A Research Framework for Empirical Studies in Organizational Memory

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Abstract

In 1991, Walsh and Ungson [27] defined an organizational memory (OM) research agenda encompassing three sequential phases: (1) assessing the structure of OM; (2) parsing the OM acquisition, retention, and retrieval processes; and (3) assessing the consequences of OM. One way for researchers to address Walsh and Ungson's research agenda and enable OM to evolve as a research domain is by theory testing through hypothesis generation and empirical research. This paper defines an initial research framework for guiding empirical studies of OM based on a widely accepted CSCW research framework, and describes an exploratory laboratory study based on factors identified in this framework.

1. Introduction

Stein and Zwass [26] define organizational memory (hereafter referred to as OM) as "the means by which knowledge from the past is brought to bear on present activities, thus resulting in higher or lower levels of organizational effectiveness." Thus, OM involves applying past knowledge to a broad range of activities and impacts the organization and organizational outcomes. It is essential to, and irrefutably influences (for better or for worse), the way an organization reacts and adapts to new situations.

In their seminal paper, Walsh and Ungson [27] define an OM research agenda encompassing three sequential phases: (1) assessing the structure of OM; (2) parsing the OM acquisition, retention, and retrieval processes; and (3) assessing the consequences of OM. Research to date has largely fallen into two streams. One is largely conceptual and explores OM definitions, goals, structures, sources, and potential impacts from an organizational science viewpoint. Another addresses issues regarding OM system implementations and initial usage descriptions.

Another way for researchers to address Walsh and Ungson's research agenda and enable OM to evolve as a research domain is by theory testing through hypothesis generation and empirical research. The purpose of this paper is to define an initial research framework for guiding empirical studies of OM, and to describe a laboratory study based on factors identified in this framework. The paper is organized as follows: Section 2 draws on background literature in organizational memory, computer-supported cooperative work, organization science, and information retrieval in order to develop a causal model for OM studies. Section 3 describes an exploratory laboratory experiment where subjects are required to perform a familiarization task with the treatment group using an OM information system and the control group using paper archives. Section 4 summarizes our conclusions.

2. Framework Development

Stein and Zwass [26] propose that organizational effectiveness can be described in terms of the Parsons [18] effectiveness functions for systems of action: (1) integration, or the degree of organizational coordination and management of information; (2) adaptation to changes in the environment; (3) goal attainment; and (4) pattern maintenance, or the ability to maintain the cohesion and morale of the workforce. We believe that the development of future computer information systems supporting OM (hereafter referred to as OM information systems, or OMISs) will be driven primarily by the goal attainment function, and that OMISs initially will be used to support specific processes or tasks. More comprehensive OMISs will be attained by consolidating and integrating these task histories over time with the organizational coordination and control infrastructure.

Primary objectives of organizational memory are information exchange and equivocality reduction [12, 27]. These are also primary functions of group processes [9]. OM can be thought of as extending computer-supported collaborative work (CSCW) along an additional dimension: longitudinal time. Since groups and group tasks are increasingly being viewed as the basic unit of formal organizational structure, the workgroup or task team presents a logical starting place for empirical evaluation of organizational memory. Using the basic causal model for CSCW empirical

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studies shown in Figure 1 [8, 19] as our starting point, we will now explore empirical OM research issues within the framework of this model and develop a revised causal model to specifically guide OM-related empirical studies.

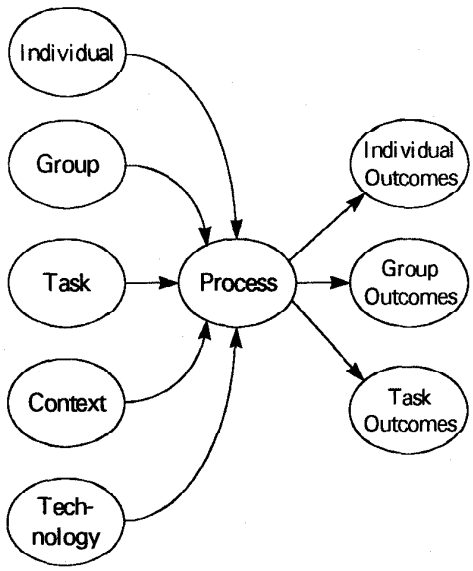

Figure 1. General CSCW Causal Research Model

Individual factors

Individual OM users fall into two overlapping categories: information providers and information seekers [1]. To reflect this duality, we propose replacing the term "Individual" in the original CSCW model with a factor called "Agent." (This term comes from object-oriented nomenclature, where an agent is an object that can operate on as well as be operated upon by other objects). As in CSCW research, agents can be characterized according to personal characteristics (attitudes, abilities, background, demographics), knowledge domains and corresponding experience/expertise levels, and tenure and roles in the organization. Specific characteristics of information providers include accessibility and willingness to provide information [25]. An aspect of the seeker/provider relationship is the amount of trust and confidence that the seeker has in the provider. Additionally, information providers can be "designated" (e.g., end-user support personnel) or volunteers [2].

Group factors

From an empirical standpoint, an OM "group" may be an individual retrieving archives of previous individuals or groups, or a project team creating and/or retrieving their own archives as well as archives of past related team processes. For studies involving the latter, the group structural factors (size, proximity, time frame, etc.) and situational factors (reasons for membership, stage in group development, etc.) constitute potential independent variables. (For a comprehensive discussion see [8, 19]).

Task factors

Tasks are the activities that enable an organization to attain its goals. Tasks may be characterized as atomic (accomplishable in a single non-decomposable process), or complex (comprised of a series of atomic tasks). Complex collaborative tasks can be characterized as quasi-repetitive (addressing the same atomic collaborative task multiple times but with different inputs and outcomes) or integrated (addressing and integrating different complex tasks) [6]. Tasks can also be characterized according to whether they are structured or unstructured [14], non-decomposable or decomposable-consensual, and according to their complexity (i.e., the amount of information that needs to be processed or the number of variables that must be examined) [6].

Context factors

Organizations are complex structures that involve a myriad of social, environmental, technological, and structural interactions. Many contextual variables have been proposed that potentially impact development, use, and impacts of OM. For example, Stein and Zwass [26] highlight the organization's environment (defined in terms of complexity and turbulence) and position in its life cycle. Schatz [24] suggests that the competitive culture and reward system within the organization will impact how readily individuals and groups contribute information to an OMIS. OM can also be impacted by organizational structures. Another contextual factor is the organization's external environment [11]. As in CSCW research, studies assessing OM impacts on individual or group processes will probably confine contextual variables to their study unit's immediate environment [19].

Technology factors

In the CSCW model, *technology* refers to the type (e.g., communication support, decision modeling, etc.), degree, and technical capabilities of the technology used within the collaborative process. Application of OM to the collaboration process introduces unique technological factors.

Walsh & Ungson [27] propose that an OM consists of five retention facilities (individuals, culture, transformations, structures, and ecology) that are

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independent of information technology or traditional information archives. Stein and Zwass [26] extend this definition by proposing that OM may also have an information systems component that serves to augment the interactions between knowledge seekers and human experts. Within this IS component, they propose the existence of two layers: (1) a set of subsystems supporting one or more of Parsons' [18] organizational effectiveness functions. and (2) a set of mnemonic functions for knowledge acquisition, retention, maintenance, search, and retrieval that are common to all OMISs.

We believe that the non-automated, or "in situ" OM, is composed of multiple repositories (as shown in Figure 2). We propose that this in situ component can interact with one or more technology-supported OMISs, which we have represented essentially according to Stein and Zwass's [26] model. (The retention structure, labeled the "Memory Base," has been separated from the other mnemonic functions because it is a static repository while the other functions represent active agent-involved processes). Empirical studies can be used to evaluate the different OM *types* (in situ versus OMIS), *functions* (integration, adaptation, goal attainment, pattern maintenance), and *memory base factors* (size, structure).

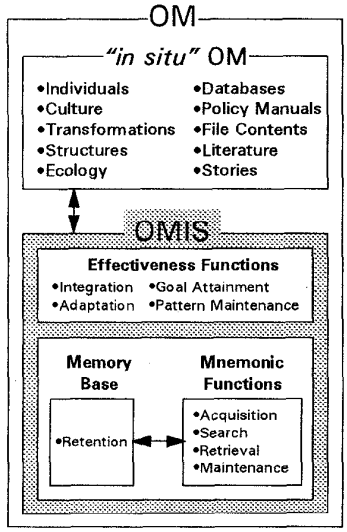

Figure 2. Generalized OM Structure

Process factors

In CSCW research, process entails two components: (1) the group process, which includes group communication characteristics, coordination approaches, leadership functions, and interpersonal relationships; (2) the task process, which considers the structure imposed upon the process by the nature of the task. We propose splitting process into two separate factors: the CSCW Process (which may be manual, supported by a GDSS, etc.), and the OM Process. The OM process involves the mnemonic functions of acquisition, search and retrieval, and maintenance. In the following paragraphs, we suggest areas for empirical evaluation within these functions.

Acquisition. Based on discussions in [25] and [26], we propose that three types of information (and corresponding acquisition processes) exist in a generalized OMIS memory base: (1) *archives*, information purposefully placed in the memory base by human agents either at system startup or as a result of task processes; (2) *answers*, information placed in the memory base by human information providers as a result of specific queries from information seekers, and subsequently available to all system users; and (3) *automatic insertions*, information automatically inserted in the memory base by system processes acting as artificial information providers.

Search and retrieval. Experts suggest that information retrieval techniques can be classified on a continuum ranging from *active* (purposeful, conscious searching) to *passive* (effortless recall or fortunate appearing) (e.g., [13. 15, 17]). Potential approaches for active search and retrieval include querying, filtering, navigation, guided exploration, and asking an expert. (For more details on implementing these strategies in OMIS systems, see [16]). Passive search can be characterized as scanning (wide-range sensing of organization's external environment) and noticing (unintended acquisition of information about external environments, internal conditions, or performance) [12]. Potential sources of passive search information include informal personal contacts both within and outside the organization (such as information exchanged informally by the coffee pot or on the golf course), and formal internal communications such as memoranda and information circulated via electronic mail distribution lists [7].

Maintenance. OM maintenance addresses how the OMIS responds to new knowledge and integrates it with the existing memory, and how it selectively "forgets" knowledge [26]. Other specific maintenance topics

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include quality control [24] and memory privacy and security.

Outcomes

From an empirical viewpoint, OMIS usage outcomes can be characterized according to precision and recall [4], cost [23], usage quantity [1], search process/outcome satisfaction, and outcome confidence. (Precision = number of relevant items retrieved/number of items retrieved; Recall = number of relevant items retrieved/total number of relevant items in memory base). These outcomes can potentially impact agent, group, task, and organizational outcomes, as shown in Figure 3. (Although not shown explicitly, it should be noted that all outcomes are potentially inter-related).

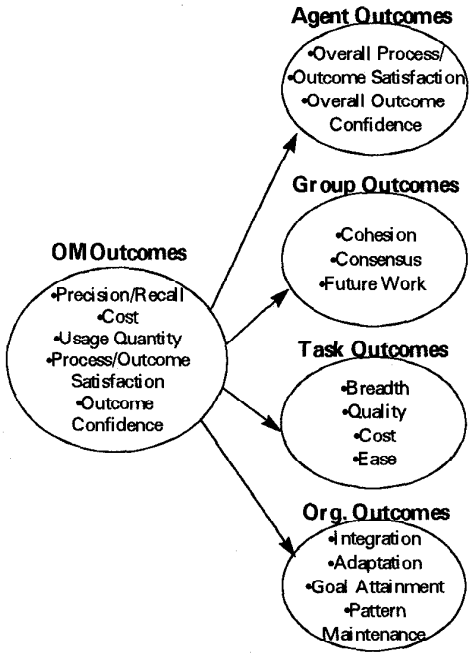

Figure 3. Potential Outcome Factors and Relationships

In empirical CSCW research, outcomes are usually characterized according to how they relate to individuals (e.g., task process and outcome satisfaction, task outcome confidence), to the group unit (e.g., group cohesion, consensus, willingness to work together in the future), and to the task (e.g., breadth, quality, cost, ease). From an organizational outcomes viewpoint, OM has two principal goals [20, 27]: to integrate information across organizational boundaries and to control current activities and thus avoid past mistakes. Although no simple causal link exists, OM researchers must strive to evaluate OM impacts in terms of organizational effectiveness. One promising approach involves the four effectiveness functions (integration, adaptation, goal attainment, pattern maintenance) previously defined. These functions are the basis of the Competing Values Approach (CVA) to organizational analysis, which asserts that collective units such as groups or organizations have alternative and competing priorities (for an overview, see [21]).

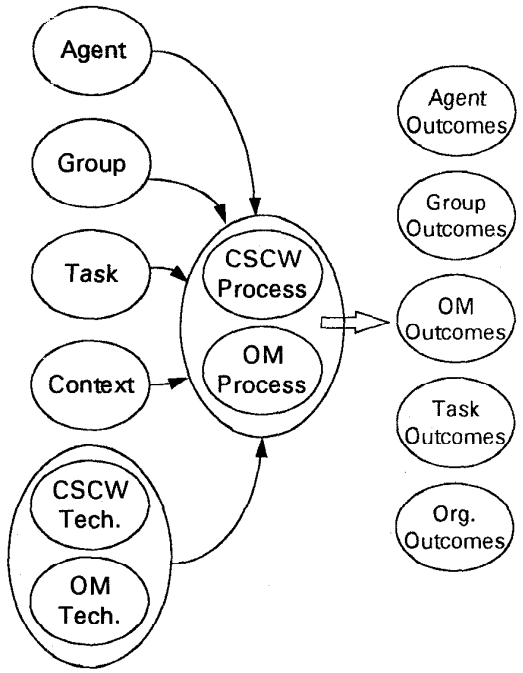

Figure 4. General OM Causal Research Framework

Figure 4 summarizes the general OM research framework developed in the preceding paragraphs. As previously noted, the agent(s), group, task, context, and technology (both CSCW and/or OM) all impact both the CSCW and OM processes. These processes then lead to different outcome measures for the agent(s), group, OM, task, and organization. Interactions within the independent and dependent variables are bound to exist but are not shown on the diagram. An exploratory study based on this framework will now be described.

3. Exploratory Study

The purpose of our exploratory experimental study was twofold: (1) to refine the previously-developed research framework; and (2) to assess the impacts and value of an OMIS versus an *in situ* OM (e.g., paper file

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archives). Our experimental subjects were asked to complete a familiarization task using historical information, where the role of OM was to avoid "reinventing the wheel" by educating personnel on past issues or events [20].

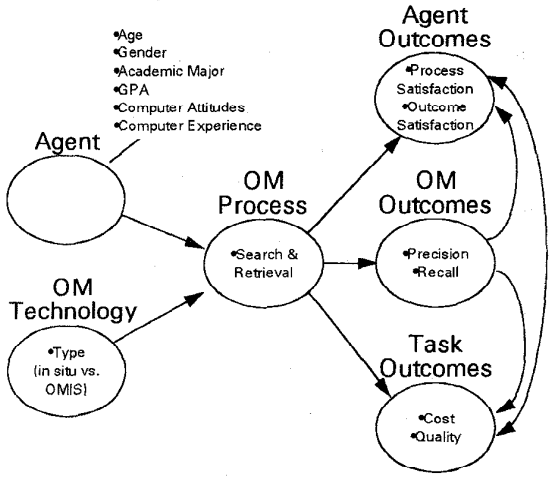

Figure 5. Experimental Study Framework

Since the agents interacted with historical archives, the Group, CSCW Technology, CSCW Process, and Group Outcome factors in the general research framework are not applicable. Task and Context remained constant through all treatments and are omitted from the research model. Since this was an exploratory study with limited scope, Organizational Outcomes were not considered. The relevant components of the general framework corresponding to the experimental study are shown in Figure 5.

Background and research exploration

Prior research applicable to our current study comes from three domains: decision support system (DSS) evaluations, text information retrieval studies, and previous experiments using a prototype OMIS. DSS evaluation studies usually involve a single user, and evaluate methods of information storage, retrieval, presentation, and manipulation. The most notable studies are "The Minnesota Experiments" [10], which focused on evaluating different approaches (e.g., paper vs. computerized, raw vs. summarized, tabular vs. graphical, etc.) for storing, retrieving, and presenting numerical data for production-related tasks. Of potential relevance to our study were the conclusions that: (1) process and outcome confidence may be higher for users who are more familiar with the attributes of the system; and (2) computer systems may enhance process satisfaction. This leads to our first research proposition:

P1: *OMIS users with more computer experience and more positive computer attitudes will have better outcomes than OMIS users with less experience and poorer attitudes.*

Since the data in our study involves wholly textual archives (e.g., a project seeking to develop a strategic plan for a business school) rather than numerical data, studies on text search and retrieval were examined. A study by Blair and Maron [4] suggested that successful search outcomes are inversely proportional to the size of the document base: in a study of a large legal document base (over 350,000 pages), poor rates (approximately 20%) were reported for recall. This study has sparked an ongoing debate among researchers as to the validity of the experiments as well as the viability and future directions of full-text retrieval systems (e.g.,[5, 22]). An important conclusion from this literature stream is that for "small" document sets, computer-supported document bases seem to have higher levels of both precision and recall.

Another area that serves as a research basis is within emerging OM literature. Stein and Zwass [26] suggest that the "depth" offered by an OMIS will result in increased decision or outcome confidence. A field study of the Answer Garden System indicated that users were most satisfied with the system when they found the information they were seeking quickly and without having to "wade through a considerable amount of text to find that the answer was not present" [1]. In other words, user process and outcome satisfaction was positively correlated to search precision. These two streams of literature lead to our second proposition:

P2: *Subjects using the OMIS will have higher precision and recall rates than subjects using the "in-situ" paper documents, and as a result, will experience greater process satisfaction.*

The literature seems to be inconclusive or limited for potential impacts of demographics (e.g., age, gender, academic major, grade point average), cost (e.g., time to outcome), outcome quality, outcome satisfaction, and interactions among precision and recall. Therefore, these will assume the role of exploratory variables.

Subjects, treatment and measures

Subjects were 24 upper-level undergraduate business (primarily MIS and accounting) students at a large public university. All participants were given a pretest questionnaire to ascertain demographic data as well as general computer expertise and attitudes. Subjects were then separated into randomly assigned treatment (OMIS) and control (paper archives) groups and taken to separate sites, where they were told that they had been chosen to

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assume leadership of a committee formed to create a strategic plan for the university's business college, and that information on the committee's activities to date are being provided through the existing archives of the committee. Subjects were instructed to use the information from these documents to answer a series of five questions ranging from details of historical events in the project to open-ended questions asking for recommendations for bringing the project to a smooth conclusion. The subjects worked individually, and subsequent data analysis was done on an individual basis. The text of the questions is provided in the Appendix. In addition to providing responses to the questions, subjects were directed to record identifying numbers of all documents reviewed, and list those documents that were most helpful in responding to each question. They were also told to indicate their satisfaction both with the search process leading to each response, and the quality of their answer. A time limit of 75 minutes was imposed based on pilot studies that indicated this was adequate time for both the manual and computer groups to complete the task. Following collection of the completed answer sets, a post-test questionnaire was distributed to the participants to elicit overall outcome and process satisfaction as well perceived completeness, organization, and indexing quality of the documents and their satisfaction with the amount of data available to answer the questions.

The documents used in the study were actual archives from a strategic planning committee. The control group's paper documents were arranged the same way as they were given to us from the chairperson of the committee: in folders labeled by topic, and ordered in reverse chronological order within each subject folder. For the treatment group, the research team retrieved or scanned the documents into the OMIS, and, using only information found within the text of the documents, indexed them according to topics, keyword terms, and dates. Additional project contextual information was gleaned from the documents (primarily team membership information and meeting dates, topics and outcomes) and included in the system.

A panel of two "experts" (who were both members of the committee that created the original archival documents) evaluated answer quality. Each expert ordered the responses to each question by perceived quality, grouping equivalently ranked answers together. The quality measure for the responses was then derived by assigning a ten to the highest ranked answer(s) and a one to the lowest ranked answer(s) for each expert, interpolating the scores for the answers in between, and finally averaging the scores from each expert.

Table 1. Means and Standard Deviations

	Overall (n=24)		OMIS (n=13)		Paper Archives (n=11)	
Variable	Mean	SD	Mean	SD	Mean	SD
Age	21.38	1.93	21.46	2.40	21.27	1.27
Gender (1=M, 2=F)	1.25	0.44	1.23	0.44	1.27	0.47
Major (1=MIS, 2=Other)	1.71	0.46	1.77	0.44	1.64	0.50
GPA	3.33	0.39	3.36	0.43	3.29	0.34
[1]Gen. Computer Experience	2.00	0.53	2.18	0.36	1.79	0.63
[2]Gen. Computer Attitudes	2.26	0.61	2.19	0.61	2.33	0.63
Overall # of Docs. Retrieved	23.00	21.57	13.62	8.03	34.09	27.26
Overall # of Relevant Docs. Retrieved	6.25	4.90	4.46	2.15	8.36	6.38
Overall Precision	0.36	0.21	0.42	0.25	0.30	0.14
Overall Recall	0.15	0.11	0.10	0.05	0.19	0.15
Overall Answer Quality	5.62	1.66	5.47	1.87	5.79	1.45
[4]Overall Process Satisfaction	2.79	0.72	3.08	0.76	2.45	0.52
[4]Overall Outcome Satisfaction	2.83	1.05	2.92	1.26	2.73	0.79
Overall Time (Max. = 75 min.)	69.04	7.82	71.77	6.41	65.82	8.39
[5]Satisfaction with info. completeness	3.67	0.98	3.29	0.76	4.00	1.07
[6]Satisfaction with info. organization	2.73	1.10	3.14	0.90	2.38	1.19
[7]Satisfaction with info. indexing	2.93	1.28	3.29	1.25	2.63	1.30
[8]Satisfaction with info. quantity	4.86	2.07	3.86	1.77	5.86	1.95

[1]0=None, 6=Very High
[2]1=Very Negative, 6=Very Positive
[3]1=poorest answer group; 10=best answer group (see text)
[4]1=Very Unsatisfied; 6=Very Satisfied
[5]1=Very Incomplete, 6=Very Complete
[6]1="Very Poorly Organized"; 6="Very Well Organized"
[7]1=Very Poorly Indexed, 6=Very Well Indexed
[8]1=Not Enough, 4=Just Right, 7=Too Much

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Table 2. Summary of Multiple Regression Results (All Variables)

Regression Coefficients

Variables	Time	# Docs. Ret.	# Rel. Docs. Ret.	Overall Precision	Overall Recall	Overall Ans. Qual.	Proc. Satis.	Outcome Satis.	Satis. w/ info. comp	Satis. w/ info. org.	Satis. w/ indexing	Satis. w/ quant.
Age	1.23	-2.52	-0.46	0.01*	-0.01	-0.08	0.08	0.21	-0.01	0.09	0.29**	-0.28
Gender	5.22	-14.28	-3.91	0.04	-0.09	0.76	0.66	0.57	0.43	-0.34	0.35	0.59
Major	2.44	-22.02	-2.33	0.03	-0.05	-0.39	0.60	0.24	-1.41	0.36	-0.35	-9.18**
GPA	-10.81**	17.40	3.10	-0.02	0.07	1.16	-0.58	-0.37	-0.32	-1.55*	-1.23	1.05
Group	2.54	-8.83	-1.95	0.25****	-0.05	0.10	0.40	0.30	0.23	1.53**	1.24**	2.42
Gen. Computer Exp.	13.97**	-35.26**	-7.74*	0.01	-0.18*	-1.22	0.48	-0.52	-2.66*	-2.20**	-2.48**	-7.60**
Gen. Computer Att.	5.14	1.08	-3.31	0.00	-0.08	-0.11	-0.22	0.07	-1.66*	-1.59**	-2.23***	-2.64
R^2	0.55*	0.48	0.36	0.96****	0.36	0.25	0.35	0.25	0.62	0.85**	0.90**	0.79

*p<=.1; **p<=.05; ***p<=.01; ****p<=.001

Table 3. Mean Responses (Individual Questions)

		# of Docs. Retrieved	# of Relevant Docs. Retrieved	Precision	Recall	Answer Quality	Process Satisfaction	Outcome Satisfaction
Question 1	Overall	4.58	1.08	0.34	0.36	5.50	2.88	3.21
(Structured)	OMIS	2.77	1.00	0.43	0.33	5.97	3.54	3.15
RD = 3	Control	6.73	1.18	0.24	0.39	4.94	2.09	3.27
Question 2	Overall	5.00	0.92	0.46	0.46	7.43	3.38	3.67
(Structured)	OMIS	2.38	0.77	0.58	0.38	7.72	3.69	3.77
RD = 2	Control	8.09	1.09	0.32	0.55	7.08	3.00	3.55
Question 3	Overall	3.92	2.25	0.43	0.11	5.23	3.26	3.26
(Semi-structured)	OMIS	2.15	1.00	0.37	0.05	5.44	3.67	3.33
RD = 21	Control	6.00	3.73	0.49	0.18	4.98	2.82	3.18
Question 4	Overall	2.75	2.00	0.72	0.12	4.91	3.13	3.29
(Semi-structured)	OMIS	2.15	1.69	0.72	0.10	4.29	3.62	3.62
RD = 17	Control	3.45	2.36	0.71	0.14	5.64	2.55	2.91
Question 5	Overall					5.03	2.63	2.67
(Unstructured)	OMIS					3.94	2.54	2.38
RD = 30	Control					6.32	2.73	3.00
RD = # of relevant documents								

Analysis, Results and Discussion. Table 1 presents means and standard deviations for all independent and dependent variables (as illustrated in Figure 6) for all subjects as well as results sorted by treatment groups. Correlation analysis revealed no strong evidence of collinearity among the independent variables, so we performed a least squares multiple regression (Table 2) to test for relationships among independent and dependent variables. The OMIS group displayed a significantly higher overall precision ($p<=.001$) than the control group, indicating that an additional 25% of the documents retrieved by the OMIS group were relevant as compared to the manual group. The value and significance ($p<=.001$) of the R^2 factor indicates that 96% of this dependent variable's variation is explained by the independent variables. Since the OMIS subjects retrieved less than half as many documents as the manual subjects, it appears that they retrieved far fewer irrelevant documents. This was expected, since the OMIS provided keyword indexing along with project categorization and date sequencing. The OMIS subjects were also generally more satisfied, particularly with the organization and indexing of the information. This was also expected, since previous literature suggested that precision may be correlated to user satisfaction. Regression analysis specifically investigating a potential mediating effect between precision and recall and satisfaction, did not reveal any consistent significant relationships.

The experimental treatment was designed so that Questions 1 and 2 had distinct "right" answers that could be found in only a few documents. Conversely, Questions 3 and 4 were semi-structured and required the participants to synthesize the contents of multiple documents, and Question 5 was unstructured, allowing

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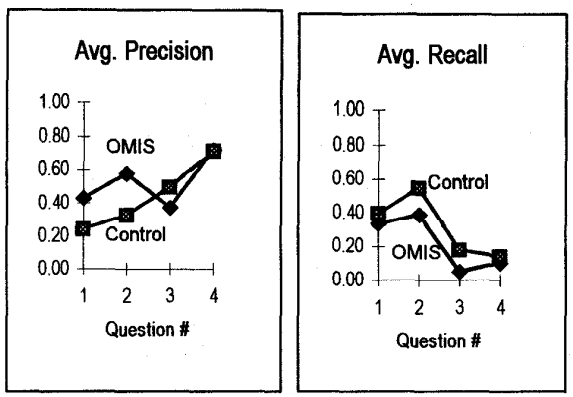

Figure 6. Precision and Recall Trends

the subjects to select a general direction to pursue, and then support it with appropriate documentation. Table 3 presents the average answer quality, precision, recall, and process/outcome satisfaction results for each question. Question 5 was probably the most difficult question, requiring the subjects to synthesize the project's activities and propose a plan for continuing the strategic planning process. This question was unique because all of the documents in the memory base were relevant in some way, but none clearly gave the correct answer; planning and organizational skills were required in addition to the ability to find information. Many subjects said that all of the documents were retrieved and seemed helpful, but, because of the unstructured nature of the question, we could not clearly delineate a set of "relevant" documents. As a result, no values for precision or recall could be determined for this question. Subjects were not required to answer the questions in any particular order, but most addressed the problems sequentially, and interesting trends exist in the data for individual questions. For the first two questions, the control group subjects generally retrieved more documents but about the same number of relevant documents as the OMIS subjects. This resulted in lower initial precision rates and higher initial recall rates. As the tasks became less structured, however, the control subjects' precision and relevant document retrieval rates improved to rates nearly equal that of the OMIS group, probably as a result of some "internal" indexing or sorting mechanism performed by the control subjects (and already provided by the OMIS). These precision and recall trends are illustrated in Figure 6.

Of additional interest are the trends in answer quality and process/outcome satisfaction shown in Figure 7. The OMIS subjects gave slightly better answers for the first three questions, but the control group showed higher answer quality for Questions 4 and 5. We hypothesized that this may indicate the OMIS was better for answering structured questions due to its keyword indices, but once the control group subjects had familiarized themselves with the documents, the paper archives provided a better sense of continuity and context and were better for answering the semi-structured questions.

This phenomenon may also be reflected in the satisfaction results. Process satisfaction is significantly higher ($t=2.84$, $p<.05$) among the OMIS subjects for the first four questions, and then essentially equal to that of the control subjects for the final question. Outcome satisfaction measures are essentially the same for both groups except for the final question, where OMIS outcome satisfaction becomes lower.

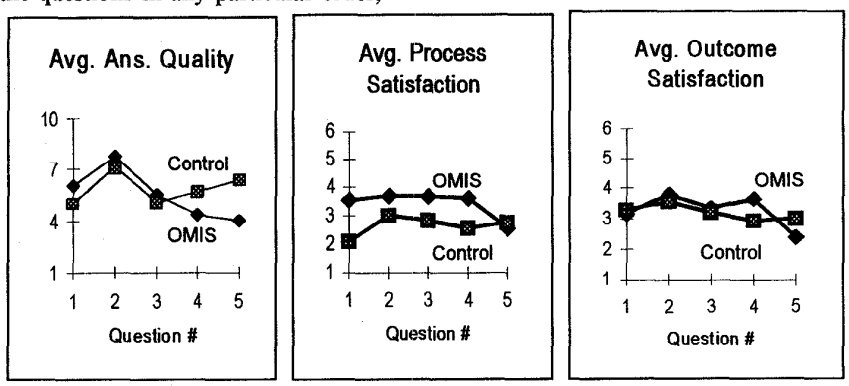

Figure 7. Average Answer Quality and Satisfaction Responses

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Table 4. Summary of Regression Results (Precision & Recall Impacts on Individual Question Satisfaction and Outcomes)

Regression Coefficients												
	Question 1			Question 2			Question 3			Question 4		
Variables	Process Satis.	Outcome Satis.	Answer Quality	Process Satis.	Outcome Satis.	Answer Quality	Process Satis.	Outcome Satis.	Answer Quality	Process Satis.	Outcome Satis.	Answer Quality
Precision	2.70***	2.19**	3.96*	2.07***	1.54**	4.45**	1.61	1.87**	-0.17	-0.12	-0.90	-0.34
Recall	-1.07	0.29	3.57	-0.15	-0.10	-0.73	-2.21	-1.88	4.07	-5.33	-0.84	26.79**

Correlation analysis of the individual question data revealed no potential multicollinearities among independent variables, yet regression revealed no consistently significant trends among the independent variables and question types. Regression analysis using individual question precision and recall as independent variables (shown in Table 4), however, indicated that precision significantly predicted process and outcome satisfaction for the structured questions but not for the semi-structured questions. These results are not surprising: most people can identify with the frustration experienced while sifting through a stack of documents and trying to organize them in a meaningful way to complete a given task. Also, most people can identify with the difficulty of keeping a sense of organization and context with data displayed on a computer screen.

4. Conclusions, Limitations, and Future Research

This paper suggests an initial research framework for supporting empirical OM research, and describes an exploratory study that illustrates this framework. The study suggests that OMIS-supported subjects were superior at finding specific answers to structured questions, and were consistently more satisfied with the task process. In situ OM (e.g., paper documents) users appeared to perform better on the less-structured questions.

Our experimental memory base contained only 30 documents, which was only a fraction of the actual documents provided to us from the strategic planning project. Still, many of the "paper archive" subjects felt that too much information was provided. We hypothesize that at some point, the size of the memory base will make the "paper archive" approach untenable, although the context and continuity provided by paper documents is still needed. Future OMISs may be used "on line" only for direct queries and structured questions. For less structured tasks, OMISs may be used for identifying and retrieving documents that are then printed on paper.

The OMIS-supported subjects achieved higher precision levels, especially for the structured questions, and these were positively correlated to increased process satisfaction. A learning effect seemed to be present with the paper archive subjects, as they progressed to unstructured tasks but not with the OMIS subjects. Future studies will explore relationships among task types (structured vs. unstructured) and internal subject indexing and learning processes by randomizing the order of the questions and analyzing the cognitive processes of the subjects. Future studies also will investigate if OMIS-supported subjects take advantage of any of the contextual information provided with the documents.

No significant differences were seen for study outcome satisfaction and cost (e.g., time) measures. A major limitation of the study was its artificial laboratory environment: subjects were not realistically motivated or personally interested in the subject matter. We were also concerned that placing a 75-minute time limit on the study damaged the validity of some of our measures, because several subjects (primarily in the OMIS group) did not finish in the allotted time. This imposed an artificial upper limit on completion time and may have affected other outcomes. Future experiments should involve actual ongoing groups with more of a stake in the process outcomes. Further, the memory base should consist of items inserted by actual users.

In spite of the acknowledged limitations of the pilot study, it provides worthwhile insights into the research framework. For example, we became skeptical of the value of recall as an outcome measure for OM studies. Recall was difficult to measure because relevance of a document to a given task is somewhat "in the eye of the beholder." For many business applications, retrieval of all relevant documents is not important or even desirable given the cost factor; users are more concerned with finding "good enough" information quickly.

OM has the potential to significantly impact organizational outcomes. Future studies investigating the entire OM lifecycle and considering both individual and group aspects as suggested in our research framework

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can aid researchers investigating OM structures, processes and impacts.

APPENDIX. Text of questions posed to experimental subjects: (1) Why does the College need a new strategic plan; (2) Who developed the initial draft of the strategic plan, and when was it developed; (3) Based on what information has the initial plan been revised; (4) What key problems existed in the first draft of the mission statement; (5) Outline a plan for completing the project.

References

1. Ackerman, M.S., "Augmenting the Organizational Memory: A Field Study of Answer Garden," in *CSCW '94*, Nov. 1994.
2. Ackerman, M.S. and Mandel, E. "Memory in the Small: An Application to Provide Task-Based Organizational Memory for a Scientific Community," in *Proc. of the 28th HICSS*, Jan. 3-6, 1995, , Vol. IV, 323-332.
3. Bartschii, M. "An Overview of Information Retrieval Subjects," *IEEE Comp.* 18,5 (May 1985), 67-84.
4. Blair, D.C. and Maron, M.E., "An Overview of Retrieval Effectiveness for a Full-Text Document Retrieval System," *C ACM* 28,3 (March 1985), 289-299.
5. Blair, D.C. and Maron, M.E., "Full-Text Information Retrieval: Further Analysis and Clarification," *Info. Proc. & Mgt* 26,3 (Mar. 1990), 437-447.
6. Carley, K. "Organizational Learning and Personnel Turnover," *Org. Science* 3,1 (Feb. 1992), 20-46.
7. Daft, R.L. and Weick, K.E., "Toward a Model of Organizations as Interpretation Systems," *Acad. Mgt. Rev.* 9,2 (April 1984), 2848-295.
8. Dennis, A.R., George, J.F., Jessup, L., Nunamaker, J.F. Jr., and Vogel, D.R., "Information Technology to Support Electronic Meetings," *MIS Quarterly* 12,4 (Dec. 1988), 591-624.
9. DeSanctis, G. and Gallupe, R.B., "A Foundation for the Study of Group Decision Support Systems," *Mgt. Sci.* 33,5 (May 1987), 589-609.
10. Dickson, G.W., Senn, J.A. and Chervany, N.L., "Research in Management Information Systems: The Minnesota Experiments," *Mgt. Sci.* 23,5 (May 1977), 913-923.
11. Elofson, G.S. and Konsynski, B.R. "Performing organizational learning with machine apprentices," *DSS* 10 (1993), 109-119.
12. Huber, G. P. "Organizational Learning: The Contributing Processes and the Literatures," *Org. Science* 2,1 (Feb. 1991), 88-115.
13. Kahneman, D. *Attention and effort.* Prentice-Hall, Englewood Cliffs, New Jersey, 1973.
14. March, J.G. and Simon, H.A. *Organizations.* Wiley, New York, 1958.
15. Mintzberg, H., Raisinghani, D. and Theoret, A., "The structure of "unstructured" decision processes," *Admin. Sci. Q.* 21 (1976), 246-275.
16. Morrison, J., "Organizational Memory Information Systems," working paper, University of Wisconsin, Eau Claire, 1995.
17. Neustadt, R.E. and May, E.R. *Thinking in time: The uses of history for decision makers.* The Free Press, New York, 1986.
18. Parsons, T., "General Theory in Sociology," in *Sociology Today: Problems and Prospects*, R. Merton, L. Broom, and L.S. Cottrell Jr., Eds., Basic Books, New York, 1959, 3-37
19. Pinsonneault, A. and Kraemer, K.L. "The Impact of Technological Support on Groups: An Assessment of the Empirical Research," *DSS* 5 (1989), 197-216.
20. Rao, V.S. and Goldman-Segall, R. "Capturing Stories in Organizational Memory Systems: The Role of Multimedia," in *Proc. of the 28th HICSS*, Jan. 3-6, 1995, Vol. IV, 333-341.
21. Reagan, P. and Rohrbaugh, J. "Group Decision Process Effectiveness: a Competing Values Approach," *Group & Org. Studies* 15,1 (March 1990), 20-43.
22. Salton, G., "Another Look at Automatic Text-Retrieval Systems," *C ACM* 29,7 (July 1986), 648-656.
23. Sandoe, K. and Olfman, L. "Organizations of Memory: A Simulation," in *Proc. of the 27th HICSS*, Jan. 4-7, 1994, Vol. IV, 161-170.
24. Schatz, B.R. "Building an Electronic Community System," *J. MIS* 8,3 (Winter 1991-1992), 87-107.
25. Stein, E.W. "A Method to Identify Candidates for Knowledge Acquisition," *J. MIS* 9,2 (Fall 1992), 161-178.
26. Stein, E.W. and Zwass, R. "Actualizing Organizational Memory With Information Systems," *Info. Systems Res.* 6,1 (1995), 85-117.
27. Walsh, J.P. and Ungson, G.R. "Organizational Memory," *Acad. Mgt. Rev.* 16,1 (1991), 57-91.

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