings involving groups of managers and allows forecasts to be easily and publicly changed during these meetings. The old 'ruler and paper' system would not be compatible with such meetings. Senior Managers also want to be able to exercise some control and monitoring of this process. From their perspective the system also has a facility which allows for adjustment for market intelligence (in computing terms this is actually no different from the baseline adjustment) and, by requiring documentation of these adjustments, they perceive that control over the process can be exercised. Also, in relation to total turnover, the cost of the system was small (though it was large enough to be regarded as a serious tool).

How stable is the actor-network? Any proposal to replace the existing system with an alternative would probably be resisted by all of the actors. To the middle managers it would involve the risk of losing the benefits of control over the forecasts, disruption and (in the case of the logistics managers) the need to learn a new system. For the senior managers changing to another system would involve purchasing and other costs, disruption and probably resistance from middle managers. All of this has served to consolidate the alignment of interests of the vendor and middle and senior managers and helped to ensure the irreversibility of the network. Although managers indicated that they felt their forecast's accuracy could be improved (this was part of their main motive for inviting us into the company) they evidently wished to make these improvements within the existing structure. A suggestion by one the researchers at the end of the interviews that the company might be using an inappropriate system, and that what was needed was a model that supported extrapolations based on product life cycles, was received sceptically. It was apparent that the company would like to find ways of making better use of available information in order to improve the quality of their judgmental interventions, but the role of the forecasting system would remain unchanged.

DISCUSSION AND CONCLUSIONS

From the technological imperative perspective, where people make rational economic decisions and make optimal use of appropriate technology, the forecasting process in this company is inexplicable. However, by adopting the complementary perspectives of individual forecasters' cognitive processes and actor-network theory, where actors form alliances of interests, the decision to purchase the system and then continue to heavily rely on judgment becomes understandable.

Of course, as outsiders, we may never be able to gain a complete understanding of an organization like this and the behaviour of its members. For example, our presence at review meetings, where we may have been regarded as forecasting experts, may have influenced the processes that took place, despite our attempts to act only as silent, non-judgmental observers. As far as possible, we tried to implement the 'principle of suspicion' in case people were simply presenting an 'official company view' or a view that was designed to impress us (Klein &

Myers, 1999). We were helped in this by the presence of the placement student. As a relative outsider, who had nevertheless already worked in the company for nine months, he was able to provide an alternative perspective during his interview. Nevertheless, Myers (1997) has argued that no final interpretation is ever achieved, since each interpretation may itself be subject to critical reflection.

Venkatesh, Morris, Davis, and Davis (2003) argue that the acceptance of information technology depends on the potential user's *perception* that: i) the technology will bring demonstrable gains in job performance, ii) the system will be easy to use and iii) 'important others' believe that the system should be used. In this company these three conditions were clearly met, but the acceptance of the system was only achieved because managers used the system in a way which did not accord with its design and advertised purpose.

Unusually, the research has focussed on the on-going operation of an IS, the individual psychological reasons for sub-optimal (economic) use and why these patterns of behaviour have persisted. This research poses a stark question to those seeking to improve the quality of forecasting in supply-chain companies: how can individual cognitive biases *and* the organisational and personal barriers embodied in actor-networks like this be overcome to achieve more efficient forecasts? No elements of the established network facilitate process improvement or provide an incentive for individuals to change their mental models of the forecasting task. Instead, the research shows that change can only occur through external interventions such as the company wide 6-sigma project or the introduction of researchers such as us, analysing forecast errors and the processes and software from which they derive. The vested interests that many actors have in continuing to make heavy use of judgmental interventions, despite their limitations, makes improvements hard to achieve.

REFERENCES

Akrich, M. (1992).The description of technical objects. In W.E. Bijker & J. Law (Eds), *Shaping Technology/Building Society*, Boston: MIT Press, 205-234.

Alexander, P.M. (2004). *Towards reconstructing meaning when text is communicated electronically*. Doctoral dissertation, University of Pretoria, South Africa.

Auer, T. (1998). Quality of IS use. *European Journal of Information Systems,* 7, 192-201.

Bagchi, S., Kanungo, S., & Dasgupta, S. (2003). Modeling use of enterprise resource planning systems: a path analytic study. *European Journal of Information Systems,* 12, 142-158.

Barley, S. (1986). Technology as an occasion for structuring: evidence from observation of CT scanners and the social order of radiology departments. *Administrative Science Quarterly,* 31, 78-108.

Beach, L.R., Christensen-Szalanaski, J., & Barnes, V. (1987). Assessing human judgment: has it been done, can it be done, should it be done? In G. Wright & P. Ayton (Eds.), *Judgmental Forecasting,* Chichester: Wiley, 49-62.

Benbasat, I., Goldstein, D.K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly,* 11, 369-386.

Berg, M. (1998). The politics of technology: on bringing social theory into technological design. *Science, Technology and Human Values,* 23, 456-490.

Callon, M .(1991). Techno-economic networks and irreversibility. In J. Law (Ed.) *A Sociology of Monsters: Essays on Power, Technology and Domination*. London: Routledge, 132-161.

Dalrymple, D.J. (1987). Sales forecasting practices, results from a United States survey. *International Journal of Forecasting,* 3, 379-391.

Davis, G.B., Lee, A.S., Nickles, K.R., Chatterjee, S., Harthung, R., & Wu, Y. (1992). Diagnosis of an information systems failure. A framework and interpretive process. *Information and Management,* 23, 293-318.

Davis, F.D., & Kottemann, J.E. (1994). User perceptions of decision-support effectiveness - 2 production planning experiments. *Decision Sciences*, 25, 57-78.

Dawes, R.M. (1979). Robust beauty of improper linear-models in decision-making. *American Psychologist,* 34, 571-582.

Easterby-Smith, M., Thorpe, R., & Lowe, A. (2002). *Management Research,* London: Sage Publications.

Falk, R., & Konold, C. (1997). Making sense of randomness: implicit encoding as a basis for judgment, *Psychological Review*, 104, 301-318.

Fildes, R., Goodwin, P., & Lawrence, M. (2006). The design of forecasting support systems and their effectiveness. *Decision Support Systems*, 42. 351-361.

Fildes, R., & Hastings, R. (1994). The organisation and improvement of market forecasting. *Journal of the Operational Research Society*, 45, 1-16.

Fischhoff, B. (1975). Hindsight not equal to foresight. Effect of outcome knowledge on judgment under uncertainty, *Journal of Experimental Psychology –Human Perception and Performance,* 1, 288-299.

Galbraith, C.S. & Merrill, G.B. (1996). The politics of forecasting: Managing the truth, *California Management Review,* 38, 29-43.

Goodwin, P. (2002). Integrating management judgment with statistical methods to improve short-term forecasts. *Omega, International Journal of Management Science*, 30, 127-135.

Goodwin, P., & Fildes, R. (1999). Judgmental forecasts of time series affected by special events: Does providing a statistical forecast improve accuracy? *Journal of Behavioral Decision Making*, 12, 37-53.

Hanseth, O.(2004). Actor-network theory and information systems: what's so special? *Information Technology and People*, 17, 116-123.

Hanseth,O., & Braa, K. (2000). Who's in control: designers, managers or technology? Infrastructures at Norsk Hydro. In C.U. Ciborra and associates (Eds.), *From Control to Drift*. Oxford: Oxford University Press, 125-147.

Hoch, S. J., & Schkade, D.A. (1996). A psychological approach to decision support systems. *Management Science,* 42**,** 51-64.

Kanter, R.M. (1977). *Men and Women of the Corporation*. New York Basic Books.

Kaplan, S.E., Reneau J.H., & Whitecotton, S. (2001). The effects of predictive ability information, locus of control, and decision maker involvement on decision aid reliance. *Journal of Behavioral Decision Making*, 14, 35-50.

Klassen, RD., & Flores, B.E. (2001). Forecasting practices of Canadian firms: survey results and comparisons. *International Journal of Production Economics*,70, 163-174.

Kleinmuntz, B. (1990). Why we still use our heads instead of formulas - toward an integrative approach. *Psychological Bulletin*, 107, 296-310.

Klein, H.K., & Myers, M.D. (1999). A set of principles for conducting an evaluating interpretive field studies in information systems. *MIS Quarterly*, 23, 67-94.

Latour, B. (1987). *Science in Action*. Cambridge, MA: Harvard University Press.

Latour, B. (2005). *Reassembling the Social: An introduction to Actor Network Theory.* Oxford: Oxford University Press.

Lawrence, M., Goodwin, P., & Fildes, R. (2002). Influence of user participation on DSS use and decision accuracy. *Omega, International Journal of Management Science*, 30, 381-392.

Mady, M.T. (2000). Sales forecasting practices of Egyptian public enterprises: survey evidence. *International Journal of Forecasting,* 6, 359-368.

McGovern, T., & Hicks, C. How political processes shaped the IT adopted by a small make-to-order company: a case study in the insulated wire and cable industry. *Information and Management*, 42, 243-257.

Makridakis, S., Wheelwright, S.C., & Hyndman, R.J. (1998). *Forecasting. Methods and Applications (*3rd ed.). Chichester: Wiley.

McGrath, K. (2002). The Golden Circle: a way of arguing and acting about technology in the London Ambulance Service. *European Journal of Information Systems*, 11, 251-266.

Mitroff, I., & Linstone, H. (1993). *The Unbounded Mind. Breaking the Chains of Traditional Business Thinking*. New York: Oxford University Press..

Monteiro, E. (2000). Actor network theory and information infrastructure. In C.U. Ciborra and associates (Eds.), *From Control to Drift*. Oxford: Oxford University Press, 71-83.

Myers, M.D. (1997). Critical ethnography in information systems. In A. S. Lee, J.A. Liebenau, & J.I. Degross (Eds.). *I.S. and Qualitative Research*. London: Chapman & Hall, 277-300.

Nandhakumar, J., & Jones, M. (1997). Too close for comfort? Distance and engagement in interpretive information systems research. *Information Systems Journal*, 7, 109-131.

Nardulli, P.F. (1978). *The Courtroom Elite: An Organizational Perspective on Criminal Justice*. Cambridge, MA: Ballinger Press.

Orlikowsi, W.J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organizational Science*, 11, 404-428.

Orlikowsi, W.J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11, 404-428.

O'Connor, M., Remus, W., & Griggs, K. (1993). Judgemental forecasting in times of change. *International Journal of Forecasting*, 9, 163-172.

Payne, J.W., Bettman, J.R., & Johnson. E.J. (1993). *The adaptive decision maker*. Cambridge: Cambridge University Press.

Rose, J., & Jones, M. (2005). The double dance of agency: A socio-theoretic account of how machines and humans interact. *Systems, Signs and Actions*, 1, 19-37.

Sanders, N.R., & Ritzman, L.P. (2001). Judgmental adjustment of statistical forecasts. In. J.S. Armstrong (Ed.). *Principles of Forecasting*. Norwell:MA: Kluwer Academic Publishers, 405-416.

Sanders, N.R., & Manrodt, K. B. (1994). Forecasting practices in US Corporations: Survey results. *Interfaces*, 24, 92-100.

Siegrist, M., Cvetkovich, G.T., & Gutscher, H. (2001). Shared values, social trust and the perception of geographic cancer clusters. *Risk Analysis*, 21, 1047-1053.

Stellwagen, E.A., & Goodrich, R.L., (1994). *Forecast Pro for Windows*. Belmont, MA.

Business Forecast Systems Inc.

Sidorova, A., & Sarker, S. (2002). *Unearthing Some Causes of BPR Failure: An Actor network Theory Perspective*. School of Accounting, Information Systems and Business Law, Washington State University.

Siegel, J., Dubrovsky, V., Kierler, S., & McGuire, T.W, (1986). Group processes in computer-mediated communication. *Organizational Behavior and Human Decision Processes*, 37, 157-187.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: heuristics and biases. *Science*, 185, 1124-1131.

Venkatesh, V., & Davis, F.D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46, 186-204.

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. (2003). User acceptance of information technology: towards a unified view. *MIS Quarterly*, 27, 425-478.

Vidgen, R., & McMaster, T. (1996). Black boxes, non-human stakeholders and the translation of IT though mediation. In W. Orlikowski, G. Walsham, M.R. Jones & J.I. DeGross (Eds.). *Information Technology and Changes in Organizational Work*. London: Chapman and Hall, 250-270.

Walsham, G. (1995). Interpretive case-studies in research - nature and method. *European Journal of Information Systems*, 4, 74-81.

Walsham, G. (1997). Actor-network theory and IS research: Current status and future prospects. In A.S. Lee, J. Liebenau &.I. DeGross (Eds.). *Information Systems and Qualitative Research* London: Chapman and Hall, 466-480.

Walsham, G., & Sahay, S. (1999). GIS for district-level administration in India: Problems and opportunities. *MIS Quarterly*, 23, 39-66.

Yaniv I., & Kleinberger E. (2000). Advice taking in decision making: Egocentric discounting and reputation formation. *Organizational Behavior And Human Decision Processes*, 83,: 260-281.

Zackariasson, P., & Wilson, T. (2004). Internetworked after-sales service. *Industrial Marketing Management*, 33, 75-86.

Table 1: An Analysis of the Actors' Interests

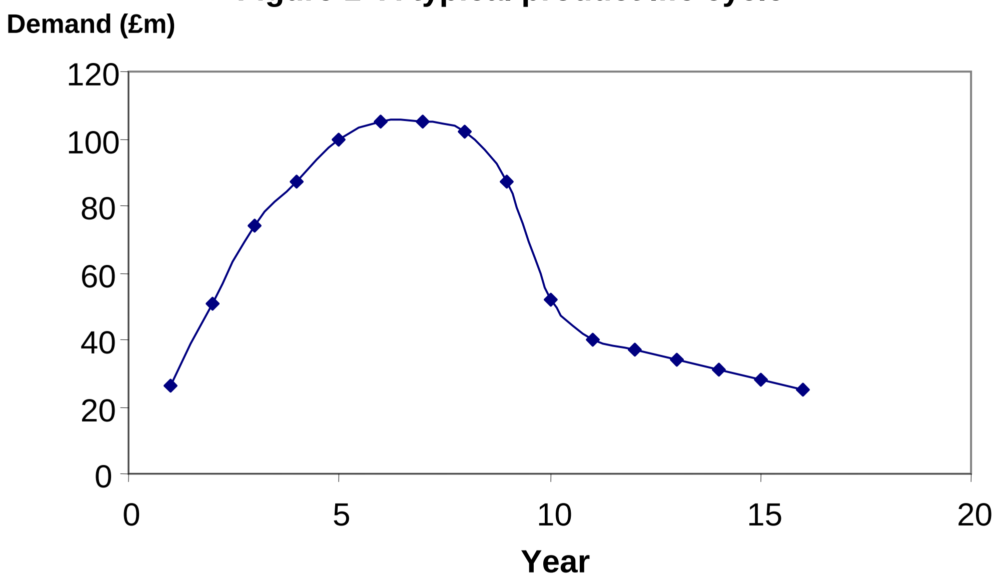
	Interests		
Actors	**Rational**	**Organisational**	**Individual**
Senior managers*	Ensure forecasts are received which are useful for monitoring business and supporting plans and decisions i.e. forecasts which are accurate, timely, cost-effective and complete. Ensure forecasts minimise chances of stockouts without excessive safety stocks Balance purchase cost of software and associated training costs with benefits	Exercise control over forecasting process. Ensure forecasting are seen to be using 'modern' methods. Ensure all relevant people are involved in forecasting. Minimise chances of conflict between middle managers. Retain existing software to avoid disruption through change	
Marketing & Product managers	Achieve high sales and high quality of service to customers - minimise chances of stock outs	Ensure forecasts are high enough to minimise chances of stockouts. Maintain some control over forecasts. Understand limitations of baseline forecasts	Demonstrate expertise relating to product. Maximise sales commission Maintain good personal relationships with customers. Make sure forecasts are not too high as they will look good if they exceed forecasts. Adjust forecasts without documentation of rationale. Avoid being seen to manipulate forecasts in one's own interests. Avoid large forecast errors - given joint responsibility. Be associated with introduction of system that will impress senior managers.
Accountants	Minimise costs resulting from forecast errors Minimise inventory costs	Counter Product Managers when they push for higher forecasts & more safety stocks, but still minimise chances of stockout. Have some control over forecasts	Avoid large forecast errors -given joint responsibility

Continued/

Table 1: An Analysis of the Actors' Interests (continued)

Actors	Interests Rational	Organisational	Individual
Logistics managers who produce 'baseline forecasts	Produce accurate forecasts	Counter conflicting tendencies of Product managers and accountants for over and under forecasting. Be seen to be making forecast in professional manner by using an advanced software system. Keep Product Managers on board as their MI is crucial for forecast accuracy.	Share responsibility for significant forecast errors. Minimise work involved in producing base line forecasts by having easy to use software. Maintain image of competence by producing 'baseline' forecasts that look intuitively reasonable at review meetings. Avoid significant conflict at review meetings. Demonstrate expertise in use of software. Maintain control over forecasts given responsibility. Minimise documentation of forecasts' rationale. .Stay with current system to minimise changeover costs and effort. Be associated with a system that will impress senior managers.
Software vendors*	Maximise profit derived from sales and support of forecasting software, Employ robust forecasting methods capable of widespread use across many companies and industries -rather than industry specific methods. Maintain loyalty of customers through user conferences	Advertise accuracy and sophistication of software's statistical methods but provide facilities for judgmental overrides. Ensure that software is easy to use. Allow easy use by non-forecasting experts. Ensure continued customer loyalty. Minimise costs of writing and providing software	Maximise sales. Avoid responsibility for any forecast inaccuracy
The software*	Maximise reputation and number of users	Ensure continued use. Maximise user satisfaction and ease of use. Provide displays capable of being used in meetings. Maximise analytical power and flexiblity of software. Outshine rivals	

Figure 1 A typical product life cycle



University of Bath School of Management
Working Paper Series

School of Management
Claverton Down
Bath
BA2 7AY
United Kingdom
Tel: +44 1225 826742
Fax: +44 1225 826473
http://www.bath.ac.uk/management/research/papers.htm

2006		
2006.01	Neil Allan and Louise Beer	Strategic Risk: It's all in your head
2006.02	Richard Fairchild	Does Auditor Retention increase Managerial Fraud? - The Effects of Auditor Ability and Auditor Empathy.
2006.03	Richard Fairchild	Patents and innovation - the effect of monopoly protection, competitive spillovers and sympathetic collaboration.
2006.04	Paul A. Grout and Anna Zalewska	Profitability Measures and Competition Law
2006.05	Steven McGuire	The United States, Japan and the Aerospace Industry: technological change in the shaping of a political relationship
2006.06	Richard Fairchild & Yiyuan Mai	The Strength of the Legal System, Empathetic Cooperation, and the Optimality of Strong or Weak Venture Capital Contracts
2006.07	Susanna Xin Xu, Joe Nandhakumar and Christine Harland	Enacting E-relations with Ancient Chinese Military Stratagems
2006.08	Gastón Fornés and Guillermo Cardoza	Spanish companies in Latin America: a winding road
2006.09	Paul Goodwin, Robert Fildes, Michael Lawrence and Konstantinos Nikolopoulos	The process of using a forecasting support system

2006.10	Jing-Lin Duanmu	An Integrated Approach to Ownership Choices of MNEs in China: A Case Study of Wuxi 1978-2004
2006.11	J.Robert Branston and James R. Wilson	Transmitting Democracy: A Strategic Failure Analysis of Broadcasting and the BBC
2006.12	Louise Knight & Annie Pye	Multiple Meanings of 'Network': some implications for interorganizational theory and research practice
2006.13	Svenja Tams	Self-directed Social Learning: The Role of Individual Differences
2006.14	Svenja Tams	Constructing Self-Efficacy at Work: A Person-Centered Perspective
2006.15	Robert Heath, David Brandt & Agnes Nairn	Brand relationships: strengthened by emotion, weakened by attention
2006.16	Yoonhee Tina Chang	Role of Non-Performing Loans (NPLs) and Capital Adequacy in Banking Structure and Competition
2006.17	Fotios Pasiouras	Estimating the technical and scale efficiency of Greek commercial banks: the impact of credit risk, off-balance sheet activities, and international operations
2006.18	Eleanor Lohr	Establishing the validity and legitimacy of love as a living standard of judgment through researching the relation of being and doing in the inquiry, 'How can love improve my practice?'
2006.19	Fotios Pasiouras, Chrysovalantis Gaganis & Constantin Zopounidis	Regulations, supervision approaches and acquisition likelihood in the Asian banking industry
2006.20	Robert Fildes, Paul Goodwin, Michael Lawrence & Kostas Nikolopoulos	Producing more efficient demand forecasts