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An Exploratory Research on Data Management in the Multidatabase Environment

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ABSTRACT

This paper outlines a research framework on data management in the multidatabase (MDB) environment with the specific focus on the implementation of the federated database system (FDBS). We propose that (1) one essential goal of data management in MDB environment is to balance the organizational tension between empowered subunits and organizational integration and coordination; (2) the selection of FDBS development methodology depends on topologies of organizations; (3) elements of political and power balancing are much relevant to understanding resistance to FDBS implementation; and (4) the role played by middle managers of organizational subunits is two-fold. Empirical studies will be developed with a multi-method approach to investigate relationships proposed herein.

Keywords

Multidatabase, FDBS, data management, resistance, middle managers.

INTRODUCTION

Today, most organizations are operating in MDB environment (Sage and Cuppan, 2001), within which one of the most fundamental organizational tensions is the one between various autonomies of empowered subunits and overall organizational integration and cohesion (Ghoshal and Gratton, 2002). To anticipate and evaluate interactions of IT-organizations, it is essential for Information Systems researchers to take into account the existing institutional contexts and intentions and actions of key players within. However, questions are still untouched as to how data management in MDB environment addresses the preceding tension, or what are the critical factors that shape the organizational transformation associated with the process. This paper presents a research framework on data management in MDB environment with the specific focus on the implementation of FDBS.

DATA MANAGEMENT IN MDB ENVIRONMENT

MDB environment is formed from a variety of component systems (Sage et al., 2001). Legacy systems and cutting-edge technologies may coexist in the organization. Also, over the last decade, large organizations focused on creating empowered managers by breaking up the hierarchical structure into small functional subunits (Ghoshal et al., 2002). Depending on processes and methods to configure these subunits, database systems may have been developed independently without considerations of data incorporation and integration. Moreover, organizations may experience mergers or splits. In either situation, existing systems have to evolve accordingly (Atzeni, Cabibbo and Mecca, 2000). Thus, MDB environment is best considered as an outcome of contingencies upon system variations and organizational evolution.

MDB environment is usually characterized along three dimensions: distribution, heterogeneity and autonomy (Sheth and Larson, 1990). When data are distributed among organizational subunits as a natural state rather than an artificial outcome of partitioning a single database entity, data redundancy and discrepancies are always the case; one may also face value inconsistencies (Litwin, Mark and Roussopoulos, 1990). Therefore, fitting in subunit autonomy with operational and managerial independence, database systems are often under separate and isolated control among various value activities with self-governing and empowerment (Hoffer, Prescott and McFadden, 2004). Data heterogeneity due to differences in database management systems (DBMS) and data semantics further complicates the situation.

MDB environment brings forth an organizational tension between autonomous subunits and overall organizational integration and cohesion. Creating relatively autonomous subunits achieved significant benefits (Applegate, Austin and McFarlan, 2002; Handy, 1992). The existence of autonomy, however, also leads to fragmentation and deficiencies among

organizational activities. It is a natural need for organizational integration and cohesion to achieve benefits of knowledge sharing and coordination across organizational subunits (Ghoshal et al., 2002).

However, organizations operate within interplays of various forces; even the most decentralized of organizations have to maintain a strong need for central control over standards and operating procedures (Porter, 1985). In MDB environment, for the good of the organization, data management efforts need to preserve managerial benefits of the empowerment and, in the meantime, support the pursuit of organizational integration and cohesion. One of our research objectives is to define a workable model of IT to address the preceding organizational tension. The end product of the model is common access to an overall architectural information foundation, which in turn leads to consistency of data, more easily integrated systems, and corporate-wide knowledge sharing.

Proposition 1: One essential goal of data management in MDB environment is to properly balance the organizational tension between empowered subunits and organizational integration and coordination.

FEDERATED DATABASE SYSTEM

Different than the classical database systems (Litwin et al., 1990), FDBS represents “a newly rediscovered” approach to data management in MDB environment (Sage et al., 2001). Vimercati et al. (1997) characterize FDBS as a collection of cooperating autonomous component databases. These systems make databases interoperable without a globally integrated schema, and allow applications to be systematically designed such that different data can reside in dedicated databases.

By encouraging autonomy of subunits with organizational integration and combining functional varieties with shared purposes, FDBS provides an opportunity to increase abilities to coordinate various value activities organization wide. As subunits are generating more data and performing activities functionally, FDBS allows comprehensive analyses and use of the expended data. In this sense, benefits of subunit empowerment can accrue when FDBS creates new interrelationships and expands organizations such that the desired “ecological balance” is obtained for organizational efficiencies and effectiveness (Sage et al., 2001).

Proposition 2: A dual goal of data management in MDB environment can be satisfied with the implementation of FDBS, by which both autonomy of component database systems and organizational needs for data sharing and coordination can be well-recognized compatibly and simultaneously.

Technically, the implementation of FDBS primarily consists of integrating existing component databases. Sheth et al. (1990) propose two methods for the purpose. With the bottom-up method, a federated schema is generalized from a set of more specialized applications. The top-down method follows the reverse procedure, which collects and analyzes federation user requirements to define new external schemas or extensions to the existing external schemas. In both processes, a data repository plays an important role in coordinating heterogeneous data activities.

Specifically, FDBS development methodology depends on topologies of organizations, within which sets of rules and structures provide premises to identify and understand data flow and data utility among various organizational activities (Davis, 1982). The most observable variables that have direct influence on FDBS implementation are the existing formal structure and political alignment of an organization. In a centralized organization, decision-making, flow of goods and services, and functional activities are initiated at the same central point or place of concentration and disseminated to local authorities. In a decentralized organization, decision-making and actions are initiated by end users or locations rather than by a consolidated central organization (Bridgefieldgroup, 2005). Sujitparapitaya, Janz and Gillenson’s study (2003) ties the implementation of data warehouse to modes of IT governance, and provides an insightful angle to view the interaction of IT-organizations. Our research uses their framework to examine the relationship between the implementation of FDBS and characteristics of organizations.

Proposition 3: In a centralized environment, where an existing FDBS may have already been in function, or a distributed database system with a single centralized DBMS may have been taking role, it is more appropriate to implement FDBS with the top-down method.

Proposition 4: In a decentralized environment, where more organizational functions and powers are dispersed or distributed within subunits, it is more appropriate to use the bottom-up method to integrate the existing databases.

ORGANIZATIONAL TRANSFORMATION

FDBS as a highly “adaptive system” may induce profound structural evolution of organizations (Drucker, 1999). FDBS is directed toward defining the organization’s relationship to its environment by taking the whole organization as the unit of

analysis. The corresponding data management efforts attempt to re-describe dynamics of IT-organizations. Although managerial traditions of organizational subunits are respected to some degree, data management in MDB environment involves a great deal of complexity in both technical and political aspects as intraorganizational walls may be torn down and the interrelationships among systems, functions, and subunits are re-examined. Therefore, autonomy and empowerment of subunits have to be adjusted to fit in the need for organizational coordination and cohesion. To date, there is no systematic examination of organizational transformation surrounding FDBS implementation. This research investigates impacts of two variables involved: implementation resistance and roles of middle managers.

Elements of political balancing and power reallocating are much relevant to the understanding of resistance to the implementation of FDBS and of organizational transformation it stirs. People instinctively hate changes, especially when these changes involve power and politics (Dennis and Wixom, 2003). In an organization, autonomy and empowerment of subunits may differ in the extent to which they actively seek to gain power, however, as the interaction theory suggests, once the power and interest structure has been formed, it is usually hard to change or make people give it up voluntarily (Markus, 1983). Likewise, politics has “a chilling effect” for fear of harming a political position (Browne and Ramesh, 2002). Markus (1983) defines resistance to system implementation as “behaviors intended to prevent the implementation or use of a system or to prevent system designers from achieving their objectives.” This research takes the framework of the interaction theory to examine the nature of resistance in the context of FDBS implementation.

FDBS attempts to balance management paradoxes of power and control tension by controlling the process in a well-recognized way (Sage et al., 2001). However, when data management efforts cut across several diverse organizational subunits with heterogeneous databases and managerial traditions, it is the very case that the organizational restructuring and the implementation features of FDBS create new interest and power groups, and encourage more data mobility among subunits. Thus, intraorganizational political balancing and power reallocating become inevitable. This research examines the relationship between the degree of resistance to the implementation of FDBS and the degree of power and interest redistribution designed into FDBS. Basically, the empirical study by Markus (1983) suggests that resistance to system implementation be viewed as a variable intervening between the degree of change in the intraorganizational balance of power and the degree of power shift actually realized in the organization.

Proposition 5: Strength of resistance to the implementation of FDBS is strongly related to the size of the political loss and its perceived importance of the organizational subunits, and is also likely to be affected by “the organizational position of the person or subunit to whom one loses power.”

One key variable involved in FDBS implementation is middle managers of subunits due to their impacts on the competitive environment at industry, corporate, and business unit levels (Ruefli and Wiggins, 2003). On the one hand, data management efforts in MDB environment act on individual managers, who serve as mediators to address various organizational tensions. Through the lens of the structurational model of technology (Orlikowski, 1992), FDBS, once physically and socially constructed, becomes sets of rules and resources reified and institutionalized with independent and inhuman forces, which middle managers are required to follow and in turn define their behaviors and perceptions of the organization. On the other hand, human actors are highly knowledgeable and reflexive; they are proactively approaching to the environment (Giddens, 1984). While these managers are shaped by institutional rules and resources over the process, they can reshape the local conditions and the institutional environment in the form of behavioral and managerial adoption of or resistance to it.

Proposition 6: Within the process of FDBS implementation, the role played by middle managers is two-fold: as a predictor variable, they exercise significant impacts on the success of data management efforts within MDB environment; and, as a criterion variable, they have to adjust themselves managerially and behaviorally in response to FDBS implementation.

METHODOLOGY

In this research, a multi-method approach including replicated case studies, follow-up interviews, and two research surveys is administered to IT-related and other functional/divisional managers in seven multinational companies configured with heterogeneous systems. The case study accompanied with document examination allows conducting a thorough examination of data environment and potential organizational tensions within each organization. The follow-up interviews and the research surveys are conducted to collect information about management practice of middle managers, their system requirements for decision-making, and perceptions of and response to possible power re-structuring. The multi-method approach attempts to combine qualitative and quantitative methods to meet needs of research discovery and justifications in one single research.

CONCLUSION

This paper outlines a research framework on data management in MDB environment. A series of propositions are presented for empirical studies to address functionalities of data management and FDBS implementation. With a multi-method research approach, specific empirical investigations of the relationships between involved organizational variables attempt to define their causative relationships within a structural modeling so that specific mediation effects as well as direct casual effects can be identified and assessed.

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