Success of Data Resource Management in Distributed Environments: An Empirical Investigation[1]

By: Hemant Jain
University of Wisconsin-Milwaukee
School of Business Administration
Milwaukee, WI 53201
U.S.A.
jain@csd.uwm.edu

K. Ramamurthy
University of Wisconsin-Milwaukee
School of Business Administration
Milwaukee, WI 53201
U.S.A.
ramurthy@csd.uwm.edu

Hwa-Suk Ryu
Samsung Data Systems Co. Ltd.
Imkwang Bldg., 219-1, Migun Dong.
Seodaemun-Gu, Seoul, 120-020
SOUTH KOREA

Masoud Yasai-Ardekani
University of Wisconsin-Milwaukee
School of Business Administration
Milwaukee, WI 53201
U.S.A.
yasai@csd.uwm.edu

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Abstract

The trend toward distributed processing has significantly increased the awareness of data as a key corporate resource and underscored the importance of its management. In spite of this, there is a lack of empirical investigation of issues related to data resource management (DRM) in distributed processing environments. Being perhaps the first empirical attempt, this exploratory study identifies four information systems (IS) variables related to DRM in a distributed environment. It also seeks to examine the notion of gestalt fit *to describe the nature of the relationships among these variables. In addition, the study evaluates whether internally congruent groups outperform their opposites in realizing DRM success. The results of* cluster analysis *support the view of gestalt fit by identifying five clusters. The results also suggest that organizations represented by a well-blended configuration of high intersite data dependence, high centralization of IS decisions, high concentration IS resources at the central site, and low DRM-related autonomy granted to local sites appear to realize a greater degree of DRM success than the other groups. The implications of the study are discussed, and further research directions are proposed.*

Keywords: Data resource management, distributed processing, distributed databases, gestalt fit, cluster analysis, autonomy, centralization, intersite data dependence

ISRL Categories: AI0104, AI0401, AI0402, AI0403, AI0607, AI0702, EG0101, EG0102, EG0103, EG0201, EG0202

Introduction

Significant developments in hardware, telecommunications, and database technologies, accompanied by greater computer literacy of end-users, allow organizations to be more responsive by providing timely information to users in widely dispersed locations

(Cash et al. 1992; O'Brien 1993). To effectively achieve this goal, organizations are moving toward distributed processing systems that allow local processing and storage of data and greater end user control. Additional benefits offered by these systems include greater flexibility, enhanced reliability, faster response time, lower costs, and improved performance (Bray 1982; Cash et al. 1992). In order to realize these benefits, organizations are downsizing or re-engineering fairly large and complex systems to client/server and cooperative processing environments (Charan 1991; Schlack 1991). However, in a distributed environment, there is much greater propensity for proliferation of locally developed systems on a variety of platforms. This results in redundant and fragmented data sources with their accompanying problems of data inconsistency, security, and integrity. Thus, there is increasing need for companies to recognize data as an important corporate resource that they should carefully plan and manage (Niederman et al. 1991).

In many organizations, data resource management (DRM) is responsible for a number of data planning and DRM policy functions, such as developing and enforcing data naming conventions, data dictionary standards, and data integrity and security policies (Guide 1977; Kahn 1983; Tillmann 1984). The technical DRM functions include managing operation of the database, data modeling and design, database protection, documentation, and education and support (Auerbach 1975; Gillenson 1982; Kahn 1983; Leong-Hong and Marron 1978; Weldon 1981).

The complexity and the importance of DRM increase significantly in a distributed processing environment. In this environment, DRM should support local autonomy and control while ensuring adherence to an organization's data management policies and standards. Poorly organized DRM functions in distributed environments can result in important corporate information being locked in a variety of systems. This makes it difficult to compile, integrate, and consolidate information, and to interpret and share data across applications and sites. Furthermore, conflicts may arise among local sites and with corporate groups on issues of responsibility, accountability, and control over data resources, thereby affecting organizational performance. On the other hand, an effectively organized DRM function offers a number of benefits such as reducing errors and increasing the ability to access previously unavailable information (Goodhue et al. 1988).

Success of DRM requires a set of processes for effectively formulating and implementing DRM policies through data administration and data base administration functions (Laudon and Laudon 1991). A hierarchical structure based on a central DRM with global responsibility for DRM functions and local DRMs with responsibility for DRM functions at local sites has been proposed (Jain and Ryu 1988). However, adequate guidelines for organizing effective DRM functions in a distributed environment do not exist (Goodhue et al. 1992a).

A DRM function can be considered effective and successful if it meets key objectives such as maintaining data integrity and data availability and allowing standard enforcement. The effectiveness of the DRM function in a distributed environment is likely to depend upon many factors including the need for sharing information among the various sites, the role of IS within the firm, the nature of IS leadership style, the structure of the IS function, the pattern of IS resource deployment across sites, the demand for data security, and the organization of the DRM function. However, greater DRM effectiveness results in conditions where there is congruence among key IS factors. The idea that congruence or fit among key organizational and environmental factors yields greater effectiveness underscores much of the contingency theories of organizations. The importance of the fit concept has been quite extensively discussed in the organization theory and strategic management literature. Several approaches for empirical testing of the fit concept have been proposed (Venkatraman 1989; Venkatraman and Camillus 1984). Researchers have suggested that high performance results from a proper alignment/congruence between the following: environment and organizational structure (Burns and Stalker

1961), strategy and structure (Chandler 1962; Grinyer et al. 1980), strategy and managerial characteristics (Hambrick and Mason 1984), and strategy and reward systems (Norburn and Miller 1981).

In the IS literature also, researchers have begun to examine the effect of fit among organizational factors on IS performance. A taxonomy of possible alignments between IS and organizational structure has been presented and the argument made that ensuring proper alignment of the organization's structural design and the structure of its IS function is a strategic necessity for many organizations (Leifer 1988). However, no large scale empirical study exists in the IS literature that explores the concept of alignment/congruence or fit between the relevant organizational factors and the performance of one or more IS subfunctions, such as data administration.

The objective of this study is to examine how the concept of fit can be applied to complex IS issues such as those related to designs of effective IS organizations. Specifically, this study focuses on the nature of interrelationships among four IS factors and their impact on DRM success. These IS factors include *intersite data dependence,* reflecting the need for sharing of data among the various sites; *centralization of IS decisions,* depicting the structure of IS decision making; *concentration of IS resources,* representing the pattern of IS resource deployment across sites; and *DRM-related autonomy,* reflecting the organization of the DRM function at various sites. We expect that congruence among these four IS factors will enable corporations to realize greater DRM success and propose a number of congruent configurations. Cluster analysis is relied upon to identify groups of firms that share common characteristics along the four IS factors noted above. This method of analysis is most useful for evaluating fit among a number of variables. The paper is structured as follows: First, the conceptual framework for the study is presented. The operationalization of the constructs used in the study and evaluation of their psychometric properties follows. The data analysis approaches are explained, after which the results are presented. Discussion of the results, their implications for IS practice and research, limitations of the study, and conclusions follow.

Conceptual Framework

The success of the DRM function in a distributed environment can manifest in several different ways. Success may be reflected by the degree to which preset DRM objectives are realized. In most organizations, DRM objectives relate to improvements in efficiency and effectiveness of the DRM function. Such objectives include maintaining data integrity, accuracy, security, and availability; providing timely data; designing efficient data distribution strategies; enhancing operational efficiency; setting and enforcing standards; facilitating enhanced data sharing and reducing redundancy; developing strategic data plans; and training IS personnel and end users, among others.

In a distributed environment, success of the DRM function depends on a number of IS factors. The limited amount of research in this domain suggests that some of the key factors that could influence DRM success include intersite data dependence, centralization of IS decisions, concentration of IS resources, and DRM-related autonomy (Ceri and Pelagatti 1984; Goodhue et al. 1992a, 1992b; Jain and Ryu 1988). Some of these factors, such as intersite data dependence, may depend on the nature of the product/market domains in which the firm operates and the firm's overall organizational structure. Thus, the IS function may not have much influence in determining the extent of intersite data dependence. On the other hand, the IS function may have a great deal of influence on the degree of centralization of IS decisions, degree of concentration of IS resources at the central site, and the level of DRM-related autonomy granted to local sites. The following sections will provide definitions of each factor and discuss the impact of their congruence on the success of the DRM function.

Intersite data dependence

The degree to which local sites (divisions or departments) of an organization are functionally interdependent influences to a significant degree their need for sharing data. This determines the type of and the extent to which intersite data/information flow takes place (Goodhue et al. 1992b). The term intersite data dependence is defined as *the need for sharing data among the various business locations or sites.*

Intersite data dependence is affected by the design of overall organizational structure and the interdependencies among the product/market domains in which the firm operates. Product/market interdependencies are significant in the case of larger, divisionally structured firms that have pursued a strategy of related diversification. Such firms typically operate in a large number of product/market domains that share market and technological similarities. For example, consider a firm that operates in banking, insurance, and real estate markets. In this case, the various product/market domains share significant similarities in terms of their client bases as well as technologies used for delivery of products and services. This situation leads to a complex web of internal and external interdependencies that must be managed effectively to realize synergistic benefits. Effective management in such an environment, however, requires a significant amount of data sharing across sites, resulting in higher levels of intersite data flow.

By contrast, unrelated diversified firms operate in product/market domains that share little market or technological similarities. Consider, for example, a firm that operates in medical electronics, jet engines and paper-making machinery markets. Given the unrelated nature of the product/market domains, the potential for realization of market-related or technologically related synergistic benefits may be very limited. In such an environment, each division may be responsible for its own product development, manufacturing, marketing, and distribution. The need for sharing data in such an environment is generally limited to transferring financial information between the business segments/divisions and the corporate office for financial planning and control purposes. This results in low levels of intersite data flow.

When the data/information flow is primarily within local units, the need for global enforcement of standards can be minimal. This results in a reduced need for hardware, software, and systems compatibility across sites. On the other hand, when a significant amount of data flow occurs among sites, compatibility and standards become important and conflicts may arise. In this environment, it is important to have processes that promote cooperation and aid in the resolution of conflicts between organizational units (Goodhue et al. 1992b; Thomas and Burns 1982). In the absence of coordination and control enabled by the DRM function, important corporate information may either get locked in incompatible local systems or may get held up in turf battles of data ownership. This could cause delays when managers need such information to make key decisions affecting organizational performance.

Centralization of IS decisions

Organizations differ on the extent to which IS decisions are centralized. Decisions that typically fall within the domain of the IS organization include technology acquisition, IS personnel management, selection of systems development projects, and day to day IS operating decisions. Centralization of IS decisions is defined as *the degree to which the authority to make IS decisions is concentrated at the apex of the IS organization.*

Centralization of IS decisions regarding technology acquisition makes it easier to implement various standards, thereby ensuring hardware and software compatibility across sites. Furthermore, centralization of decisions on systems development projects makes it easier to control data redundancy and to enforce uniform data-naming standards. Such centralized IS decision-making structures are deemed suitable for organizations that operate in a single or a few related product/market domains where the level of intersite data dependence is expected to be relatively high. In such an environment, the need for compatibility of both hardware and software platforms across sites is greatest and users at local sites are not likely to have demands for many unique pieces of data/information.

Decentralization of IS decisions is deemed suitable for large, unrelated diversified organizations because such organizations have a low level of intersite data dependence. Decentralization of IS decisions on hardware and software acquisition and systems development projects increases flexibility when selecting hardware and software and systems development projects that best meet the needs of the local environments. However, such flexibility may lead to incompatibility, making it difficult to implement various standards. It may also create data redundancy. But this may not be a problem in conditions where intersite data dependency is relatively low. Hence, designs that either match high centralization of IS decisions with conditions of high intersite data dependence, or match low centralization of IS decisions with conditions of low intersite data dependence, are likely to result in higher DRM success.

Concentration of IS resources

In a distributed environment, IS resources such as hardware, systems and application software, data, and IS personnel can be concentrated to various degrees at the central site. For example, companies may have large mainframes located at a central site, while mid-range and microcomputers may be distributed across various local sites. Similarly, the IS development staff may either be located at one central location or distributed to various locations. Concentration of IS resources is defined as *the degree to which various IS resources such as hardware, software, data, and development staff are concentrated at a central site.*

Concentration of hardware and software resources at the central site makes it easier to ensure compatibility among hardware and software platforms. Furthermore, concentration of other IS resources such as data at the central site may facilitate closer control and management of the data resources in terms of their integrity, security, and compatibility. This may also enable better enforcement of data standards. Moreover, concentration of IS resources will facilitate development of a holistic and comprehensive strategic data plan for the entire corporation and support queries requiring integrated information. Concentration of IS resources may thus be most appropriate for organizations with high levels of intersite data dependence and high degrees of centralization of IS decisions where the need for coordination and control of IS resources may be the greatest. However, concentration of resources also may lead to inefficiencies and delays because all requests for data/information will need to be channeled to the central site for processing.

On the other hand, distribution of IS resources throughout the organization will enable storage of all the data relevant to each site at that site and facilitate rapid responses to local queries. Distribution of IS resources may be most appropriate for organizations with low levels of intersite data dependence and low degrees of centralization of IS decisions, where needs for adaptability and local responsiveness are the greatest. Distribution of IS resources, however, may result in longer response time for queries requiring integration of information from various locations. However, this may not pose a major problem in an environment where intersite data dependencies are relatively low.

DRM-related autonomy

The term autonomy has been used quite extensively in administrative sciences to indicate how much power an organization has relative to its environment (Price and Mueller 1986; Selznick 1953; Van de Ven and Ferry 1980). Whereas centralization of IS decisions relates to the extent to which the authority to make IS decisions is located at the apex of the organization, DRM-related autonomy is defined as *the extent to which local DRM units independently perform their data resource management functions.*

Motivated by popular themes such as downsizing, empowerment, total quality management, flexibility, and quick response to customers, organizations all over the world increasingly have realized that trust in and empowerment of employees hold the key to business success (Davenport and Short 1990; Hammer 1990). The theme underlying the autonomous work group is that the motivation and satisfaction of group members can be increased by providing them with a significant level of autonomy in deciding how to perform a given job (Hackman 1976; Nadler et al. 1979).

It is expected that more autonomy and empowerment will motivate the local DRM groups to work with greater zeal to achieve DRM objectives. Additionally, greater DRM-related autonomy can facilitate a number of technically desirable features in a distributed environment. For example, each site can operate independently and continuously with its own data without requiring other sites to agree on global data structures or definitions (Ceri and Pelagatti 1984). For organizations with low levels of intersite data dependence, low degrees of centralization of IS decisions, and low degrees of concentration of IS resources, high levels of DRM-related autonomy may be most appropriate. In such an environment, low intersite data dependence and decentralization of IS decisions allow for specific hardware and software platforms that are customized to best meet local needs. High levels of DRM-related autonomy will further add to such flexibility and may result in greater DRM success.

However, high levels of DRM-related autonomy also can be a serious and contentious issue in a distributed environment due to potential biases. The danger is in favoring the interests of local sites above the overall corporate interests. Furthermore, if too much DRM-related autonomy is granted to sites, it can result in systems with incompatible databases, data structures, and data naming. It also could lead to important corporate data being locked in smaller, often incompatible, systems leading to a chaotic operating environment. However, in an environment with low intersite data dependence, biases favoring local sites and potential incompatibility of systems may not pose a major problem.

Low levels of DRM-related autonomy may be beneficial in instances where data resources have to be managed to ensure a high degree of standardization, security, and integrity. For organizations with high levels of intersite data dependence, high degrees of centralization of IS decisions, and a high degree of concentration of IS resources, low levels of DRM-related autonomy may be most appropriate. This will ensure a high degree of standardization, security, minimum redundancy, and greater compatibility leading to increased DRM success. However, too little autonomy may be dysfunctional as it is incompatible with the themes of empowerment, local ownership/control, flexibility, and responsiveness in contemporary organizations.

Congruent configurations

Based on the above discussion, it is clear that the four IS factors (intersite data dependence, centralization of IS decisions, concentration of IS resources, and DRM-related autonomy) are intricately tied to the success of DRM. This paper proposes that the success of DRM in distributed environments depends upon the proper alignment/fit among these four IS factors. A model depicting such congruence is shown in Figure 1.

The notion of congruence reflected in the conceptual model suggests that an organization's position within this four-dimensional space influences the extent of DRM success. For instance, when an organization has a high level of intersite data dependence, the need for coordination and control of DRM activities is much higher. In such a context, it appears prudent to locate most of the IS resources at a central site. Concentration of IS resources at the central site enhances coordination of resources, enables closer control, ensures greater security, and results in greater efficien-

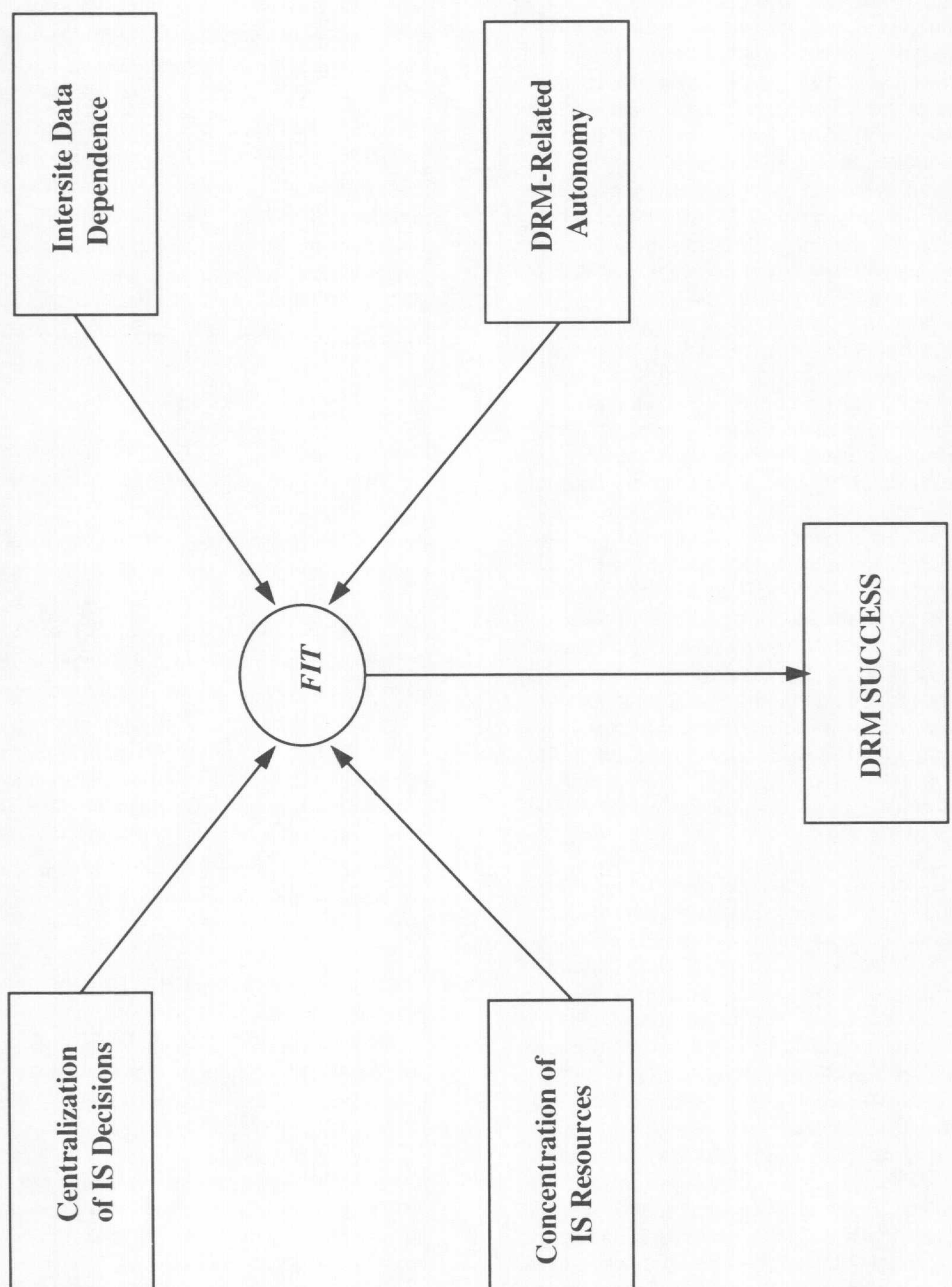

Figure 1. A Model of Fit Among IS Factors and DRM Success

cies in resource utilization. Also, centralization of strategic and management control of IS decisions will facilitate development of more comprehensive long-term plans for resource acquisition and usage in an environment where most of the IS resources are concentrated at the central site and the need for data coordination is high. Furthermore, in such an environment, it appears logical to permit low levels of DRM-related autonomy to local sites in order to avoid proliferation of incompatible databases, minimize data redundancy, and permit greater sharing of common data across multiple sites.

On the other hand, if the local units/sites are independent of each other, as in the case of an unrelated diversified firm, then intersite data dependence is relatively low. In such an environment, the need for local responsiveness of DRM is much higher. Greater distribution of the IS resources to local organizational units is in order, as it permits greater flexibility in processing information. It also allows more timely responses to users' information needs. In such an environment, decentralization of IS decisions will facilitate development of hardware and application architectures that are customized to the needs of the local organizational units. Additionally, in these conditions, higher levels of DRM-related autonomy granted to local sites will allow them to respond quickly and effectively to the unique informational needs of the site.

Not all organizations achieve congruence among all of the four IS factors. For instance, consider an organization with high centralization of IS decisions accompanied by high concentration of IS resources at the central site and low levels of DRM-related autonomy to local sites. If such a firm is a fairly large and unrelated diversified corporation operating in multiple markets without much market or technological similarities, as already noted, there is bound to be little, if any, intersite data dependence. While there is congruency among the first three IS factors, this configuration is non-congruent with low intersite data dependence. Although this firm will be able to function, it is easy to visualize that the non-congruence among the IS factors will lead to considerable delays and inefficiencies in responding to both internal and external information needs. In the same vein, consider an organization with low centralization of IS decisions accompanied by low concentration of IS resources at the central site and high levels of DRM-related autonomy to local sites. If this firm is operating in product/market domains that have high market or technological similarities, then there is bound to be a high level of intersite data dependence resulting in a significant amount of data flow between these sites. In such a scenario, the lack of congruence can lead to a duplication of efforts, difficulty in coordinating and integrating information, inaccurate information, and wasted resources.

Based on the previous discussions, in well-designed distributed processing environments, the configuration characterized by high intersite data dependence, high centralization of IS decisions, high concentration of IS resources, and low DRM-related autonomy is likely to result in greater DRM success. Likewise, the opposite configuration—characterized by low intersite data dependence, low centralization of IS decisions, low concentration of IS resources, and high DRM-related autonomy—is also likely to lead to greater DRM success. Between these two extremes there may be other congruent configurations where these IS factors are at moderate levels. Various types and levels of non-congruence may also exist, which can hamper DRM success.

Thus, we posit that only the congruent combinations of the four IS factors are expected to be associated with greater DRM success. Such a view is in accordance with the notion of fit as a gestalt (Venkatraman 1989). The following hypothesis is proposed:

> Organizations with internally congruent combinations of the four IS factors—intersite data dependence, centralization of IS decisions, concentration of IS resources, and DRM-related—autonomy will display greater DRM success than those without such congruence.

Research Methodology

Data

Data were collected from firms across the mainland of the United States through a survey instrument. An initial version of the survey instrument was developed based on the theory-grounded operationalization of the various constructs. This version was subsequently refined through extensive pretesting with academics having significant expertise in databases, distributed systems, data administration, and management. The instrument was further pilot tested with ten data administrators and chief information officers from different firms in a major metropolitan area in the Midwest. The multiple phases of instrument development and testing resulted in a significant degree of refinement and restructuring of the survey instrument as well as establishing the initial content validity (Nunnally 1978).

Since larger organizations are more likely to have well-established DRM functions and are also likely to be operating in a distributed systems environment, *Business Week*'s top 1,000 companies in the U.S. (*Business Week* 1989) served as the target population. Given the importance of this contemporary topic, the questionnaire was personally addressed to the CIOs of all the 1,000 firms after verifying their names with the *Directory of Top Computer Executives* (Applied Computer Research 1989). A total of 220 usable responses were returned, providing a response rate of 22%. Given that the survey was unsolicited and the instrument quite complex, this response rate can be considered satisfactory and comparable to other studies in IS research (Raho et al. 1987).

The responding firms were generally large in size (mean = 18,217; median = 6,000 employees) and represented a wide variety of industries in manufacturing (automotive products, chemicals, pharmaceutical, electronics, etc.) as well as in service (banking, insurance, utilities, transportation, food services, retail) sectors. There was an even distribution between manufacturing and service sectors (51.4% in manufacturing and 48.6% in service). These firms operated a fairly large number of facilities (mean = 88) as well as a number of DRM sites (mean = 11), suggesting that a distributed environment is indeed a fair representation of the organizations at the time of the study.[2]

Operationalization, validity, and reliability of research constructs

An exploratory factor analysis using principal components factor analysis with varimax rotation was performed to examine the *unidimensionality/convergent validity* (Nunnally 1978) of each predefined multi-item construct. A joint factor analysis (using all the indicator items of all the antecedent variables) employing the same factor extraction and rotation approach was employed to determine *discriminant validity* (Price and Mueller 1986). The four commonly employed decision rules (Hair et al. 1979) were applied to identify the factors: (1) minimum eigen value of 1; (2) minimum factor loading of 0.40 for each indicator item; (3) simplicity of factor structure; and (4) exclusion of single item factors from the standpoint of parsimony. Reliability was evaluated by assessing the internal consistency of the indicator items representing each construct using Cronbach's alpha (Cronbach 1951). Previous research suggests a value of 0.60 to 0.70 to be acceptable in exploratory research (Yoon et al. 1995, p. 92). As will be detailed, the results affirm that all of the scales display satisfactory levels of reliability with alpha values much higher than the minimum threshold.

The results of factor analysis relating to unidimensionality/convergent validity are shown in Appendix A. Details of the indicator items used for operationalization of variables, factor load-

[2]An analysis of these demographic variables across the five clusters of firms derived in this study is discussed later. In light of the fact that the largest 1,000 firms in the U.S. were sampled, that there was an even distribution of both manufacturing and service sectors, and, furthermore, that all of the industry segments in both manufacturing and service sectors were fairly well represented, the results of this study can be generalized to large firms in practically all types of industries.

ings, reliability evaluation, and descriptive statistics for *intersite data dependence, centralization of IS decisions, concentration of IS resources, DRM-related autonomy,* and the two measures of *DRM success* are also provided in Appendix A. These measures are briefly described below.

Intersite Data Dependence

Intersite data dependence captures the extent of interdependence among various business locations (sites) in terms of the intensity of information flows among the sites. Information flow was classified into four categories: online transactions, batch updates, regular report generation, and ad hoc queries. Respondents were asked to indicate the proportion of data involved in each category as a percentage of the total amount of data within the organization. For each data category, the intensity of data flow between sites was measured using a seven-point scale ranging from (1) very little to (7) great extent. The proportion of data flow within each category was multiplied by its intensity. Factor analysis of these four measures resulted in a single factor explaining 54.7% of the total variance. The composite measure of intersite data dependence is constructed as the sum of the proportion of data flow within each category weighted by its intensity. The extent of intersite data dependence (mean = 4.304) appears to be moderate.

Centralization of IS Decisions

Centralization of IS decisions is defined as the degree to which the authority to make IS decisions is located at the apex of the IS organization. The measure of centralization of IS decisions uses 24 of 37 decision items originally developed by Pugh et al. (1968). These items were selected based on their appropriateness and were adapted to represent a wide range of IS decisions. Respondents were asked to indicate which level of management had the authority to make each decision. Management levels were represented on four-point scales ranging from (1) lower management, (2) middle management, (3) chief information officer or CIO, and (4) above the CIO. Respondents were asked to leave out items that were not relevant to them.

Factor analysis of the 24 items revealed four factors explaining 66.9% of the total variance. As shown in Appendix A, these factors represent centralization of IS decisions pertaining to management of IS personnel, selection of hardware and software, IS operational control, and IS project planning. Mean values of items with highest loading on each factor are used as measures of the degree of IS centralization. Factor loading and reliability coefficients are shown in Appendix A. As can be seen, the reliability coefficients are satisfactory. The mean values for these four measures of centralization ranged from 1.77 to 2.48, indicating that, on average, the locus of decision making falls between CIO and middle management.

Concentration of IS Resources

Concentration of IS resources was measured as a percentage of each of the four categories of IS resources: hardware, application software, data, and IS personnel located at central vis-à-vis local sites. Factor analysis of the four items yielded a single factor explaining 83.4% of the total variance. The factor loading ranged from 0.88 to 0.93. The extent of concentration of IS resources is represented by the mean score of these four items. Higher values on this measure denote higher resource concentration at the central site. As can be seen from Appendix A, the reliability of this construct is at a satisfactory level. The sample mean of 72.9% indicates that, on average, a very high percentage of IS resources is concentrated at the central site.

DRM-Related Autonomy

The measure of DRM-related autonomy captures the degree to which local DRM units independently perform the data resource management functions for their sites. Twenty-eight items were used to represent the DRM activities (Durell 1985; Gillenson 1982; GUIDE 1977; Kahn 1983; Leong-Hong and Marron 1978; Tillmann 1984). The respondents were asked to indicate whether each of these activities was predominantly carried out at the local level, central/corporate level, or jointly at both levels. Each item was scored as (1) if the activity was entirely performed at the local level, (0) if the responsibility for the activity resided at the central/corporate level, and (0.5) if the responsibility was shared by both. Respondents also had an option to choose "not applicable" if a particular DRM activity was not performed.

Factor analysis of the 28 *DRM-related autonomy* items resulted in three factors explaining 67.6% of the total variance. These three factors correspond with the paradigm of three management levels (Anthony 1965). As can be seen from Appendix A, the three factors represent the levels of autonomy with respect to operational control DRM functions, management control DRM functions, and strategic planning DRM functions. DRM-related autonomy for each of the three levels was evaluated by the mean score of the individual items with highest loading on each factor. The reliability of these three measures of DRM-related autonomy is satisfactory. The autonomy scores range from 0 to 1 with higher scores indicating greater autonomy. The mean values of these three measures range from 0.17 to 0.23 indicating that, on average, the local sites have low levels of DRM-related autonomy.[3]

DRM Success

While there is a vast body of research on defining and measuring IS success, there is no single measure that covers all aspects (see DeLone and McLean (1992) for a comprehensive summary). In light of the difficulties in establishing a direct link between IS success and organizational performance, user satisfaction, or user information satisfaction (Bailey and Pearson 1983; Ives et al. 1983) has emerged as a good surrogate measure. Even though DRM is a subset of the IS function, a direct application of IS success measures is likely to result in inappropriate scope and lack of precision. More specific and detailed measurement is necessary to evaluate DRM success.

In past research, the performance of data administration usually has been operationalized as a self-reported single-item scale measuring the degree of success (successful, partially successful, or unsuccessful) of data administration in an organization (Gillenson 1982; Kahn 1983). Problems with relying only on such single-item scales are quite well known (Galletta and Lederer 1989). In light of these inadequacies, DRM success was evaluated by two different measures: (1) extent to which preset DRM objectives are achieved and (2) the overall success in implementation of the DRM function.

Achievement of DRM Objectives: Twenty-two items were used to represent various DRM objectives. Respondents were asked to indicate on five-point scales ranging from (1) not successful to (5) very successful the extent of success in achieving each of the 22 DRM objectives. Factor analysis of these 22 items resulted in five factors explaining 69.8% of the total variance (Appendix A). These five factors represent achievement of DRM objectives related to database administration efficiency and effectiveness, strategic planning and information requirement analysis, training and consulting, standard setting and enforcement, and improved data sharing and reduced data redundancy. As can be seen from Appendix A, the reliability of these five measures is at a satisfactory level. Mean values of items with highest loading on each of the five factors are used as measures of success in achieving DRM objectives. The mean values of these DRM success measures range from 3.0 to 3.8, suggesting that, on average, the respondents believe that they have been able to achieve an above average degree of DRM success. A composite measure of overall achievement of

[3]The low values appear to be reflective of the nature of distributed database environment prevailing at the time of the study. However, in view of the skewed values, caution must be exercised while interpreting the results.

DRM objectives was also developed by aggregating the five individual scales.

Overall Success: This measure of DRM success is analogous to the measures used by Kahn and by Gillenson. Respondents were asked to indicate on a seven-point scale ranging from (1) not successful to (7) very successful the overall success in implementation of DRM functions. The mean value of 4.2 for this construct indicates that, on average, the respondents believe that they have realized a better than average level of success in implementation of DRM functions.

Discriminant Validity of Antecedent and Outcome Variables

A joint domain factor analysis was performed, including all of the items used to develop the four original *antecedent* research constructs. The result provides significant support for *factorial/discriminant validity* of the measurement scales (see Appendix B). Seven factors emerged in this analysis. *Intersite data dependence, concentration of IS resources* and *DRM-related autonomy* emerged as single factors. *Centralization of IS decisions* emerged as four subfactors. All 28 items of DRM-related autonomy loaded on a single factor without any cross-loading onto the four subfactors of centralization of IS decisions.[4] This result reiterates the conceptual distinction across these two constructs. The factor loadings were quite high and ranged from 0.43 to 0.89; the seven factors explained 70.8% of the total variance.

Unlike in the antecedent variable domain, *achievement of DRM objectives* was the only multi-indicator variable of DRM success, with the other variable, *overall success*, being a single-item scale. Hence, there was no need to perform joint factor analysis to assess discriminant validity in the outcome variable domain. As already noted earlier in unidimensionality checks, factor analysis of 28 DRM objective items resulted in a five-factor solution with satisfactory factor loading that ranged from 0.54 to 0.85 and explained 69.8% of the total variance. Overall, the various factor analyses results demonstrate satisfactory support for both convergent and discriminant validity of the scales developed to measure the antecedent variables as well as the scales developed to measure DRM success.

Zero-order correlation among all the IS variables are shown in Table 1. Descriptive statistics as well as interitem reliability coefficients (Cronbach alpha) are also displayed in this table. The results of zero-order correlation between the DRM success measures indicate significant correlation (r = 0.37-0.57; $p < 0.001$) between the five dimensions of achievement of DRM objectives and the measure of overall success. This also provides evidence for *criterion validity* of the measure of achievement of DRM objectives (Nunnally 1978). Of the two measures of DRM success, the measure of objective achievement is more comprehensive and focuses on specific DRM functions within an organization. This measure is therefore examined in detail in subsequent statistical analyses presented in this paper. The single item measure, overall success, is used as another indicator of DRM success to provide a more complete picture.

Methods of Analysis

The *fit* or *congruence* among the four IS factors is viewed within a multivariate perspective as one of *gestalt* rather than one of a bivariate fit between each pair of factors. As set forth in the conceptual model, the congruence among the four IS factors is expected to be related to enhanced DRM success. As elucidated in prior research, cluster analysis is recommended as the most appropriate statistical technique for examining such a fit (Venkatraman 1989). Cluster analysis is a technique for grouping individuals, cases, objects, or entities (firms in this study) into groups. It differs from other techniques such as discriminant analysis primarily because of the data inductive approach

[4]Note, however, that the three subfactors of autonomy hat emerged during unidimensionality assessment were used in the subsequent statistical tests so as to not lose the finer granularity of analysis it affords.

Table 1. Correlation Matrix for Antecedent Variables[a]

No. Variables	Mean (S.D.)	VAR-1	VAR-2	VAR-3	VAR-4	VAR-5	VAR-6	VAR-7	VAR-8	VAR-9
1. Intersite Data Dependence	4.304 (1.648)	(0.724)								
Centralization of Decisions on:										
2. Management of IS Personnel	2.484 (0.617)	___	(0.914)[b]							
3. Hardware and Software	2.338 (0.515)	___	0.520****	(0.880)						
4. IS Operational Functions	1.769 (0.588)	___	0.508****	0.549****	(0.851)					
5. IS Project Planning	2.413 (0.429)	___	0.537****	0.532****	0.647****	(0.789)				
6. **Concentration: IS Resources**	72.900 (30.8)%	0.196***	___	0.144**	___	0.186***	(0.937)			
DRM Related Autonomy on:										
7. Strategic DRM functions	0.184 (0.281)	- 0.132*	- 0.131*	- 0.137*	___	- 0.226***	- 0.719****	(0.965)		
8. Mgt. Control DRM Functions	0.232 (0.288)	___	- 0.150**	- 0.183**	- 0.120*	- 0.257****	- 0.683****	0.894****	(0.942)	
9. Operational DRM Functions	0.171 (0.285)	___	___	___	___	- 0.142*	- 0.587****	0.688****	0.797****	(0.802)

Correlation Matrix for DRM Success Variables[a]

No. Variables	Mean (S.D.)	VAR-1	VAR-2	VAR-3	VAR-4	VAR-5	VAR-6
Achievement of DRM Objectives:							
1. DBA Efficiency/Effeciveness	3.787 (0.698)	(0.800)					
2. Str. Planning/Req. Analysis	3.011 (0.846)	0.378****	(0.881)				
3. Training/Consulting	3.317 (0.759)	0.528****	0.421****	(0.751)			
4. Standard Setting/Enforcement	3.196 (0.966)	0.454****	0.430****	0.394****	(0.816)		
5. Data Sharing/Redundancy	3.214 (0.854)	0.382****	0.452****	0.367****	0.454****	(0.736)	
6. **Overall SUCCESS**[c]	4.158 (1.229)	0.571****	0.509****	0.497****	0.494****	0.395****	(N/A)

Note: Only significant correlation coefficients reported; ****p < 0.001; ***p < 0.01; **p < 0.05; *p < 0.10.

[a]Sample sizes vary from 185 to 218 due to missing values.

[b]Cronbach Alpha values within parentheses for each factor.

[c]Scale range is 1 to 7 for this variable while it is 1 to 5 for all others in the table.

in deriving the number and characteristics of the groups/clusters which are not known prior to the analysis (Afifi and Clark 1990). It must be noted that this technique is exploratory in nature. Primarily, this approach seeks to draw out groups whose internal membership is highly coherent in terms of the various attributes/characteristics of objects/entities that are of interest while simultaneously distinguishing each group from other groups. This usually is achieved by maximizing the *Euclidean distance* (of original variables or their transformation to standardized form) and/or *Mahalanobis distance* (Afifi and Azen 1979). This study made use of the *K-Means* clustering technique using the *Quick Cluster* routine available in SPSS software.

Results

Given the exploratory nature of the research study, we experimented with culling out a different set of clusters consisting of two, three, four, five, and six groups, and used different options (*Euclidean* and *Mahalanobis distance*). Regardless of the option, it was imperative to meet the final goal of deriving a parsimonious set of clusters that could be clearly distinguished from one another. To evaluate the distinctiveness of each derived cluster, equality of variable means across the clusters was tested, using the F-test. A *five-cluster* solution was chosen based on meaningfulness of the pattern of relationships among the variables (Hambrick 1983). Table 2 shows variable means and standard deviations related to each of the five clusters (columns 1 through 5). F-values and significance levels associated with the test of equality of variable means across the five groups are shown in column 6. The last column shows pairs of clusters where the variable means are significantly different.

As can be seen from Table 2, both the F-tests and the results of tests of significance of pairwise contrasts indicate that the group means of these five clusters are significantly different except in the case of autonomy on strategic DRM functions. Clusters one and two appear to be internally congruent while the remaining three clusters are non-congruent. Cluster one, relative to the other clusters, represents a group of firms with high intersite data dependence, high centralization of IS decisions, a high concentration of IS resources, and low levels of DRM-related autonomy. Just the opposite characteristics are depicted by cluster two firms. This cluster represents a group of firms with low to moderate intersite data dependence, a low centralization of IS decisions, low concentration of IS resources, and high levels of DRM-related autonomy. Table 2 further shows that clusters three, four, and five depict firms with varying levels/types of non-congruence among IS factors. Table 3 presents the same results in a summary form categorizing the group means of each antecedent variable as "high" (H), "moderate" (M), and "low" (L).

As can be seen from Table 3, cluster three firms display moderate levels of intersite data dependence, a high degree of centralization of IS decisions, a moderate degree of resource concentration, and low levels of DRM-related autonomy. Whereas high degree of centralization of IS decisions and low levels of DRM-related autonomy are congruent, this pattern is noncongruent with moderate levels of intersite data dependence and moderate degree of IS resource concentration. Cluster four firms exhibit a moderate degree of centralization of IS decisions, which fits with the moderate levels of DRM-related autonomy. However, these firms display the lowest levels of intersite data dependence and also low degree of concentration of IS resources leading to a fair degree of non-congruence. Cluster five further illustrates a condition of non-congruence among the IS factors. The firms in this cluster exhibit high levels of intersite data dependence, a low degree of centralization of IS decisions, moderate levels of DRM-related autonomy, and a moderate degree of resource concentration. The source of non-congruency for firms in this cluster is predominantly their high intersite data dependence and low centralization of IS decisions.

The central thesis of this study was that organizations with internally congruent IS factors will outperform (in terms of DRM success) those

Table 2. Cluster Analyses: Five Clusters[a]

Variables	Mean (S.D.) of Cluster Groups: Congruent Groups		Non-congruent Groups			F (d.f./sig.)[b]	Significant Contrast Values
	Group 1 (n = 24)	Group 2 (n = 41)	Group 3 (n = 29)	Group 4 (n = 22)	Group 5 (n = 38)		
Intersite Data Dependence	6.048 (0.59)	3.665 (0.89)	3.869 (0.69)	1.547 (0.55)	5.787 (0.61)	177.1(4,149)*****	1–2****; 1–3****; 1–4****; 2–4****; 2–5****; 3–4****; 3–5****; 4–5****
Centralization of IS Decisions:							
Management of IS personnel	2.800 (0.51)	1.971 (0.47)	3.007 (0.44)	2.573 (0.59)	2.168 (0.45)	26.3 (4, 149)****	1–2****; 1–5****; 2–3****; 2–4****; 2–5*; 3–4****; 3–5****; 4–5****
Selection of hardware/ software	2.692 (0.36)	1.954 (0.44)	2.717 (0.43)	2.418 (0.37)	2.084 (0.41)	23.4 (4, 149)****	1–2****; 1–4**; 1–5****; 2–3****; 2–4****; 3–4**; 3–5****; 4–5****
IS operational control functions	2.142 (0.40)	1.371 (0.37)	2.179 (0.48)	1.918 (0.51)	1.450 (0.33)	28.1 (4, 149)****	1–2****; 1–4*; 1–5****; 2–3****; 2–4****; 3–4**; 3–5****; 4–5****
IS project planning	2.900 (0.48)	1.932 (0.50)	2.945 (0.38)	2.527 (0.52)	2.138 (0.31)	34.8 (4, 149)****	1–2****; 1–4****; 1–5****; 2–3****; 2–4****; 2–5**; 3–4****; 3–5****; 4–5****
Concentration of IS Resources	88.0% (15.1)	60.5% (33.1)	77.8% (30.7)	65.7% (32.6)	78.6% (28.6)	4.32 (4, 149)***	1–2****; 1–4**; 2–3**; 2–5****; 4–5*
DRM-Related Autonomy on:							
Operational DRM functions	0.090 (0.22)	0.281 (0.37)	0.135 (0.22)	0.219 (0.24)	0.153 (0.25)	2.41 (4, 149)**	1–2****; 2–3**; 2–5**
Management control DRM functions	0.160 (0.24)	0.338 (0.36)	0.150 (0.20)	0.217 (0.25)	0.232 (0.30)	2.42 (4, 149)**	1–2**; 2–3****; 2–5*
Strategic DRM functions	0.139 (0.25)	0.256 (0.37)	0.121 (0.22)	0.163 (0.20)	0.175 (0.29)	1.17 (4, 149)$^{n.s.}$	2–3**

[a]Cluster groups derived from *K-Means* procedure using Quick Cluster analysis of SPSS.

[b]Test of significant differences across *Cluster Groups* using one-way ANOVA.

*****$p < 0.0001$; ****$p < 0.001$; ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Table 3. Summary of Cluster Analyses Results: Five Clusters[a]

Variables	Congruent Groups: Group 1 (n = 24)	Congruent Groups: Group 2 (n = 41)	Non-Congruent Groups: Group 3 (n = 29)	Non-Congruent Groups: Group 4 (n = 22)	Non-Congruent Groups: Group 5 (n = 38)
Intersite Data Dependence	H	M	M	L	H
Centralization of IS Decisions:	H	L	H	M	L
Management of IS personnel	H	L	H	M	L
Selection of hardware/software	H	L	H	M	L
IS operational control functions	H	L	H	M	L
IS project planning	H	L	H	M	L
Concentration of IS Resources	H	L	M	L	M
DRM-Related Autonomy on:					
Operational DRM functions	L	H	L	M	M
Management control DRM functions	L	H	L	M	M
Strategic DRM functions	L	H	M	H	M

[a]Cluster groups derived from *K-Means* procedure using Quick Cluster analysis of SPSS. H (High), M (Moderate), and L (Low) indicate relative magnitude of the group means on each variable across five clusters.

organizations that lack such a congruence. One-way ANOVA was used to test for performance differences across the five clusters identified above. As noted earlier, achievement of DRM objectives and overall success are used as indicators of DRM success. The results are shown in Table 4. Columns 1 through 5 show the mean values and the standard deviations of respective DRM success measures for each of the five clusters. Column 6 presents the F-values, degrees of freedom, and significance levels. For each DRM success measure, clusters where the mean values are significantly different from each other are identified and presented in column 7.

As can be seen from Table 4, the results appear to partially uphold the central thesis of the study. The F-tests indicate that the group means of these five clusters are significantly different on the composite measure of achievement of DRM objectives and two of its subfactors: (1) achievement of DRM objectives with respect to training and support to IS and end user and (2) enhanced data sharing and reduced data redundancy. The group means also are significantly different on the measure of overall success. Cluster one firms, which displayed a high level of congruency among the four IS factors, appear to have realized high levels of DRM success. These firms display the highest mean ratings on all measures of achievement of DRM objectives: database administration efficiency and effectiveness; strategic planning and information requirement analysis; training and support to IS and end-user; standard setting and enforcement; and enhanced data sharing and reduced data redundancy. The mean ratings on these measures (maximum score of 5.0) represent high levels of success in achievement of DRM objectives. Furthermore, cluster one firms achieved the highest mean rating on the composite measure of achievement of DRM objectives and also on the seven-point scale representing overall DRM success. These mean values are significantly higher than those of other non-congruent clusters as shown in column 7 of Table 4. Firms represented by cluster two, another congruent group, also display high levels of DRM success. This group also attained higher mean ratings than the non-congruent clusters on almost all measures of DRM success. Firms represented by the remaining three non-congruent clusters (clusters three, four, and five) appear to generally display lower levels of DRM success.

Table 4. One-Way ANOVA Across Five Cluster Groups for DRM Success Variables[a]

Dependent Variables	Mean (S.D.) of Cluster Groups: Congruent Groups: Group 1 (n = 24)	Group 2 (n = 41)	Non-congruent Groups: Group 3 (n = 29)	Group 4 (n = 22)	Group 5 (n = 38)	F (d.f./sig.)	Significant Contrast Values
Overall Achievement of DRM Objectives[b]	3.709 (0.57)	3.461 (0.56)	3.268 (0.68)	3.330 (0.57)	3.379 (0.55)	2.187 (4, 148)*	1–2*; 1–3***; 1–4**; 1–5**
Achievement of DRM Objectives related to:							
1. Database Administration Efficiency and Effectiveness	4.063 (0.51)	3.870 (0.75)	3.731 (0.77)	3.689 (0.63)	3.773 (0.77)	1.094 (4, 148)$^{n.s.}$	1–3*; 1–4*; 1–5*
2. *Strategic Planning and* Info. Req. Analysis	3.264 (0.99)	3.058 (0.74)	2.776 (0.86)	3.167 (0.97)	3.141 (0.78)	1.304 (4, 144)$^{n.s.}$	1–3**; 3–5*
3. Training and Support to IS and End Users	3.715 (0.64)	3.531 (0.71)	3.152 (0.73)	3.258 (0.69)	3.243 (0.78)	2.963 (4, 147)**	1–3***; 1–4**; 1–5**; 2–3**;2–5*
4. Standard Setting and Enforcement	3.625 (0.82)	3.213 (0.86)	3.184 (1.05)	3.227 (0.90)	3.175 (1.09)	1.012 (4, 148)$^{n.s.}$	1–2*; 1–3*; 1–5*
5. Data Sharing and Reduced Data Redundancy	3.646 (0.76)	3.250 (0.78)	3.190 (0.97)	2.886 (0.94)	3.118 (0.87)	2.448 (4, 148)**	1–2*; 1–3*; 1–4***; 1–5**
Overall SUCCESS[c]	4.750 (0.99)	4.263 (1.22)	3.714 (1.24)	4.000 (1.15)	4.579 (1.08)	3.684 (4, 145)***	1–2*; 1–3***; 1–4**; 2–3*; 3–5***; 4–5*

[a]One-way ANOVA to evaluate significance of differences on the *success* variables across the derived Cluster Groups.
[b]Composite of the (five) subfactors that emerged in factor analyses.
[c]Scale range is 1 to 7 for this variable while it is 1 to 5 for all others in the table.
***p < 0.01; **p < 0.05; *p < 0.1.

Conventional wisdom would suggest that larger firms may devote a greater amount of resources to the DRM function and pursue DRM activities more systematically, thereby realizing greater success in their DRM efforts. It is also possible that the nature of industry might influence the level of importance and the amount of attention devoted to the DRM function. For instance, firms in service industries that are usually more information intensive, such as banks and insurance companies, might be expected to pay greater attention to data management than firms in other industries. It is, therefore, prudent to test for the potential confounding effects of such factors on the relationship of the fit among the IS factors and DRM success. Hence, the study tested for differences among the five clusters in terms of industry representation (service vs. manufacturing) and organizational size as reflected by number of DRM sites and number of facilities operated by the firms. The results indicate that there are no major differences between the firms in the congruent and non-congruent clusters on these three demographic characteristics. Thus, the findings are not confounded by these demographics.

Discussion and Implications

Cluster analysis technique proved to be useful in deriving distinct and meaningful clusters from the data. Clusters one and two were internally coherent and meaningful. Cluster one represented firms with high intersite data dependence. The IS organization within these firms is characterized by high centralization of both operational and strategic IS decisions. These organizations have also managed to retain and concentrate practically all of the IS resources such as hardware, software, data, telecommunications, and personnel at their central site. This configuration allows for greater control over IS resources and ensures hardware and software compatibility across the organization. Furthermore, the low level of autonomy granted to local sites on DRM functions facilitates data standardization, reduces data redundancy, and helps maintain data integrity. This results in a smooth flow of accurate and quality data/information between units of the organization which is most critical to organizations with high intersite data dependencies. The findings presented here are consistent with the arguments on the appropriateness of centralization of IS decisions for organizations with high degrees of functional interdependencies (Goodhue et al. 1992b).

Organizations represented by cluster two have IS characteristics opposite those organizations in cluster one. These firms have low intersite data dependence and have most of their IS resources distributed to local sites. These organizations have further decentralized authority to make operational and strategic IS decisions to lower levels of management. Moreover, local sites within these organizations also enjoy the highest levels of autonomy and control over their DRM functions. This configuration permits greater adaptability and faster response to local needs that is essential for firms that operate in distinctly different product/market domains where intersite data dependencies are relatively low.

Overall, cluster one and two firms appear to be highly congruent and yet different (statistically) from each other on all of the IS characteristics except on the level of autonomy on strategic DRM functions, as indicated in Table 2. This suggests that, regardless of the degree of autonomy designed for the local sites, there may be a tendency to retain the authority to manage strategic DRM functions at the central site. This is because strategic DRM decisions may best be handled at the central site in order to provide unity of strategic direction. As noted earlier, firms represented by clusters three, four, and five display varying degrees of non-congruency among the IS factors. The cluster five firms have perhaps the worst internal fit.

The results further indicate that organizations within cluster one have achieved the highest level of DRM success. As noted above, the design of the IS function in these organizations is characterized by high intersite data dependence, high centralization of IS decisions, high concentration of IS resources, and low DRM-related autonomy. The results appear to reinforce the concept that the fit or congruence among a set of key organizational variables yields greater effectiveness. On their own, high degrees of centralization and low DRM-related autonomy may be stifling and tie up the organization in excessive bureaucracy. This could render the organization inflexible and non-responsive. However, the internal congruence that is achieved when these IS factors are matched with conditions of high intersite data dependence and high concentration of IS resources enables achievement of greater DRM success.

While the results appear to suggest unequivocally the relevance and importance of gestalt fit as indicated by the superior performance of the internally congruent cluster one, the same argument cannot be forcefully made for the other equally internally congruent cluster two. At this stage, we can only speculate that technological changes such as powerful/cost-effective workstations and LANs have enticed some organizations to migrate to distributed environments earlier than they otherwise might have done. Requisite organizational changes such as formulating DRM policies, creating data standards, and educating end-user developers on data hygiene should precede or at least accompany such a move. However, considerable time and organizational learning is required for effective implementation of these changes. It may also be noted that the study was performed in 1989, when the DRM concept was just being accepted as a reality in companies. Consequently, it may be too early for the distributed DRM environment to yield benefits.

Implications for management practice

With the increasing trend toward distributed systems, it is imperative that IS managers evaluate the importance of the key IS factors in designing effective IS organizations. The findings of this study emphasize the need to design IS organizations that are internally congruent in order to realize greater effectiveness. Specifically, the focus of this study on DRM underscores the importance of managing data resources in a distributed environment. The congruent structures identified in this study provide IS managers with a benchmark against which they can compare the design of their own DRM functions.

Implications for future research

Rapid changes occurring in the information systems area often require study of the problems and issues for which a well established theory or conceptual model does not exist. The encouraging results of this study indicate that the concept of fit is useful for studying complex and messy organizational issues such as data administration.

Although there was no evidence of differences across the cluster of firms that emerged in this study in terms of some of the demographic factors (e.g., size, industry type), it may be necessary to fine-tune the analysis by a more extensive study of specific industries/environments. This may serve to validate the salience of the clusters that emerged in this study. For instance, it is possible that concerns of data standardization and sharing may be more important in service industries such as banking and insurance than for manufacturing companies with multiple plant sites. Replications of the study need to be conducted across different environmental settings to further validate the existence of such gestalt fit among the IS factors and the success of the DRM function. Furthermore, this study considered only four IS factors. There may be a number of other relevant factors that may influence the effectiveness of the DRM function in distributed environments, such as overall organizational structure, leadership style/culture, role of IS, data security requirements, and constraints imposed by the migration/evolution path of the distributed environment. These factors can be considered for inclusion in future studies.

Finally, data resource management is only one of the many responsibilities of the IS function within an organization. It would be insightful to apply the concept of fit and the method of cluster analysis to study other complex IS-related issues such as new application development and data center operation.

Limitations

Due to limited resources, the study was restricted to only four key antecedent variables and two aspects of DRM success. These are not necessarily the only variables of importance. Other variables, as noted in the previous section, may be important. In order to attain a high level of responses, only the CIO of each organization was solicited. While having a high level of confidence in the quality of information gathered—because the respondents were very senior executives in IS function—there is still potential for method/reporting bias since the same executive provided information on both the antecedent and dependent variables.

Conclusions

Lack of an established theory on design of data resource management for distributed processing environments motivated us to undertake this exploratory study. In light of increasing recommendations from recent studies (Niederman et al. 1991) to treat data as a corporate resource and the importance of the DRM function in distributed environments, this study is both timely and significant. However, being exploratory in nature, it should be considered as setting the stage for further work in this domain. While many organizational researchers have made assertions on the importance of *fit* among key organizational variables and have promoted the need to go beyond viewing fit from bivariate to a multivariate perspective (Venkatraman 1989), there is a lack of empirical studies. This is one of the earliest attempts to conceptualize *fit as gestalt* and empirically validate such a view through cluster analysis. This study further examines performance differences among the groups of firms identified through the cluster analysis. The results of this study provide significant support for the concept of *gestalt fit* among the variables that were examined.

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About the Authors

Hemant Jain is Lawrence G. Regner Research Professor of Management Information Systems and the director of UWM MIS Consortium in the School of Business Administration at the University of Wisconsin-Milwaukee. Jain received his Ph.D. in industrial engineering and information systems from Lehigh University in 1981. His current research interests are in the area of distributed and cooperative computing systems, data modeling and database design, object oriented analysis and design, decision support systems, model management systems, group decision support systems, and information systems design. He has published a large number of articles in prestigious journals such as *IEEE Transactions on Software Engineering, Information Systems Research, Decision Support Systems, Decision Sciences,* and *Information & Management.* Professor Jain is on the editorial board of the *Journal of Database Management* as well as a consultant to a number of large corporations. He is currently developing (along with three of his Ph.D. students) an integrated knowledge-based approach for the design of co-operative computing environments (hardware, software, and network architectures), strategies for object partitioning and distribution in co-operative computing environments, and approaches for operation and control of co-operative computing environments.

K. Ramamurthy is an associate professor of MIS at the University of Wisconsin-Milwaukee. He received his bachelor's degree in mechanical engineering and a graduate diploma in statistical quality control and operations research in India, an M.B.A. from Canada, and a Ph.D. degree in management information systems from the University of Pittsburgh. He has over 19 years of industry experience and has held several senior technical and executive positions. His current research interests include adoption, implementation, and diffusion of modern information technologies; strategic IS planning; electronic commerce including interorganizational systems/EDI and the Internet; data resource management in distributed environments; decision systems for individual and group support; self-directed teams; business process reengineering; TQM; and management of computer integrated manufacturing technologies. He has published quite extensively in major journals including *MIS Quarterly, Journal of Management Information Systems, Decision Sciences, International Journal of Man-Machine Studies, IEEE Transactions on Engineering Management, International Journal of Production Research, OMEGA, Transportation Journal,* and *INFOR,* and in a number of conference proceedings. He is a member of INFORMS, AIS, and the Beta Gamma and Sigma Honor Society.

Hwa-Suk Ryu received his Ph.D. in management science/MIS from the University of Wisconsin-Milwaukee in 1990. He has undergraduate and master's degrees in business administration. He is currently the general manager of Samsung Data Systems in Seoul, Korea. His research interests are in the areas of data administration and database management systems. A 1988 paper appeared in the *Proceedings of the International Conference on Information Systems.* He has been a member in TIMS, Decision Sciences Institute, ACM, and SIGBDP.

Masoud Yasai-Ardekani is an associate professor of strategic management at the School of Business Administration, University of Wisconsin-Milwaukee. He holds a bachelor's degree in electrical engineering from the Imperial College of Science and Technology, University of London, and a Ph.D. in management studies from the Graduate Business Center, the City University, London. He conducts research in the area of strategic management. His research interests include designs for strategic planning processes, and competitive intelligence systems; industry environment-strategy and firm performance; organizational decline, strategic change and turnaround. He is also engaged in multi-disciplinary research on: expert systems and cognitive mapping for strategic decisions, designs of decision processes and structures for effective management of information systems; quantification of uncertainty in organizations; and strategic management of public sector organizations. He has published several articles in leading management journals such as *The Academy of Management Journal, Academy of Management Review, Strategic Management Journal, Management Science Organization Studies, Journal of Management Studies,* and *IEEE Transactions on Engineering Management.*

Appendix A

Individual Factor Analysis for Undimensionality/Convergent Validity Check

The following indicator variables were suitably reworded, randomly assigned and cast as questionnaire items. Operationalization of each construct, the results of factor analyses of the study's variables, factor loadings, interitem reliability (Cronbach's alpha), and descriptive statistics of each of the factors are displayed.

1. **Intersite Data Dependence (DEPEND):** Responses were sought on the proportion of each of the following four classes of data w_i (out of the total data within the responding firm) and the extent of data flow across sites x_i on a 1 to 7 scale (1 = very little and 7 = significant extent). A weighted aggregate would represent the extent of the intersite data dependence. A single factor emerged in factor analysis.

	Factor Loadings
1. Online Transactions.	0.624
2. Batch Updates.	0.694
3. Regular Report Generation.	0.853
4. Ad hoc/Unscheduled Queries.	0.766

Intersite Data Dependence = $\Sigma\, w_i\, x_i$ for i = 1 to 4

where w_i = proportion of i^{th} category of data out of total amount of data processed
x_i = extent of data flow of i^{th} category across the sites (on 1 to 7 scale)

Cronbach's α = 0.7237; Interitem Correlation = 0.396; Mean (S.D.) = 4.304 (1.648)

2. **Centralization of IS Decisions:** Responses were sought as to the level of management to whom the decision making on *each* of the indicated 24 information systems (IS) activities is delegated even if others have to confirm the decision. Value of 1 assigned if locus of decision making is *lower* IS management, 2 for *middle* level IS management, 3 for CIO, and 4 for *above* the CIO level. Four (out of 24) indicator variables were dropped out after multiple runs of factor analyses (with varimax rotation) as they failed to meet preset decision criteria. Finally, four factors of IS decision-making structure emerged, which were labeled as:

A. **Centralization of decisions related to management of IS personnel (CENTR-1:** Five indicator variables; Cronbach's α = 0.9140; Interitem Correlation = 0.680; Mean (S.D.) = 2.484 (0.617))

	Factor Loadings
1. Determining the number of IS supervisors required.	0.702
2. Appointment of IS supervisory staff.	0.852
3. Promotion of IS supervisory staff.	0.851
4. Salary increase of IS supervisory staff.	0.784
5. Dismissal of IS supervisor.	0.819

B. **Centralization of decisions related to selection of hardware and software (CENTR-2:** Five indicator variables; Cronbach's α = 0.8797; Interitem Correlation = 0.594; Mean (S.D.) = 2.338 (0.515))

	Factor Loadings
1. Selection of type or brand for new main-frame computer.	0.667
2. Selection of type or brand for new PCs/Workstations.	0.673
3. Selection of type or brand for DBMS software.	0.819
4. Selection of type or brand for data dictionary.	0.800
5. Selection of type for data communication service.	0.786

C. **Centralization of decisions related to IS operational control (CENTR-3:** Five indicator variables; Cronbach's α = 0.8511; Interitem Correlation = 0.588; Mean (S.D.) = 1.769 (0.588))

	Factor Loadings
1. Scheduling development tasks.	0.560
2. Setting standards for data definition.	0.795
3. End-user training methods to be used.	0.816
4. To determine data access control method.	0.748
5. To (re)schedule responsibilities/areas of work of senior analyst/programmers.	0.546

D. **Centralization of decisions related to IS project planning (CENTR-4:** Five indicator variables; Cronbach's α = 0.7894; Interitem Correlation = 0.429; Mean (S.D.) = 2.413 (0.429))

	Factor Loadings
1. To determine a new systems development project.	0.689
2. Setting end-user requirements priority.	0.632
3. "Buy or development" decision for application software.	0.682
4. Creation of a new information center.	0.636
5. Creation of a new project team.	0.585

3. **Concentration of IS Resources at Central vis-à-vis Local Sites (RESOURCE):** Responses were sought on the proportion (as a percentage) of the total of each of the following IS resources that were retained at central site vis-à-vis distribution to local sites. An aggregate would represent IS resource availability at central site. A single factor emerged in factor analysis.

	Factor Loadings
1. Mainframe/Mini Computers.	0.928
2. Data Sources.	0.926
3. IS Personnel.	0.875
4. Application Software.	0.922

Cronbach's α = 0.9369; Interitem Correlation = 0.788; Mean (S.D.) = 72.9% (30.8%)

4. **DRM-Related Autonomy (AUTONOMY):** Responses were sought as to whether *each* of the indicated 28 DRM activities were carried out predominantly at local/divisional, central/corporate, or both local and central levels. A value of 0 assigned to central, 0.5 to both, and 1 to local level responses. These 28 indicator variables split into three factors in factor analysis (with varimax rotation) mapping Anthony's (1965) paradigm.

A. **Autonomy on operational control DRM functions** (12 indicator variables; Cronbach's α = 0.9654; Interitem Correlation = 0.699; Mean (S.D.) = 0.184 (0.281))

	Factor Loadings
1. Evaluate and select hardware and software including DBMS, data dictionary, etc.	0.652
2. Logical and physical database (re)design.	0.650
3. Develop and monitor database performance measure.	0.736
4. Develop end-user support policies.	0.784
5. Monitor and maintain data integrity and security.	0.729
6. Resolve database operational problems.	0.748
7. Maintain DBMS and related software.	0.842
8. Maintain data dictionary/directory.	0.672
9. Support application systems designers that use DBMS.	0.681
10. Enforce database operation standards.	0.781
11. Database performance tuning.	0.799
12. Data communication administration.	0.702

B. **Autonomy on management control DRM functions** (13 indicator variables; Cronbach's α = 0.9415; Interitem Correlation = 0.553; Mean (S.D.) = 0.232 (0.288))

	Factor Loadings
1. Assess impact of changes in technology and information requirements on data.	0.542
2. Develop global and local data dictionary.	0.577
3. Analyze data requirements, both global user view and local user view.	0.751
4. Data distribution (fragmentation and allocation of data to local sites).	0.583
5. Set standards for data definition/naming convention.	0.558
6. Set data security standard.	0.606
7. Set policies and procedures for database backup and recovery.	0.695
8. Enforce standards for data definition.	0.619
9. Training and educating end users.	0.573
10. Maintain consistency and compatibility between local sites.	0.617
11. Liaison with systems and application analyst.	0.667
12. Liaison with programmers.	0.674
13. Liaison with end users.	0.739

C. **Autonomy on strategic planning DRM functions** (three indicator variables; Cronbach's α = 0.8022; Interitem Correlation = 0.575; Mean (S.D.) = 0.171 (0.285))

	Factor Loadings
1. Development of strategic plans for data as corporate resource.	0.732
2. Define database goals in support of DP and organizational goals.	0.717
3. Development of long-range plans for DB to achieve database goals.	0.786

5. **DRM Success:** The degree to which DRM was successful was measured by multiple methods as follows:

Extent to which DRM Objectives are Achieved (DRM-OBJECT): Responses were sought on the extent of success in achieving *each* of the indicated 22 DRM objectives on a 1 to 5 scale (1 = not successful and 5 = very successful). Three (out of 22) indicator variables were dropped out after multiple runs of factor analyses (with varimax rotation) as they failed to meet standard decision criteria used in research. Finally, five factors of the extent of success in achieving DRM objectives emerged. These were labeled as:

A. **Database administration efficiency and effectiveness objectives** (six indicator variables; Cronbach's α = 0.8001; Interitem Correlation = 0.400; Mean (S.D.) = 3.787 (0.698))

	Factor Loadings
1. Maintaining data integrity.	0.831
2. Maintaining data accuracy.	0.797
3. Maintaining data security.	0.624
4. Providing timely data.	0.712
5. Maintaining data availability.	0.759
6. Efficient data distribution.	0.542

B. **Strategic planning and information requirement analysis objectives** (four indicator variables; Cronbach's α = 0.8806; Interitem Correlation = 0.648; Mean (S.D.) = 3.011 (0.846))

	Factor Loadings
1. Developing strategic plans for data as corporate resource.	0.819
2. Developing long-range plans for database.	0.713
3. Identifying your company's information needs.	0.846
4. Establishing priorities of information needs.	0.789

C. **Training of/support to both IS personnel and end users' objectives** (four indicator variables; Cronbach's α = 0.7508; Interitem Correlation = 0.430; Mean (S.D.) = 3.317 (0.759))

	Factor Loadings
1. Training end users.	0.753
2. Providing consulting to end users.	0.744
3. Training data processing personnel.	0.605
4. Providing consulting to data processing personnel.	0.602

D. **Standard setting and enforcement objectives** (three indicator variables; Cronbach's α = 0.8161; Interitem Correlation = 0.597; Mean (S.D.) = 3.196 (0.966))

	Factor Loadings
1. Maintaining data dictionary.	0.777
2. Setting standards for data definition.	0.763
3. Enforcing data standards.	0.697

E. **Enhanced data sharing and reduced data redundancy objectives** (two indicator variables; Cronbach's α = 0.7363; Interitem Correlation = 0.583; Mean (S.D.) = 3.214 (0.854))

	Factor Loadings
1. Reducing data redundancy.	0.807
2. Promoting data sharing.	0.815

Overall Success (SUCCESS): Response was solicited on the extent to which DRM functions have been successfully implemented in the firm on a 1 to 7 scale (1 = not successful and 7 = very successful).

Cronbach's α and Interitem Correlation N/A (being single-item scale); Mean (S.D.) = 4.158 (1.229).

Appendix B

Joint Factor Analysis/Discriminant Validity Check for Antecedent Variables[a]

Indicator Items	AUTONOMY	CENTR-1	CENTR-2	CENTR-3	RESOURCE	CENTR-4	DEPEND
AUT1	.5991						
AUT2	.7050						
AUT3	.6837						
AUT4	.8039						
AUT5	.7328						
AUT6	.8848						
AUT7	.7959						
AUT8	.7543						
AUT9	.7605						
AUT10	.8112						
AUT11	.8544						
AUT12	.7483						
AUT13	.8136						
AUT14	.8440						
AUT15	.7380						
AUT16	.8012						
AUT17	.8517						
AUT18	.8613						
AUT19	.8868						
AUT20	.8879						
AUT21	.7296						
AUT22	.6693						
AUT23	.8731						
AUT24	.8483						
AUT25	.8485						
AUT26	.7338						
AUT27	.8682						
AUT28	.7773						
CEN1		.7175					
CEN2		.8587					
CEN3		.8564					
CEN4		.7909					
CEN5		.8140					
CEN7			.6819				
CEN8			.6571				
CEN9			.8007				
CEN10			.7902				
CEN11			.7731				
CEN16				.5810		.4431	
CEN19				.7907			
CEN20				.7940			
CEN21				.7481			
CEN22				.5558			
CEN12						.6266	
CEN15				.4624		.5556	
CEN17						.6533	
CEN18						.4478	
CEN23						.5726	
RESO1					.7958		
RESO2					.8087		
RESO3					.6150		
RESO4					.7097		
DEPND1							.5647
DEPND2							.7280
DEPND3							.8489
DEPND4							.7566
Eigen Value	20.38	8.165	2.556	2.022	1.993	1.747	1.535
Cum Variance	36.4%	51.0%	55.6%	59.2%	62.8%	65.9%	68.6%

[a]Only factor loadings greater than 0.40 shown; Final factor analysis (CEN6, CEN13, CEN14, and CEN24 dropped out).