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Investigating the Use of a Data-Warehouse at a Fortune 500 Company

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Abstract

This exploratory study investigated the role of a data-warehouse as an information source for decision support applications and its recognized value by the system users. Also, system and non-system issues that should be addressed for the effective use of a data-warehouse were discussed. Relevant data were collected through a survey and interviews from users of the data-warehouse at a large enterprise. Data analysis, in general, confirmed that data-warehouse was critical especially for managerial decision supports. However, there were several system design- and system management-related issues that needed more attentions to optimize its utility and to increase the satisfaction of users.

Introduction

Data-warehouse has emerged a strategic technology to serve the organizational information need. Its potential to catalyze the effectiveness and efficiency in managing businesses was numerously quoted. Organizations use the data-warehouse for a variety of tasks such as planning, customer-oriented target marketing, decision-making, analysis, and customer services to name a few. Practitioners agree that the data-warehouse is changing the way business gets done. Its effective use not only creates differences in operational performances but also can facilitate re-engineering of organizational procedures (i.e., streamlined reporting) and resource allocations. This exploratory study investigated the role of a data-warehouse as an information source for decision support applications and its recognized value by the system users.

Data Collection

Development of a Survey

A survey (many with 7-point Likert scale) was designed to gather relevant information on the usage of a data-warehouse and its perceived value as a decision support system. To collect additional information that was difficult to acquire through the survey, unstructured interviews were conducted as well. Interviews were held twice and each lasted about two hours. Besides, frequent talks with two managers at the department of information technology were highly informative in carrying out this study. Four MIS professors assisted the validation of survey items in its appropriateness and clarity of question items. IT manager from the surveyed company also got involved in its evaluation.

Data Collection

Data was collected from a large Fortune 500 enterprise. It has created a data-warehouse system to address challenges posed by the exponential growth of databases and to respond the need of more integrated environment for an intelligent information support. The company installed a powerful UNIX-based DBMS system that supports parallel processing to optimize the throughput of database computing in the data-warehouse. Data in the data-warehouse were periodically updated from various transactional and other operational databases housed at online transaction servers and a mainframe computer. It was learned that the data-warehouse maintained about 1,400 tables.

Respondents were randomly selected from the users of the data-warehouse. Users from 14 different functional departments including finance, marketing, operations, and information technology (IT) participated in the survey. There were five categories of hierarchical status at the company: union workers, 1st line (or lower) management, middle management, top management, and contracted consultants, each belonging to a grade scale.

Data Analysis

Tasks Characterization

Users of the data-warehouse were characterized in terms of the nature of their organizational tasks. Average values indicated that data-warehouse users, in general, dealt with complex tasks (5.57/7) that require frequent decision-makings (5.51/7). Many respondents agreed that their tasks require cross-departmental processes (5.54/7). Data-warehouse users needed extensive access to company information (6.09/7) to carry out their tasks. Respondents, in general, didn't have the problem of information overload (3.51/7). Rather, certain users appeared to suffer from the lack of information (4.68/7) and low reliability of available information (4.68/7).

Next, the responses from the 1st line management were compared with those from the middle management based on two sample t-tests (Table 1). As expected, middle management dealt with more complex and cross-functional tasks than lower management. Overall, the chance that manager's tasks were hampered due to the information overload appeared to be low, especially for the 1st line management. The average response, on the other hand, manifested that too much information could be problematic for effective decision-makings among middle managers. Although statistically insignificant due to large standard deviations, substantial difference in average values appeared to indicate that middle management could suffer more from the reduced information reliability than 1st line management.

Table 1. Comparison between Lower Management and Middle Management

Question items	1 st Line Mgmt	Middle Mgmt	t-ratio	p
Task nature		4.18		
Q1. Task repetitiveness	3.50	5.85	-1.452	.153
Q2. Tasks complexity	5.20	5.85	-2.520	.015*
Q3. Frequent decision-making	5.45	6.03	-1.342	.186
Q4. Cross-functional tasks	5.10		-2.779	.008*
Information and decision making				
Q5. Extensive information use	5.95	6.29	-1.339	.187
Q6. Lack of information	4.55	4.74	-.389	.699
Q7. Too much information	2.95	4.22	-2.561	.014*
Q8. Lack of information reliability	4.25	4.92	-1.224	.227

Usage of the Data-warehouse

Investigation was made on the types of tasks for which data-warehouse had been used (Table 2). In general, more users were accessing the data-warehouse for the purpose of decision-making support, status monitoring, and planning than other routine tasks such as administrations. More than 70 percent of respondents were using the data-warehouse for decision-making support. The importance of the data-warehouse as a decision support system was also indicated by that the daily access frequency was highest for the tasks of decision-making (3.45/day) and status monitoring (2.82/day). Relatively fewer people used it for routine tasks such as administration, accounting, resource allocations, and budgeting. Its usage for human resource management was minimal (about 8 percent and 0.02 access/day).

Table 2. Use of the Data-warehouse for Different Tasks

Types of work	Access Yes	Access No	per day	Std.
Decision-making support	45 (70.3%)	19	3.45	7.29
Status monitoring	38 (59.4%)	26	2.82	9.02
Planning	28 (43.7%)	36	0.73	1.98
Forecasting	20 (31.2%)	44	0.63	1.99
Administration	19 (29.7%)	45	2.18	12.6
Accounting	19 (29.7%)	45	1.47	4.59
Resource allocation/budgeting	13 (20.3%)	51	0.33	1.27
Human resource/labor relations	3 (7.8%)	59	0.02	0.13
Others	12 (18.7%)	52	0.98	3.29

Perceptions of the Data-warehouse

User perceptions of the data-warehouse were investigated to reveal the areas that system designers and administrators should place more attentions in developing and maintaining the system. In general, respondents thought that data quality was acceptable, though not overwhelmingly positive. Data currency (or being updated) and level of details received relatively higher acceptance from users. However, users were not satisfied with the consistency and accuracy of the data. 'Data consistency' received the lowest acceptance among the quality dimensions. Data currency and level of details are largely affected by administrative or managerial policy for a system, whereas data consistency and accuracy are decided by the procedural quality of data processing. The statistics appeared to indicate that users were less satisfied with the latter than the former. In that the data-warehouse imported data from transactional systems as a form of data dump, most of the quality problems in consistency and accuracy were inherited from the operational systems. Nevertheless, this result warranted that more measures should be taken so that the

information or knowledge generated from the data-warehouse maintains high reliability. This issue is especially important because the data become non-volatile once they are housed in the system.

Data summary indicated that data locatability could be a major roadblock for the effective use of the data-warehouse. Users responded that data location was not easy (3.7/7) and the definition of data attributes was not detailed enough to effectively support their tasks (3.4/7). The difficulty in data location was also brought up a few times during the interviews. The results indicated critical importance of extensive, multi-level abstractive and systematic meta-data readily available and constantly updated for end-users. It also appeared that the lack of knowledge among users regarding the data structure appeared to have substantially contributed to the difficulty in locating the right information. Improved user training for the data-warehouse system was expected to address the problem. Finally, interviews revealed that end-users should be given concrete contact points when they encountered difficulties in the system use. The absence of designated people that provide relevant information appeared to have aggravated the locatability problem in this study.

Data analysis indicated that overall performance of the data-warehouse system could hamper knowledge workers' productivity. Majority of the dissatisfaction with the performance was focused on the slow response time. It appeared that the slow system response was caused partially by heavy use of the data-warehouse, by ineffective definition of data structure, and by the lack of knowledge from certain users. Interviews indicated that the lack of "deliberate intelligence" in the submitted database queries sometimes was costly enough to use up several days of computer processing time. It was also pointed out that more careful data modeling was needed (i.e., merge of tables that were frequently joined) to reduce unnecessary computing. Besides, lack of system flexibility and functionality were also discussed as the source of performance problems.

Users were highly vocal that the data-warehouse was critical in improving the productivity of their tasks (5.9/7). They were, in general, satisfied with the quality of generated information (4.9/7). Nevertheless, there were several system-related and organizational issues that had to be addressed to improve the effectiveness and the utility of the data-warehouse system.

Conclusions

The data-warehouse has emerged as a strategic computing technology for the organizational decision support. It deals with orders of magnitude larger than conventional databases and is subjected to complex ad-hoc queries. Naturally, the development and maintenance of a data-warehouse offer various challenges such as the migration of data from legacy systems, high data quality, management of the system (i.e., access policy), and education and training to name a few. This empirical study was an attempt to empirically investigate technological and organizational issues that system designing and operating staff is to be aware of to better serve the information need of data-warehouse users and optimize the strategic value of the system. This exploratory study confirmed that the system was critical in serving a variety of tasks from routine works to complex planning and decision-making support. Users were highly positive on the role of the data-warehouse in enhancing their work productivity. On the other hand, concerns (some were system-related and others were managerial) were consistently surfaced as well. Among them, organizational efforts to increase the data quality, to furnish methodology for convenient data location, and to increase system response via increased training and education appeared to be especially important. Overall, it became clear that the assessment and design of data-warehouse system from user need perspective was important for the successful adoption of the system for organizational operations.