AN EXPLORATORY INVESTIGATION INTO THE IMPACT OF INFORMATION QUALITY UPON THE PERCEIVED VALUE OF INFORMATION

Graham DOIG,
The Business School, Loughborough University, UK & Microsoft Ltd.
Tel: + 44 (0) 118 909 3053
doigg2000@hotmail.com

Neil F. DOHERTY,
The Business School, Loughborough University, UK;
Tel: +44 (0) 1509 223128
n.f.doherty@lboro.ac.uk

Chris G. MARPLES
The Business School, Loughborough University, UK;
Tel: +44 (0) 1509 223131
c.g.marples@lboro.ac.uk

Abstract: A key challenge for every organisation today is to recognise and unlock the value of its substantial collection of information resources and to utilise them for the maximum benefit of the organisation and its stakeholders. Improving the quality of information is potentially one of the most critical factors that can positively impact upon the perceived value of information within an organisation. The research presented in this paper seeks to provide a deeper understanding of the nature of the relationship between information quality and value. Based upon eight in-depth case studies, conducted at large UK-based, multinational companies, this report concludes that the accuracy, timeliness and consistency of information all have a direct impact upon its perceived value. The paper concludes by articulating some of the most important lessons that have been learned, as a result of this research project, about improving the quality of information.

1. INTRODUCTION

For information to be recognised as a valuable asset that makes a significant contribution to the success of the organisation it is important that the information provided within the organisation is of good quality. Most organisations are reliant upon information for running the business and for making important strategic decisions and for monitoring corporate performance. (Eccles, 1991; Goodman, 1993; Kaplan and Norton, 1996; Finlay 2000). With such an important role to play, the quality of the information being used is a critical factor in the long-term success of the organisation. If the information provided is inaccurate, inconsistent, or not provided in a timely manner then there is every likelihood that the managers of the organisation will make poor decisions or steer the firm in the wrong direction. (Crockett, 1992; Goodman, 1993). For these reasons it is essential that organisations have good quality information available for running the business, supporting the decision making processes, and for monitoring corporate performance. As O'Brien (2001) observed '*information that is outdated, inaccurate, or hard to understand*

would not be very meaningful, useful, or valuable … people want information of high quality, that is, information products whose characteristics, attributes, or qualities help to make the information more valuable to them'. If poor quality information is provided which results in poor decision making, it is very likely that there will be a negative opinion within the organisation on the perceived value of information.

Whilst a tremendous volume of literature has been produced regarding the quality of information, little work has been published which seeks to directly investigate the relationship between information quality and the perceived value of information. The following section reviews the relevant literature, before the research method is discussed in section three. The research results are presented in the fourth section and their importance is assessed in the final sections.

2 LITERATURE REVIEW AND RESEARCH OBJECTIVES

The aim of this section is to present a discussion of the literature with regard to the value of information and the way in which this is dependent upon its quality. In so doing, the motivations and academic justification for this research are established.

2.1 The Value of Information

'*Information is the lifeblood of the organisation*' (CBI, 1992). This powerful statement establishes a foundation for the argument, repeated over many years, that information provides value to the organisation (Porter and Millar, 1985; Glazer, 1991; Glazer, 1993; McPherson, 1994; Rayport & Sviokla, 1995; Hawley, 1995). A number of these opinions have gone as far as suggesting that information should be considered to be an asset and included on the corporate balance sheet. (Willard, 1993; McPherson, 1994). However, making bold statements of this nature is all well and good, but what basis do these statements have? What evidence exists to suggest that information does have value and why is information value important?

Over the years there have been clear indications that information does add value to the organisation. This has led to a number of researchers investigating the use of information within organisations and the value that the information adds. From this research it has become apparent that information can be perceived as valuable for the following reasons:

- information is a product in its own right (Porter and Millar, 1985; Davenport and Cronin, 1988; Mowshowitz, 1992; Rayport and Sviokla, 1995);
- information is incorporated into products to enhance their usability and value (Davenport and Cronin, 1988; Hopper, 1990; Goodman, 1993; Davies and Botkin, 1994);
- information is used for strategic purposes within the organisation (Porter and Millar, 1985; Hopper, 1990; Bowonder and Miyake, 1992; Kaplan and Norton, 1996);
- information supports the day to day operations of the business (Porter and Millar, 1985; Davenport and Cronin, 1988; Glazer, 1991; Bowonder and Miyake, 1992; Souchon and Diamantopoulos, 1996)

When considering the importance of information to all these types of activities Davenport (1993) argued that 'information is both an essential element without which they could not take place, and has the potential to confer value'.

However, it has also been identified that information has traditionally been treated as an overhead of the organisation that has to be managed as a cost rather than as an asset. (Strassmann, 1985; Willard, 1993, Orna, 1999). This perspective appears to contradict the view that information has value and can have a positive impact on corporate performance. But why should this be important, why should recognising information value be important? Most organisations invest in the assets and resources that they believe will assist them in being successful and gaining competitive advantage. (Grant, 1991; Collis and Montgomery, 1995;). The traditional view of information being an overhead has created a situation where many organisations are reluctant to invest in the resources that are required to develop information as an asset. On many occasions the activities of an organisation that are cutback when business is in decline are the information exploitation activities. If information really does provide substantial value to organisations then these cutbacks are a false economy. In identifying this situation Orna (1999) believed that 'if we can't find a way of putting information in the same framework as physical resources, they will not get serious sustained attention from decision makers and controllers of resources and they will not receive the investment they need for putting them to productive use'.

Recognising that information provides significant value to the organisation appears to be the major problem even although conventional wisdom clearly identifies that it does. The problem appears to be that this message does not register with senior management and decision makers. This problem is compounded further by the fact that in most organisations information resources appear to be under utilised. There is much more value that could be obtained if the appropriate actions were taken. As Rostick (1994) identified, 'today's invaluable corporate information asset lies like sediment at the bottom of an ocean'**.** Information value is important because recognition of this value is the catalyst for investments in information resources that lead to the utilisation of information as a strategic resource and the generation of substantial benefits. In most organisations today the value of information resources are not fully recognised by management. Many organisations are unaware of the full extent of their information resources, the information resources are under-utilised, and the additional value that could be obtained by utilising this information is being lost.

One of the most likely reasons for information not being perceived as valuable, as is discussed in the following section, is that far too often its quality is poor. Consequently, if the quality of information can be improved, then there is the potential for substantially enhancing the value of information being generated and utilised within the organisation.

2.2 The Information Quality Literature

Information quality can be measured by a wide variety of distinct dimensions. For example, Davenport et al (1992) identified integrity, accuracy, currency, interpretability and overall value as being key dimensions. Based upon the opinions of the users of data, Wang and Strong (1996) formulated a fifteen dimension framework of data quality that included accuracy, timeliness, completeness and representational consistency. As it is beyond the scope of this paper to review all the dimensions of information quality touched upon in the literature, the remainder of this section will focus upon the three dimensions ultimately utilised in this study. The justification for the selection of these three is discussed in the research method section.

1. **The accuracy of information:** Accuracy is generally acknowledged as one on the most critical dimensions of information quality (Klobas, 1995; Strong et al, 1997; Raghunathan,

1999; Alter, 1999. As defined by Alter (1999) it relates to 'the extent to which information represents what it is supposed to represent'. Having consistent information available at the right time is very important, however, if the information provided is not accurate then the value of the information will be questioned. For example, Goodman (1993) found that '*managers frequently plan, solve problems and make decisions based upon incomplete and sometimes inaccurate information*'. Similar problems were identified by McKinnon and Bruns (1992). They provided examples of managers ignoring information being provided because of the known inaccuracies. In one example 'entire columns of data were being dismissed because they had not been updated for six months'. A key focus area of the Hawley report (1995) was the accuracy of information. This report identified that there were widespread concerns about the quality of information in organisations. Of especial concern was its its accuracy and the extent to which it is misinterpreted or misunderstood because the source data is flawed or the information partial. A key recommendation produced by Hawley was, '*the organisation should review the information required at each stage of each process in its business to ensure that necessary and sufficient information is available as required for effective operation, and no more*'.

2. **The timeliness of information:** Another of the information quality dimensions that is regularly identified in the literature is timeliness (Strong et al, 1997; Alter, 1999; Maltz, 2000), which as Maltz (2000) defines is the dimension that 'refers to whether information is transmitted quickly enough to be utilized'. The importance of timely information being provided for measuring the performance of the organisation was discussed by both Eccles (1991), and Kaplan and Norton (1996). It was Kaplan and Norton who identified lack of timeliness in providing relevant information as being a constraint to effective performance measurement. Similar problems related to executive decision making were identified by Crockett (1992), and Souchon and Diamantopoulos (1996).

3. **The consistency of information:** Inconsistency of the information that is available is one of the most significant problems that business managers are confronted with. As a result of the haphazard ways that computer systems have been developed in most organisations over the last thirty years the source data that is available is often very inconsistent. As Goodman (1993) recognised when considering the plight of general managers 'their most fundamental challenges are sorting out the uncertain, diverse, and enormous amount of potentially relevant information'. These inconsistencies consist of multiple occurrences of the same data items and different values being maintained for these same data items, such as mis-spelt names, multiple codes being assigned to one entity, and inconsistent date values and formats. Multiple meanings for the same items of information is another common problem. As Wang and Strong (1996) identified 'a major manufacturing company found that it could not access all sales data for a single customer because many different customer numbers were assigned to represent the same customer'. Similar situations were identified by Lingle and Schiemann (1994), and Davenport (1994).

2.3 Summary of Literature and Research Objectives

There are potentially many factors that can influence the perceived value of information. It can be inferred from the review of the literature that information quality is one of the most critical of these. If information quality is generally regarded as being poor this will undoubtedly have a negative impact on the perceived value of information. This is because information quality

dimensions can have an immediate and significant impact on the perceptions that users of information develop, regarding its value. For example, if the information being provided fails to meet the expectations of the user in terms of its accuracy, timeliness and consistency, it is likely that the quality of the information will be regarded as being poor and the perceived value of the information will diminish. If this perception persists over a significant period of time then it is unlikely that information will be regarded as being a valuable asset, and the perception of information being a costly overhead providing little value will prevail. Whilst a strong causal logic can be derived between the quality of information and its perceived value, there is little previously published research, which explicitly tests this logic, has been identified. The aim therefore of this research is to '*investigate whether the perceived value of information is influenced by the quality of information provided to those who use it within an organisation*'.

3 RESEARCH DESIGN AND METHODS

The aim of this section is to review the overall research design, describe the targeting and execution of the case studies and then review data analysis strategy.

3.1 Research Design

Having established a clear research objective, it was necessary to choose an overall research approach that would be best suited to its exploration. Due to the lack of prior empirical research in this area, an exploratory research design was chosen, as '*it is appropriate to any problem about which little is known*' (Churchill, 1991: p 149). More specifically, it was envisaged that the research objective could best be explored by adopting a multiple case study approach, which has been defined as '*an empirical enquiry that investigates a contemporary phenomenon within its real life context*', which '*relies on multiple sources of evidence*' (Yin, 1994; p 13). Such an approach was considered ideal for studying the impact of the quality of information on its perceived value, *in situ*, within a variety of large and highly sophisticated commercial organisations. When addressing the question of information value, an obvious question is why choose a qualitative approach when a quantitative analysis might provide more immediately meaningful results. However, as Orna (1999), amongst others, has noted attributing value to information is '*a notoriously difficult subject, which economists have grappled with rather unsuccessfully for many years*'. Consequently, the adoption of a qualitative research design was considered to be more likely to provide useful results.

The detailed design of the research strategy was very strongly influence by the fact that one member of the research team was employed in the role of '*Principal Business Analyst*', for a large software firm. More specifically, he was responsible for the development and implementation of data warehouse systems, for a wide variety of commercial clients. In this position he had unrestricted access to a wide variety of relevant information and key personnel, within a variety of systems development projects, each of which would make a highly appropriate case study. Consequently, he was able to gain unique insights into this increasingly important phenomenon. The research approach adopted was, however, more akin to '*participant observation*', than '*action research*', as the aim of the study was to assess the whole of the organisational change process, involving numerous individuals, rather than to focus primarily on the role of the '*Principal Business Analyst*'.

To ensure that the data collection process was focused and structured, it was necessary at the project's outset to identify the dimensions of information quality that were to be investigated, in each case study. As noted in the review of the literature, there is a wide range of dimensions that

contribute towards information quality. This study focussed upon just three dimensions, namely accuracy, timeliness and consistency. These three dimensions were ultimately chosen as they were the ones most commonly being mentioned in the early, exploratory phases of this research project. Moreover, based upon the numbers of citations, it can be suggested that these are also considered to be the most important in the literature (e.g. Strong et al, 1997; Wang & Strong, 1996).

This research study set out to investigate the research question, presented in section 2.3, within the case study organisations, by considering whether the information provided was of good quality and whether this had a consequential impact upon the perception of information value.

3.2 Case Study Targeting and Execution

Over a five-year period the '*principal business analyst*' was employed on eight major systems development projects. In all cases, the aim the project was to develop and implement a large-scale data warehouse that would dramatically improve the quality and availability of information within the host organisation. Each project necessitated him being seconded to the project for a minimum of three months and spending much of his time working, *in situ*, at the client's site. Consequently, each of the case studies was chosen on the basis of convenience, rather than more objective criteria. However, as each of the case study organisations was a large, highly sophisticated, UK-based public limited company, they constituted a sufficiently homogeneous group to allow meaningful comparisons and contrasts to be made. More specifically the case study organisations were a clearing bank, a commercial bank, a retailer, a car manufacturer and four insurance companies that are labelled 'A' - 'D' in the remainder of the paper.

When conducting a case study, Darke et al (1998) suggests that data should be collected in a variety of ways, including '*formal interviews, questionnaires, observation, and document analysis*', so that the findings can be triangulated. In the context of this study, it was not possible to undertake formal surveys. However, it was possible to employ both formal and informal interviews, observation and document analysis techniques. More specifically, when working on each case study project, the following data collection techniques were employed:

- **Document reviews:** The principal researcher had access to a wide variety of documents, including IT, marketing and corporate strategy reports, staff communication documents and detailed design documents.

- **Interviews:** Formal interviews or informal discussions were conducted with a wide variety of stakeholders in each project, ranging from users through to very senior managers.

- **Observation:** Being an active participant in each project, the principal researcher was able to observe their day to day execution at very close quarters, including participation in the vast majority of important project meetings.

A series of note-books were compiled to ensure that a complete, coherent and contemporaneous set of evidence was captured. Furthermore, the advise of Nandhakumar & Jones (1997) was followed and time was set aside to periodically '*step back from the research context*', to write-up key findings and objectively review them with the other researchers.

3.3 Data Analysis Strategy

The source data to be analysed, for each case study, was comprised of a selection of notebooks, formal business documents and the verbatim transcripts from interviews. The first stage of the data analysis exercise was to use the '*QSR NUD*IST Vivo*' (Nvivo) software to facilitate the coding of all the source documents and the retrieval of data from them. Nvivo was chosen as it provides a range of tools for handling rich data records and information about them, for browsing and enriching text, coding it visually, and for grouping the data records by many categories. A tool of this nature was required to gather, manage, and facilitate the analysis of the wide range of data that was collected during the individual case studies and for assembling the data for cross-case analysis. The next stage of the qualitative data analysis was to create '*within-case*' displays, using the '*ladder of analytical abstraction*' approach (Miles and Huberman, 1994; p 92). More specifically, '*check-list matrices*' and a '*thematic conceptual matrix*' were created for each case study organisation. Having organised and summarised the data, at the case level, it was then possible to embark upon the '*cross case*' analysis, the key component of which was the creation of '*thematic conceptual matrices'* (Miles and Huberman, 1994; p 131). This latter analysis focused upon evaluating the levels of consensus or variability that existed, with respect to the impact of the three different dimensions of information quality upon its value, across the eight case study sites; a '*variable-oriented approach'* to cross case analysis (Runkel, 1990).

4 RESEARCH FINDINGS

The aim of this section is to provide an overview of the findings, before presenting a more detailed analysis of the impact of each of the three dimensions of information quality on the perceived value of information.

4.1 Overview of findings

The data and evidence was carefully reviewed, to evaluate how significant each quality dimension was to the participating organisations, using a four point scale: highly significant, significant, moderate and none. More specifically, the assessment of the level of impact was based upon:

1. **Current experiences:** the degree to which the case study organisation has been experiencing quality problems, with respect to each dimension;
2. **Desired outcomes:** The extent to which the data warehousing projects have explicitly targeted information quality, and would, once operational, deliver improvements to the accuracy, consistency and timeliness of information, within each case study organisation.

The analytical exercise considered current experiences and desired outcomes in tandem, as organisations who were experiencing very significant quality problems, for example in the area of accuracy, generally had high expectations that the introduction of a data warehouse would deliver significant improvements to the accuracy of their information. The results of this exercise, see table 1, therefore present a unified view of the level of impact, based upon both an organisation's current experiences and desired outcomes.

It is interesting to note that whilst information quality issues were high on the agenda of most case study companies, in two of the organisation, namely **insurance company 'A'** and the **car manufacturer**, information quality was not a significant consideration. It was not so much that these companies were uninterested in quality, but more that as their focus was very firmly elsewhere, quality was generally down-played. For example, **insurance company 'A'** had major problems simply gaining access to any data; information availability was their main concern and

quality would have been the 'icing on the cake'. Similarly, the **car manufacturer** was primarily focussed on improving the performance of its sale to delivery performance by integrating more tightly its sales and manufacturing processes. The availability of relevant information was critical to this initiative but wider quality issues were not of primary importance.

Table 1: The Significance of Information Quality within Case Study Organisations

Case	Consistency of information	Timeliness of information	Accuracy of information
Clearing Bank	***	***	***
Retailer	***	***	*
Insurance Co. 'A'			
Insurance Co. 'B'	***	**	***
Commercial Bank	**	**	
Insurance Co. 'C'	**	**	*
Car Manufacturer		*	
Insurance Co. 'D'	*	***	***

Key : * ** highly significant impact; ** ** significant impact; * ** moderate impact

As there is evidence that all three of the dimensions of information quality have an impact on its perceived value, each of these areas is more fully discussed in the remainder of this section. More specifically, the sections 4.2 - 4.4 seek to provide evidence that specific organisations have focussed strongly on a particular dimensions of quality, in the instances where the highest levels of significance have been detected. This analysis is followed, in section 4.5, by a presentation of evidence that supports the hypothesis that enhanced information quality will result in a concomitant rise in its perceived value.

4.2 Consistency of Information

Providing the business with consistent company-wide information to support decision making and corporate performance measurement was an explicit objective, within the **clearing bank.** As one manager noted: *'the bank has a growing requirement for timely, flexible and consistent information to enable strategic decisions to support the business'*. The major problem that confronted the bank was that although there was a clear understanding of what information was required, very little of this information was being provided at an appropriate quality. One manager's view of the problem was that "*there are issues of data consistency, both across the varied operational systems, and also over time … these problems of lack of accuracy and consistency, in the underlying data, limit the value of any analysis or report based on the data*".

The **retailer** had similar requirements to the clearing bank for high quality information to support decision-making and for monitoring of business performance. The problem was summarised by one manager who believed that '*the information that has been provided, had been collected in a piecemeal manner and distributed by many different methods ... this resulted in a lack of consistency and quality*'. The inconsistent nature of the information available made it very difficult for the retailer to have a clear understanding of the information that was available or the ability to provide the business with a consistent view of corporate performance. A management

report on the situation concluded that '*management reports suffer from data inconsistency ... it is difficult to help users with queries regarding the data ... it is also not possible to advise the business on the information currently available*".

Insurance company 'B' also had the challenge of providing information of an improved quality to support decision-making and the measurement of corporate performance. As the company was experiencing a period of dramatic change and internal reorganisation, it was also recognised that good quality information had to be made available to all areas of the business to ensure that the changes were being implemented consistently across the organisation. This philosophy of ensuring that information was provided to all areas of the business that required it was fundamental to the changes taking place within the organisation. This was summarised in the view that '*a comprehensive source of consistent data would be available to all users without internal constraints as to how the data elements can be accessed or viewed together*'.

4.3 Timeliness of Information

In its attempts to support decision making and improve corporate performance measurement, it had also been recognised, within the **clearing bank**, that the timeliness of information provision was a critical factor. However, the reality of the situation was that the provision of information in a timely manner was a significant problem. These problems were identified in a number of areas of the bank. The marketing function was one of the hardest hit areas where "*the ability of product managers to access information about customers and products is severely limited at present … such information as is available is difficult to get at or provides only a snap-shot of the data which is often too old to be of practical use*". These problems were reiterated by a number of managers in the bank who had observations such as "*it is often difficult to extract information in a timely fashion in a usable form*", or "*frequently, by the time the report is available the information it contains is out of data and therefore of no benefit to the user*", and "*the long lead times to gather information also prevents iterative exploration of information*".

Timeliness of information at the **retailer** was an issue, not because of a lack of timeliness but rather because of the effort and cost that was involved in delivering the information in a timely fashion. Most information was delivered to management within reasonable time-scales and on the surface the timeliness of information provision was satisfactory. For most senior managers information was being provided when they required it. However, this exterior view of the provision of adequate information in a timely manner was the tip of a very large iceberg that was hidden from the view of senior management. This iceberg was discussed in a consultancy report that stated, "*this iceberg is a substantial and complex system which requires a considerable amount of management to ensure that the necessary data is being provided to the user departments in a consistent and timely fashion*". This 'system' consisted mainly of a substantial manual effort of extracting data from many different disparate sources, transforming it into the required formats, then re-keying it into other set of computer systems.

The provision of timely information had been identified as critical for the two main strategies being adopted by **insurance company 'D'**. As the new strategies had been developed it had been recognised that the information the company had available was inadequate for what was required. As studies within the insurer had identified '*much of this information is inaccurate, untimely, and in many instances, irrelevant to the actual business needs.* Moreover, *'with the development of new business strategies for the IFA and direct divisions it had become apparent that the provision of good quality, timely and relevant information is essential if the strategies*

are to succeed'. Among the critical problems that needed resolution was the ability of the insurer to provide senior managers with up-to-date information for managing the operation. The failure to provide this information was forcing managers to manage 'in the dark'. As an internal study identified '*some of the data is only transferred on a monthly basis, leaving management unaware of business levels during the month*'.

4.4 Accuracy of Information

With the objective of providing the business with the data it required for improved decision-making and monitoring corporate performance the accuracy of the information was an important dimension for the **clearing bank**. Individual managers had identified the importance of being provided with accurate information. As one observed "*the quality of data must be appropriate in the first instance … information which is both relevant, and accurate enough, for the purposes of the business*". As has already been identified the bank had identified what was required in terms of information quality dimensions but was having difficulty in delivering the requirements. As one manager identified "*there are known problems with the accuracy of data in certain fields such as date of birth where though data is present and in the correct format, the validity of the data is questionable*". As a consequence, it was recognised that "*as well as an increased demand for information, there is likely to be increased demands for more detail, accuracy and consistency of information*".

The improvement of management decision-making was also an objective of **insurance company 'B'**. The provision of accurate information was seen as a key prerequisite to achieving this objective. As internal analysis of the situation identified '*there is also an expectation that by providing consistent, timely, and more accurate information there will be noticeable improvements in the decision making process*'. However, as with most of the other case study organisations the general opinion was that the information that was currently available was not of the required quality. In this case there was an opinion that '*a number of data quality issues were identified which still needed to be tackled ... a key problem was a perceived lack of accuracy*'. There was therefore a pressing requirement to provide "*executive access ….. to a single agreed and validated set of data … access should be to controlled data which has a known degree of accuracy*"

Insurance company 'D' was experiencing similar problems. As discussed earlier the development of its two main strategies was dependent of the provision of good quality and accurate information. However, the information being provided was not of the required standard and the company had started to recognise '*much of this information was inaccurate, untimely, and in many instances, irrelevant to the actual business needs*. As one executive noted, "*manual effort is high; in an attempt to make the data as accurate as possible, great efforts have to be made on a regular basis in order to provide the best possible picture*". For many managers this was a fundamental problem that had to be resolved. There was a view within the company that '*the provision of accurate new data should be seen as a minimum basic requirement*'. Without this there was a feeling that the strategies being adopted could result in failure.

4.5 The relationship between information quality and its perceived value

Having demonstrated that accuracy, timeliness and consistency are considered to be key dimensions of information quality, it is important to present the evidence that supports the hypothesis that there is a causal relationship between information quality and its perceived value. For example, at the **commercial bank** it was recognised that "*the importance of information had*

started to be recognised and senior management has realised that good quality information was of great importance and that without it they would have difficulty competing and maintaining their leading position in the UK market". A similar opinion of the value of high quality information was formed at **insurance company 'C'** where '*the importance of information is being recognised by the company as being imperative to future success and serious steps were now being taken to ensure that information is regarded as being a valuable asset*'. More specifically, the evidence from the case studies suggest that the enhancement of information quality can deliver value in four key areas: decision-making, strategy formulation and monitoring, flexibility and integration.

Enhanced decision-making: At **insurance company 'B'** there was an explicit objective to '*deliver in a flexible and convenient fashion high quality business information to all staff, agents, and managers who need it, regardless of their level of computer literacy*'. There was a view that by '*increasing professional potential by improving the quality of management information would lead to improved decisions, and thus provide the basis for improved job performance*'. It was also recognised that high quality information was essential to the enhancement of decision-making at the **retailer**. As one manager identified "*the benefit should primarily be better decision making and better buying decisions if the data is used effectively ... good quality information should also lead to better selling decisions in terms of reductions and locations*". This type of usage was discussed in more detail with ideas being proposed such as '*if better quality information could be supplied improved buying and selling decisions could be made. The measurement of stock utilisation could improve which would lead to better selling decisions. Better quality information would also enable the business to identify unprofitable business and to improve range and space optimisation and stock space utilisation*'.

Strategy formulation and monitoring: There was a great deal of evidence to suggest that the delivery of high quality information is essential for monitoring strategic performance and formulating effective corporate strategies. For example, there was recognition, within the **clearing bank**, that information was required for monitoring the success of the corporate strategies. As one study conducted in the bank identified '*the provision of accurate and consistent information would be required to enable measurement of performance against the bank's critical success factors*'. This view was echoed by a manager from the clearing bank who noted that '*there is a business need for good quality, consistent and timely information to support and monitor progress towards the achievement of the corporate objectives*'. The role of high quality information in strategic performance monitoring was also recognised at the **retailer**, where one manager suggested that '*by gathering good quality data senior management could be provided with Group/Corporate views of company performance'* with the result that *'improvements could be made in strategic decision making*'.

Flexibility: As an internal study at **insurance company 'B'** identified '*making consistent information widely available to support quality business decision making is key to achieving flexibility and maintaining strategic alignment*'. The **car manufacturer** also believed that improved flexibility could be achieved by the provision of better information. There was a view that '*good quality information was required to improve the performance of key processes and to achieve nimbleness*'.

Process Integration: Another area in which there was a belief that improved information could make a substantial impact was in the improved integration of key processes. Managers at the **car**

manufacturer believed that by providing the right quality information they could achieve '*integration with key functions and initiatives, such as a single common global interface with material planning and logistics'*. They were convinced that *'these interfaces could be developed and improved by the use of better quality information*'.

DISCUSSION: LESSONS LEARNED

The research presented in this paper has reinforced the message that accuracy, timeliness and consistency are all important dimensions of information quality, and that as such they have an important impact on users' perceptions of the value of information. The aim of this section is to highlight some of the strategies to improve information quality that have been identified by the case study companies. It should be noted that each strategy is very specific to the cited case study company, rather than being representative of all the companies:

- **User education and data integrity procedures are essential:** As the **commercial bank** had identified in internal studies '*the quality of the data being gathered was a major concern and a decision was made that steps would be taken to ensure that the data being gathered was of good quality*'. This was facilitated by providing focussed education and training, and implementing data integrity procedures, in all the bank's branches. As the bank identified '*the steps were all aimed at stressing the importance of data quality at the branch and the need to ensure that high quality standards were maintained*'.

- **Need to clean-up data sources:** The introduction of new information sources, such as data warehouses, will only improve the overall quality of information if the quality of all up-stream data sources are also tackled. As an internal report at **insurance company 'B'** identified '*the business need for good quality information is being continually hampered by these diverse (source) systems with inconsistent and inaccessible data*'.

- **Design for quality:** Data quality issues must be prioritised during the design and development of information systems. As the **retailer** noted '*when a new requirement for information is identified the solution is often viewed as 'tactical' and hence speed of development and reducing the cost of the build are usually viewed to be higher priority than resilience, cost of maintenance, future flexibility and data integrity*'.

- **Don't tamper with the source data:** Another major factor, which contributed to the information quality problems that faced the **retailer**, was the practice of manipulating data before information was passed to management. As one manager acknowledged "*in the past much of the data used for strategic decision making has been manipulated which has created a false inference ... by the time it has been through the mill it has changed*". This resulted in a spider's web of mismatching and incomplete information with many answers being unavailable and many answers being available for the same question, and with no one really knowing what the correct answer was.

- **Provide managers with appropriate tools:** In many cases problems were highlighted with regard to the compilation of data into meaningful information sets. For example, at **insurance company 'D'** much of the information that was required was not available in a complete form and a significant effort was required to assemble what the business was

requesting. As a study of the problems highlighted '*additional problems included data content being poor, data being fragmented forcing the business to use multiple sources, and a high level of manual effort being required to pull together the necessary information*'. Consequently, it is necessary to provide managers with appropriate tools and training, so that they can construct the reports they need.

In addition to highlighting some practical steps that organisations can adopt to improve their information quality, and in so doing their information value, this research also highlights a fundamental lessons about the nature of information quality problems. The evidence from the case study organisations suggests that information quality problems typically manifest themselves across a range of dimensions rather than a single dimension. This view was well summarised by one manger who noted '*while the Bank may have immense volumes of operational data, the current processes for extracting business information from this data are inadequate … these processes act as a bottleneck, delivering inaccurate / inconsistent data too late'*. This suggests that data / information quality problems might best be tackled holistically rather than at the level of the individual dimensions.

6 CONCLUDING REMARKS

Whilst the literatures with regard to the quality of information and its perceived value are both growing, little previous research has sought to explicitly link these two themes together. The research, reported in this paper, therefore makes an important contribution in that it shows how the quality of information is being explicitly targeted to improve its value, in eight large, multi-national organisations. Moreover, it provides some important insights into how this process can best be achieved.

Research into the role of information, within the organisational context, is an ambitious undertaking, and therefore contains a number of inherent limitations. In particular, the adoption of the case study format reduced the number of organisations that could realistically participate and there is also potential bias with respect to the way in which the principal researcher interpreted the situations to which he was exposed. Moreover, the research only addressed three of the many dimensions of information quality. Consequently, whilst the study provides many interesting and novel insights, these limitations do highlight the need for follow-up studies to be conducted that adopt different methods, and target different populations and respondents, to investigate the generalisability of the results.

REFERENCES

Alter, S., (1999), *Information Systems – A Management Perspective*, Reading MA, Addison-Wesley.

Bowonder, B. and Miyake, T. (1992), 'Creating and Sustaining Competitiveness: Information Management Strategies of Nippon Steel Corporation, *International Journal of Information Management*, Vol. 12.

Churchill, G. A., (1991), *Marketing Research Methodological Foundations*, 5th edition, Orlando: Dryden Press.

Collis, D. J. and Montgomery, C. A. (1995), 'Competing on Resources in the 1990's', *Harvard Business Review*, Jul-Aug.

Confederation of British Industry (CBI), (1992), *IT The Catalyst for Change*, London, CBI.

Crockett, F. (1992), 'Revitalising Executive Information Systems', *Sloan Management Review*, Summer.

Darke, P., Shanks, G. & Broadbent, M. (1998)'Successfully completing case study research: combing rigour relevance and pragmatism', *Information Systems Journal*, Vol 8, No 1, pp273 - 290.

Davenport, T.H. (1993), *Process Innovation. Reengineering work through information technology*, Boston MA, Harvard Business School Press

Davenport, T.H. (1994), 'Saving IT's Soul: Human Centered Information Management', *Harvard Business Review*, March-April.

Davenport, T.H., Eccles, R.G., Prusak, L. (1992), 'Information Politics', *Sloan Management Review*, Fall

Davenport, L. & Cronin B. (1988), 'Strategic Information Management - Forging the Value Chain', *International Journal of Information Management*, Vol 8 No 1

Davis, S. and Botkin, J. (1994), 'The Coming of Knowledge Based Business', *Harvard Business Review*, Sept-Oct.

Eccles, R. G. (1991), 'The Performance Measurement Manifesto', *Harvard Business Review*, Jan-Feb

Finlay, P. (2000), *Strategic Management*, Harlow, Pearson Education.

Glazer, R. (1991), 'Marketing in an Information Intensive Environment : Strategic Implications of Knowledge as an Asset', *Journal of Marketing*, Oct.

Glazer, R. (1993), 'Measuring the Value of Information: The Information Intensive Organisation', *IBM Systems Journal*, Vol 32 No 1.

Goodman, S.K. (1993), 'Information Needs for Management Decision Making', *Records Management Quarterly*, October.

Grant, R. M. (1991), 'The Resource Based Theory of Competitive Advantage: Implications for Strategy Formulation', *California Management Review*, Spring.

Hawley Report (1995), *Information as an Asset: The Board Agenda*, London, KPMG Impact Group

Hopper, M. D. (1990), 'Rattling SABRE - New Ways to Compete on Information', *Harvard Business Review*, May-Jun.

Kaplan, R. S. and Norton, D. P. (1996), 'Using the Balanced Scorecard as a Strategic Management System', *Harvard Business Review*, Jan-Feb.

Klobas, J. E., (1995), 'Beyond information quality: Fitness for purpose and electronic information resource use', *Journal of Information Science*, Vol. 21, No. 2.

Lingle, J.H. and Scheimann, W.A. (1994), 'Is Data Scatter Subverting Your Strategy', *Management Review*, May.

McKinnon, S. M.and Bruns, J. (1992), *The Information Mosaic*, Boston MA, Harvard Business School Press

McPherson, P. K. (1994), 'Accounting for the value of information', *Aslib Proceedings*, Vol 46 No 9.

Maltz, E., (2000), 'Is all communication created equal?: An investigation into the effects of communication mode on perceived information quality', *Journal of Product Innovation Management*, Vol. 17, No. 2.

Miles, M. B. & Huberman, A. M. (1994), *Qualitative Data Analysis*, Beverly Hills CA, Sage.

Nandhakumar, J. & Jones, M. (1997) "Too close for comfort? Distance and engagement in interpretive information systems research", *Information Systems Journal*, Vol. 7, No. 9, pp 109-132.

Mowshowitz, A. (1992), ‘On the market Value of Information Commodities, Parts I - III, Journal of the American Society for Information Science, Vol. 43, No. 3.

O’Brien, J. A., (2001), *Introduction to Information Systems – Essentials for the Internet worked E-Business Enterprise*, Singapore, McGraw-Hill.

Orna, E., (1999), *Practical Information Policies*, Aldershot, Gower.

Porter, M.E. and Millar, V.E. (1985), 'How Information Gives You Competitive Advantage', *Harvard Business Review*, Jul-Aug.

Raghunathan, S., (1999), ‘Impact of information quality and decision-maker quality on decision quality: a theoretical model and simulation analysis’, *Decision Support Systems*, Vol. 26.

Rayport, J. F. and Sviokla, J.J. (1995), ‘Exploiting the virtual value chain’, *Harvard Business Review*, Nov-Dec.

Rostick, P. (1994), 'An Information Manifesto', *CIO*, Sept.

Runkel, P. J. (1990), *Casting nets and testing specimens: Two grand methods of psychology*, New York NY, Praeger.

Souchon, A. L. and Diamantopoulos, A. (1996), ‘A Conceptual Framework of Export marketing Information Use : Key Issues and Research Propositions’, *Journal of International Marketing*, Vol. 4, No. 3.

Strassmann, P. A. (1985), *Information Payoff*, New York NY, The Free Press.

Strong, D. M., Lee, Y. W., Wang, R. Y. (1997), ‘Data Quality in Context’, *Communications of the ACM*, May, Vol. 40, No. 5.

Wang, R. E. and Strong, D. M., (1996), ‘Beyond Accuracy: What Data Quality Means to Data Consumers’, *Journal of Management Information Systems*, Spring, Vol. 12, No. 4.

Willard, N. (1993), 'Information Resource Management', *Aslib Information*, May.

Yin, R. K., (1994), *Case Study Research*, Thousand Oaks, Sage Publications.