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Corporate Memories: Tombs or Wellsprings of Knowledge

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ABSTRACT

This paper explores the nature of corporate memories in enhancing individual working knowledge and performance in a decision making context. Our findings from a series of studies indicate that people tended to use effectively up to two thirds of the encoded knowledge, missing at least one third of its maximum potential. Our findings also indicate that the effectiveness of knowledge repositories was highly contingent upon quantity, quality and diversity of their knowledge content. In particular, our study suggests that individuals can potentially benefit from additional knowledge management initiatives such as analytical and procedural knowledge, learning histories, guidance or interactive social environments. Future research may look at the impact of these initiatives independently, or at the possibility of a synergy effect when combined and integrated.

INTRODUCTION

Human society is experiencing a major transformation from an industry-based society to a knowledge-based society. With this transition comes a growing recognition among researchers and practitioners alike for the need to better understand the value of knowledge, what knowledge is, and how it should be managed. In general, the knowledge management literature indicates a widespread recognition of the importance of knowledge with respect to the struggle for economic success (Devlin, 1999; Drucker, 1993; Stewart, 1997), but little shared understanding of the construct itself (Davenport & Prusak, 1998; Devlin, 1999; Grayson & Dell, 1998). There are also differences among researchers in what constitutes useful knowledge and the ways in which it is created. A recent review of the knowledge management literature (Baxter & Chua, 1999) identifies two major strategies: "codification" and "personalisation". The proponents of codification show a central preoccupation with organisational databases and "explicit" knowledge. On the other hand, proponents of personalisation seem to be more interested in "tacit" knowledge sharing.

As organisations become more knowledge-based their success will depend on how successful knowledge workers are applying knowledge productively and efficiently. The central task of those concerned with organisational knowledge management is to determine ways to better cultivate, nurture and exploit knowledge at different levels and in different contexts. Knowledge management is seen as central to process and product improvement, to executive decision making and to organisational adaptation and renewal (Earl, 2001). This opens up new opportunities for research and practice in behavioural decision making.

A knowledge management framework (Hahn & Subramani, 2000) suggests that the availability of a KM system such as codified repository should lead to an increase in individual knowledge and result in improved performance. Empirical evidence to support this proposition is largely missing (Alavi & Leidner, 2001). Therefore, recognising the importance and the need for better understanding of this issue, the main purpose of this paper is to provide a deeper insight into potential and limitations of codified repositories of business artefacts in enhancing individual working knowledge and performance in the context of decision making.

Managerial decision making can be viewed as a knowledge intensive activity. Decision makers often obtain explicit knowledge from the stores of business intelligence available in organisations and gain tacit know-how in response to the demands of their work. It is implicitly assumed that the availability of such stores should lead to an increase in their working knowledge, this resulting in improved job performance. However, little is known about the actual success of these initiatives and the returns resulting from them.

With the growing abundance of business artefacts enabled by modern technology, it is of particular interest to this study to examine whether and how knowledge captured in computerised organisational stores affect individual decision makers' working knowledge, and what impact this may have on the quality of their subsequent decisions. The author conducted a series of empirical studies to address this issue. The next sections report the results of these studies and suggest some possible directions for future research.

DESCRIPTION AND RESULTS OF EMPIRICAL STUDIES

Five experiments were conducted in controlled laboratory settings using graduate students as voluntary subjects. For the purpose of the investigation, a common experimental task was designed in which subjects assumed the role of Production Manager for a fictitious firm selling fresh ice-cream from its beach outlet. All subjects were novices to the task and were required to predict daily sales of ice-cream and make corresponding production decisions over a period of 30 consecutive days. Each subject had access to a computerised repository that provided decision relevant facts and figures regarding the past product sales, as well as contextual factors such as the daily temperature, visitor-numbers and sunshine conditions expected on the beach.

Each study provided codified knowledge of varying quantity, quality and diversity. This was achieved by changing the number of contextual artefacts and correlation coefficients (r) between contextual and predicted variables provided in each study. Study 1 provided one piece of moderately predictive artefact (r1=0.8). Study 2 provided two pieces of similarly relevant artefacts ($r_{1,2}$=.8) and study 3 provided three such pieces ($r_{1,2,3}$=.8). In study 4 subjects were given a mix of three artefacts of different predictive ability (r_1=.9; $r_{2,3}$=.3), while study 5 offered all three highly predictive artefacts ($r_{1,2,3}$=.95). All artefacts were presented in the form of line graphs and accessible on request one at the time by a simple mouse click on a corresponding icon.

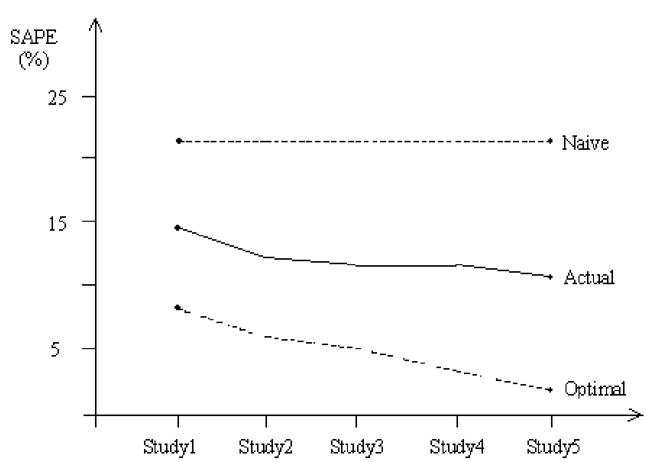
Subjects' performance was evaluated in terms of decision accuracy. It was operationalised by *symmetric absolute percentage error* (SAPE), chosen because it controls for scale and computational bias of MAPE. SAPE was obtained by dividing the absolute difference between subject-estimated and actually-demanded units of product by an average of the two values and multiplying by 100% (Makridakis, 1993). In addition, the corresponding errors of nominal naive and nominal optimal decision makers were calculated. These are the error scores that would have been obtained by people who produced their decisions by using naive (random walk) and optimal strategies. Optimal strategies were obtained by regression analysis consistent with Brunswik's (1956) lens model. Naive SAPE was set to 20.67 and optimal SAPE to 8.30, 6.28, 5.13, 4.69 and 2.63 for studies 1-5 respectively. These scores were used to assess how much of the full potential of the available artefacts to improve performance was used/unused by the actual subjects.

The difference between naive and actual subject SAPE indicated the amount of achieved improvement due to used knowledge, while the difference between actual and optimal subject SAPE indicated the amount of unrealised potential improvement due to unused knowledge. The collected data were analysed statistically using one-way ANOVAs followed by multiple comparison tests (Scheffe rule) to compare actual subjects' performance with that of their nominal naive and optimal counterparts. All results were significant at $p<.05$.

The analyses performed found significant differences in error scores between actual subjects and nominal naive decision makers in all studies. As shown in Figure 1, actual subjects tended to make smaller decision errors than their nominal naive counterparts irrespective of the experimental treatment (14.41, 11.59, 11.37, 12.21, 10.47<20.67). The results of the analyses also revealed significant differences in error scores between actual subjects and nominal optimal decision makers. Figure 1 shows that actual subjects tended to make greater decision errors than their simulated counterparts applying optimal artefact-weighting strategy on the task, regardless of the experimental treatment (14.41>8.30, 11.59>6.28, 11.27>5.13, 12.21>4.69, 10.46>2.63).

Finally, a cross-study analysis discovered significant differences in subjects' performance due to varying quantity, quality and diversity of the repository content. Figure 1 shows that achieved improvement was generally consistent with the overall task predictability due to increased quantity and quality of the available artefacts, but not diversity. The difference between naive and actual subject SAPE increased from 6.26 through 9.08, 9.30, 8.46 to 10.20 for studies 1-5 respectively. Figure 1 also shows that the amount of unused knowledge and subsequent unrealised improvement grew with increased artefact quantity, quality and diversity. In real terms, the difference between actual and optimal subject SAPE increased from 5.31 to 6.24 with increased quantity (studies 2&3); from 6.24 to 7.84 with increased quality (studies 3&5); and from 6.24 to 7.52 with increased diversity (studies 3&4) of the available artefacts. One notable exception to this general trend was a decrease from 6.11 to 5.31 in the difference score with an initial increase in artefact quantity (studies 1&2). The nature of the results across different studies enables drawing of a number of conclusions and provides a basis for possible directions for future research.

Figure 1: Mean error scores (SAPE) of actual and notional subjects by studies



DISCUSSION OF MAIN FINDINGS AND FUTURE RESEARCH DIRECTIONS

In summary, the main findings of the series of studies presented in this paper indicate that the provision of codified knowledge repositories containing task relevant artefacts was useful, but insufficient to *alone* enable individual decision makers to achieve optimal performance. The findings also reveal a highly contingent nature of the impact of these repositories, being dependent upon the quantity, quality and diversity of their available content.

The fact that subjects tended to make substantially smaller than naive decision errors suggests that they were able to make use of some of the potential of their available artefacts, and as a result, improve their subsequent performance. On average, error scores dropped by 30-49% compared to naive errors. These findings give a more optimistic picture of human judgement than earlier MCPL research (Brehmer, 1980). One potential explanation for the difference may be in the characteristics of the decision task. Participants in the current study were provided with: a meaningful task context; sequential history of task relevant variables which provided some clues to causal relationships; and forecast values of contextual variables to suggest future behaviour. It is also possible that a graphical form of presentation facilitated the use of a pattern matching task strategy and enabled subjects to correctly judge the direction of future changes and make their estimates accordingly. Such a strategy has been shown to produce good results in highly predictive environments (Hoch & Schkade, 1996).

However, the pattern matching strategy could not produce optimal performance in a non-deterministic task. Actual subjects were found to make significantly greater decision errors than their nominal optimal counterparts. Greater than optimal errors suggest that the subjects tended to use substantially less potential of the available artefacts compared with their maximum potential value. Further analysis revealed that, on average, 49-37% of the total encoded knowledge was not used across the five studies and consequently a significant amount of its improvement potential remained unrealised. One possible explanation for the phenomenon may lie in the subjects' misevaluation of the worth of the repository content. Turning artefacts into tacit knowledge requires familiarity with the relevant context and the appropriate weighting models for variables. Subjects in the current research were not given any explicit analysis of the quality of their artefacts, or rules they could apply to integrate the available facts. Instead, all subjects in each study had an opportunity to learn from their own experience through task repetition and from feedback. However, the fact that the participants responded in the appropriate direction, suggests that they could potentially achieve more improvement with more trials (Klayman, 1988) or with additional knowledge management support in the form of systems thinking, data mining, or knowledge sharing (Liebowitz, 2000).

As expected, our cross-study analysis indicated that the achieved decision improvement was generally consistent with each study's overall task predictability due to increased quantity and quality, but not diversity of the available artefacts. However, a more interesting finding concerns significant variations observed in the level of unused encoded knowledge when normatively irrelevant factors such as artefact quantity, quality and diversity were varied. The study found that the percentage of unused knowledge changed by 3-12%. While these demonstrated performance effects regarding quantity and diversity factors can be explained in terms of information load (Schroder et al., 1967) or task complexity (Wood, 1986), a different explanation is required to interpret the quality effect. Plausible explanations of the phenomenon may lie in Herbert Simon's notion of bounded rationality. Bounded rationality is people's general tendency to satisfice (i.e. to adopt a strategy that requires only enough effort to lead to comfortably good decision performance (Beach & Mitchell, 1978)), or to use fast and frugal heuristics (i.e. "to employ limited search through objects (in satisficing) or cues and exploit environmental structure to yield adaptive decision" (Gigerenzer, Todd & ABC Research Group, 1999)). Our follow-up analysis of actual strategies employed by the subjects indeed confirmed their use of reduced search and selective weighting heuristics.

To model each subject's strategy, we applied multiple regression with the available artefacts as independent variables and the subject's evaluation as the dependent variable. This is a common approach used to study how judges weight and combine information. The model parameters were then used to indicate the importance assigned to various artefacts. It was found that subjects adapted to increased complexity of the decision problem from the cognitive load imposed on them by the need to process increased quantity of artefacts by adopting selective information utilisation. In particular, they tended to place greater reliance on some and less reliance on other available artefacts. Similarly, it was demonstrated that the increased task complexity from higher information diversity led to ignoring differences in relative importance among the individual artefacts. Such behaviour diluted the effect of the best predictor on performance, and resulted in poorer performance. The findings also indicate that subjects were aware that the additional information was less useful when the certainty of the decision outcome increased. Thus, when presented with multiple artefacts of higher quality, subjects generally tended to ignore some artefacts. Consequently, the performance was poorer than that of normative strategies.

In general, our findings indicate room for further improvement in individual decision making. The high level of unused knowledge potential from codified repositories revealed in this study suggests that individuals could potentially benefit from additional knowledge management initiatives. One possible direction for future research is to examine the potential contribution of explanatory content to knowledge utilisation. Additional analytical and procedural knowledge, as well as histories of past experiences, guiding instructions, deeper explanations and richer feedback might potentially help decision makers to better understand what works when and why (Kleiner & Roth, 1998). They may also help reduce cognitive effort and minimise satisficing behaviour on the task.

Future research could also explore the role of social environment in knowledge enhancement. Organisations have come to realise that a large proportion of the knowledge needed is not captured on hard drives and filing cabinets, but kept in the heads of people. Sources report that 40-90% of the needed knowledge is tacit (AAOTE, 1998; Hewson, 1999). The spiral knowledge model assumes that the processes of sharing will result in the amplification and exponential growth of working knowledge (Nonaka, 1998). Yet, little is known of the ways in which tacit knowledge is actually shared, conditions under which this sharing occurs, and the impact it has on performance.

Finally, further research may also look at how various knowledge management initiatives when combined and integrated may interact to create a synergy effect. According to Davenport and Prusak (1997) it is only possible to realise full power of knowledge by taking a holistic ecological approach to knowledge management. The suggested directions represent only a small selection of knowledge management issues and approaches that are currently of interest to the author. Other research is necessary to systematically address various knowledge management issues in different tasks and contexts, and among different knowledge workers, if a better understanding of the area is to be achieved.

CONCLUSION

The nature of corporate memories is enhancing individual working knowledge and performance in a decision making context. Our findings from a series of studies indicate that people tended to use effectively up to two thirds of the encoded knowledge, missing at least one third of its maximum potential. Our findings also indicate that the effectiveness of knowledge repositories was highly contingent upon quantity, quality and diversity of their knowledge content. In particular, our study suggests that individuals can potentially benefit from additional knowledge management initiatives such as analytical and procedural knowledge, learning histories, guidance or interactive social environments. Future research may look at the impact of these initiatives independently, or at the possibility of a synergy effect when combined and integrated.

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