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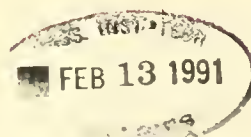
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**STRATEGIC DATA PLANNING:
LESSONS FROM THE FIELD**

**Dale L. Goodhue
Laurie Kirsch
Judith A. Quillard
Michael Wybo**

October 1990

**CISR WP No. 215
Sloan WP No. 3214-90**

Center for Information Systems Research

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**Center for Information Systems Research
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STRATEGIC DATA PLANNING: LESSONS FROM THE FIELD

Abstract

Many large organizations today are finding that even if they can access data from multiple functions, the lack of logical data integration (common data definitions and codes) across information systems makes it difficult or impossible to answer cross-functional or cross-divisional questions. This reduces their ability to take advantage of potential opportunities or respond to business problems. Strategic Data Planning is one methodology which can address such problems, within the general umbrella of information engineering. Resting on the assumption that a relatively stable group of data entities lies at the center of an organization's information processing needs, SDP is a formalized, top-down, data-centered planning approach that builds a model of the enterprise, its functions, and its underlying data as a basis for identifying and implementing an integrated set of information systems.

In spite of strong conceptual arguments for the value of the SDP approach and its use in many organizations, empirical researchers have failed to find clear-cut evidence of its general success. This raises the question of whether the approach is universally appropriate. If success is somewhat problematic, are there lessons that can be drawn from actual organizational experience? The purpose of this paper is to report the results of a series of case studies of SDP efforts, to offer insights on the conditions under which SDP is most effective, and to propose directions for future research.

INTRODUCTION

Among many managers, there is an increased appreciation for the role of data in meeting the challenges of today's business environment. Access to data from various organizational subsystems is often required to respond to the demands of an increasingly competitive global marketplace. Yet many large organizations today are finding that even if they can access data from multiple functions, the lack of logical data integration (common data definitions and codes) across information systems makes it difficult or impossible to answer cross-functional or cross-divisional questions. This reduces their ability to take advantage of potential opportunities or respond to business problems (Goodhue 1989; Gartner Group 1990).

This lack of logical data integration is generally believed to be a result of the way systems development has been conducted. IBM (1981) notes that systems have typically been developed within a functional area, with little regard for how those systems or the data they use can be shared across functional areas to better support the business's information needs.

Information Engineering and Strategic Data Planning. Information Engineering (Finkelstein 1981; Martin 1982, 1986; Hackathorn and Karimi 1988) is a management perspective and a collection of methodologies intended to address this problem of insufficient logical data integration by designing systems with the total organization's information needs in mind. "Strategic data planning," or SDP, is a methodology that fits within the general information engineering umbrella, addressing two critical phases of information engineering (Hackathorn and Karimi 1988): organizational analysis, and the strategy-to-requirements transformation.

SDP and information engineering are based on the assumption that a relatively stable group of data entities lies at the center of an organization's information processing needs. SDP is a formalized, top-down, data-centered planning approach that builds a model of the enterprise, its functions, processes, and its underlying data as a basis for identifying and implementing an integrated set of information systems that will meet the needs of the business. Sidebar #1 describes the general SDP methodology. The SDP approach can be

SIDEBAR #1. THE PROCESS OF STRATEGIC DATA PLANNING

Though there are differences between the various methodologies, there are a great many similarities. The participants in an SDP should always include business personnel (users) and may include IS personnel. Getting the right participants is critical to the quality of the final product. The planning team is charged with designing an "ideal" information environment that will support current and future business needs regardless of a particular organization structure. The process involves at least the following steps:

First, an enterprise model of the organization is developed, consisting of an identification of the business functions (usually 10 to 30) that the organization performs, further broken down into processes within functions (perhaps 100 to 300 processes all told). These processes may be further broken down in to activities within each process. The processes or activities may be related to organizational groups responsible for them.

Second, the data entities used by these various processes or activities (such as customer, purchase order, location, product) are identified. (There might be several hundred or more entities used by a medium to large business.) Each of these entities is associated with the processes or activities that use or create it.

Third, an "affinity analysis" is performed to identify groups of entities that are closely associated. These become the candidate subject databases, which should be adjusted manually based on other considerations.

Fourth, the subject databases and the processes which use or create that data are grouped so that major system areas can be identified.

Often taking place concurrently with the above, another effort documents how there business processes and activities are currently supported by existing information systems.

Senior managers are interviewed to determine the executive point of view including current and future business objectives. This usually occurs after the above steps.

These several efforts come together to produce a set of plans or architectures that typically include a list of the organization's recommended subject databases and major application areas, a migration plan from current to desired systems, targeted applications, resource allocation recommendations for application development, and guidelines concerning standards (hardware, software, and data).

distinguished from other information systems planning methodologies by its focus on defining the underlying shared data used by the organization's many functions, and by the definition of a "data architecture" to guide future systems development efforts (Lederer and Sethi 1988). Two examples of the approach are James Martin's (1982) Strategic Data Planning and the older Business Systems Planning (BSP) developed by IBM (1981).

How Successful Is Strategic Data Planning? In spite of strong conceptual arguments for the value of the SDP approach (e.g., Martin 1982; Appleton 1983; Kanter and Miserendino 1987) and its use in many organizations, empirical researchers (e.g., Lederer and Sethi 1988; Goodhue et al. 1988) have failed to find clear-cut evidence of its general success.

Lederer and Sethi (1988) surveyed 80 IS executives from medium and large organizations involved in IS planning (predominantly SDP methodologies). The respondents indicated moderate dissatisfaction with the resource requirements, and high dissatisfaction with the final execution of the plans. The two most critical problems in final execution of SDP plans were found to be: difficulty in obtaining top management commitment for implementing the plan, and lack of sufficient detail to implement the plan. The authors suggest that organizations may commit insufficient resources to complete and implement their plans.

While conducting 31 case studies on data management approaches, Goodhue et al. (1988) found five cases of SDP. None of these was completely successful, and three of the five were discarded without being implemented. They observe that "for many firms, the approach is too expensive, its benefits are too uncertain, and it is organizationally difficult to implement" (p. 383). They also noted that: SDP requires key managers to commit substantial time and effort; the business may change during the long planning process; and the specific product of the SDP effort is not always articulated, making it difficult to manage the expectations of both participants and top management. See Sidebar #2 for the complete table, "Reasons Why Strategic Data Planning Approaches are Difficult to Implement", from Goodhue et al. (1988).

Based on fifteen case studies of firms which rate themselves as effective planners, Sullivan (1985) argues that the appropriate planning methodology depends on the degree

SIDEBAR #2. WHY STRATEGIC DATA PLANNING APPROACHES ARE DIFFICULT TO IMPLEMENT

- The strategic data planning process, done in detail and with a wide scope, can be very time consuming and expensive. For the process to be successful, key operating managers must commit significant time and effort. This commitment is often difficult to obtain (and keep) from these busy individuals.
- Because of the up-front effort needed, organizations face a longer and more expensive development process for the initial systems developed with data planning methods. Line managers do not like to see project schedules lengthened. Similarly, I/S managers, who have incentives to deliver quickly and contain costs, may resist the additional effort involved.
- The methodologies require new I/S skills and, therefore, may not be easily adopted by I/S personnel.
- Often the business will change while the plan is being developed and implemented.
- Total *implementation* of a wide-scope data planning effort can be extremely expensive. There is a tendency to avoid these new costs, especially if many of the existing systems (which represent a huge investment) are still effective.
- When implementing only a subset of the plan, it can be difficult to bridge the gap from the top-down plan to bottom-up design. If proposed and existing systems interface along different boundaries, it may be hard to isolate and replace a subset of existing systems with a subset of proposed systems. The use of application packages also creates interface and boundary problems.
- It is not always clear to the planners or top management whether a strategic data model is being developed to produce a systems plan, create an architecture, or to design new databases. It is difficult to manage the expectations of those involved regarding the results and benefits of the process.

Source: "Managing the Data Resource: A Contingency Perspective," *MIS Quarterly*, Vol. 12, No. 3, Sept. 1988, p. 383.

of IS decentralization (system diffusion) and the extent to which technology use is strategic (system infusion). For example, BSP is considered the right choice when systems are strategically important and centrally controlled.

The uncertain success record of SDP suggested by these studies is somewhat surprising, given its conceptual appeal and continued practice. It raises the question of whether the approach is universally appropriate. If success is somewhat problematic, are there lessons that can be drawn from actual organizational experience? The purpose of this paper is to report the results of four case studies of SDP efforts that were conducted as a continuation of the research reported in Goodhue et al. (1988). The analysis emphasizes the various goals a firm might have in undertaking a strategic data planning effort and offers insights on a number of key issues that affect the success of a strategic data planning effort.

RESEARCH APPROACH: STUDYING A POORLY UNDERSTOOD PHENOMENON

Why Case Studies? It seems there is a gap between the theorizing about strategic data planning and the results organizations are seeing. When empirical evidence does not bear out our theories, it may be that our mental models of the phenomena are missing critical variables or critical links between variables. The poor success rate of strategic data planning suggests that SDP and its role in organizations may be more complex than has been thought. If so, researchers may need to adopt "ambivalent conceptual orientations, ambivalent inquiring practices, and varying positions on the issues" (Weick 1979, p. 63) as a way of updating our mental models.

The difficulty with research methodologies such as surveys, when we know too little about the phenomenon itself, is that they may become focused on the wrong issues or variables (Weick 1979). For example, prior surveys of SDP processes may have over-emphasized top management support, ignoring other critical but as yet unidentified factors.

Case studies, on the other hand, provide the opportunity to elicit the subtle and rich data needed to increase our understanding (Benbasat et al. 1987; Yin 1984). Since the goal of the current effort is to understand why and under what circumstances the SDP methodology is "successful", case studies appear to be the most appropriate methodology.

What is Success? If we want to identify important nuances which have a major impact on the success of SDP efforts, we must be clear about what the possible objectives and outcomes are in this context. From previous work on data management and strategic data planning¹, we argue that there are several distinct outcomes which organizations can be trying to achieve by undertaking a strategic data planning effort. These outcomes, and thus "success", might take a number of different forms including some combination of the following:

1. **Totally Integrated Systems.** The SDP could produce a detailed plan for a complete set of subject databases and integrated applications across the

¹ This work includes case study research by the Center for Information Systems Research at MIT, referred to in Goodhue et al. (1988), as well as additional case study work at both MIT and the University of Minnesota.

target domain of the planning effort, to be built in the near future.

2. Data Architecture. The term "data architecture" is often used but seldom defined. We will define it as a set of constraints on the system development process that insures a desired level of data integration (data definition and value consistency) in all future systems development or maintenance activities. A very high level data architecture might be the identification of some ten to thirty data aggregates (collections of data entities) around which future databases should be designed. A more detailed data architecture might include definitions of key entities and the relationships between them. Such a "data architecture" would provide a framework of standards and guidelines within which all new systems and revisions to old systems would be designed, gradually moving the firm toward a set of integrated applications and databases.

3. Identifying Systems Priorities. SDP could identify and prioritize a selection of applications to be built in the near future. This goal might include targeting a small number of high payoff applications, or deciding on how to allocate resources among identified projects. For this goal it is assumed that the bulk of the existing applications would remain in place.

4. Rethinking Business Processes. Given that SDP involves the identification of business processes and data, there is a potential opportunity to rethink creatively critical business processes, allowing innovation and streamlining of some processes, and possible elimination of others that are no longer essential.

5. Education and Communication. SDP could foster better understanding of the critical role of shared data in the organization, and the necessity of coordinating across organizational groups in systems and database design.

These five possible outcomes are consistent with planning objectives cited by earlier researchers. McLean and Soden (1977) cited IS planning goals of: improved communication with users and top management, better allocation of resources, identification of IS department improvement opportunities, and the identification of new and higher payoff applications. Pyburn (1983) suggested hardware and software architecture, identification of new IT opportunities, prioritization and evaluation of projects and resources, and forging a link between IS and business strategies. Lederer and Sethi (1988) conclude that the primary objectives of IS planning include: improved communication with users, increased top management support, allocation of resources, identification of high payback applications, and

development of an organization-wide data architecture. Martin (1982) notes that the goal of strategic data planning efforts is consistency of information across all systems; in other words, a set of logically integrated systems.

Research Design. The approach taken in this study was to reconstruct the history of several SDP efforts, from initial motivation to final impact, and to identify relevant factors which contributed to the final impact. Four recently completed SDP efforts in three organizations were studied.² The cases were chosen as a convenience sample, but represent three different industries and include private sector organizations and a government agency. Three of the four planning efforts were done at the department or division level; the fourth was organization-wide.

Three groups of individuals within each organization were interviewed: those responsible for maintaining and facilitating the planning methodology, those involved in individual planning efforts, and business personnel affected by the plans. Table 1 shows the number of each type of respondent for the four cases.³

Data was collected using a semi-structured interview agenda with open-ended questions on: background and organizational context for the SDP, the original motivation for the effort, specifics about the methodology (analyses conducted, level of detail, number and type of individuals involved, time spent), organization factors affecting the effort, final products, and perceptions of success.

The next section briefly presents the four cases. The descriptions do not attempt to tell the entire story, but rather they introduce the organizations, describe the motivations for the SDP efforts, present highlights from the planning process with a focus on the issues encountered, and discuss the results.

²The number of research sites agrees with Eisenhardt's (1989) observation that four to ten case studies is appropriate during theory-building efforts. She notes that it is difficult to generate theory with fewer than four cases, and difficult to manage the volume and complexity of the information with more than ten.

³In addition to the interview data, we had access to videotapes of focus groups conducted at Ventura Products, the site of the Finance and SSD case studies. The focus groups were conducted by the group responsible for the planning methodology in an attempt to identify the problems and the benefits associated with the SDP efforts. The moderator of the focus groups asked participants of planning efforts to comment on their general impression of the planning methodology, ways to improve the methodology, specific problems they encountered during the planning process, and difficulties with plan implementation.

TABLE 1. NUMBER OF RESPONDENTS BY TYPE.

Organization	Individuals Responsible for Method	Planning Participants	Individuals Impacted by Plans
LSA	3	5	5
Ventura Finance	2*	3	1
Ventura SSD	2*	6	2
Cedar	3	2	3

* Finance and SSD are two units within one large organization. In this organization, there is one centralized group responsible for the SDP methodology. The same two individuals from this group were interviewed concerning both the Finance and SSD planning effort.

THE CASE STUDIES: FOUR SHORT HISTORIES

Case #1. Logistics and Supply Agency

Background. The Logistics and Supply Agency (LSA) is a federal government agency that furnishes spare parts and consumables to other agencies. In this role, LSA provides two major services. The first is coordinating the logistics of shipments between contractors and agencies; the second is contract administration.

LSA employs over 25,000 people with an annual operations and maintenance budget of over \$500 million, and an annual stock fund budget of over \$4 billion. More than 35 groups report to the LSA director, who reports to an assistant secretary of a cabinet level department.

Most of the information systems at LSA have been developed to address specific and sometimes narrow operational needs, and have not been developed with data sharing between applications in mind. There are, however, some standard systems and data and a single standard requisition form. A single agency-wide system processes over 15 million requisitions a year. A second agency-wide system, implemented between 1986 and 1988, administers 200,000 contracts. As a result of these common systems, both part number and contractor are standardized and shared on all systems.

Even though LSA has implemented a few agency-wide standards, systems development remains quite decentralized. One early planning effort attempted to coordinate and prioritize requests for new systems on an agency-wide basis. The functional groups, which felt they lost the ability to support their own needs, resisted the process. After a two-year existence, the Agency-Wide Application Development List was replaced by a series of discussions between the director and each functional group on priorities in that area. Thus, the interdependent "agency-wide" nature of systems prioritization has been removed, giving functional areas more decentralized control over their systems.

Motivations/Goals for the SDP. A second planning effort at LSA, the focus of this study, began in 1979 when IS requested sizeable funds to upgrade its computing facilities. Authorization was given in 1979 but LSA took no action, due to internal disagreements about the degree of centralization of the new hardware. In 1983 the authorization was

withdrawn, the argument being that the request for funds should be functionally driven, and that the organization, not simply the hardware, should be modernized. IS made several attempts to incorporate a functional perspective, but these were criticized as being too technical and too fragmented. In 1985 IS turned to the Plans and Policies group within LSA for help. This group initiated a strategic planning process using a methodology derived from Martin's (1982) approach. The objective was to plan a set of integrated systems across the agency.

Highlights of the Planning Process. Early in the planning process, seventeen business areas were identified. Of these, nine were classified as essential to LSA's external mission and nine groups of individuals were formed to analyze these critical business areas. Each group consisted of 12 to 15 people, with a full time commitment of about ten weeks, as shown in Table 2.

Data modeling was by far the largest single component of the planning effort. It averaged between 70 and 80 percent of the person hours spent on all analysis activities, with some participants working a considerable number of overtime hours formulating and revising the models. In spite of this effort, some team members felt that time simply ran out before the models were stabilized. There was a concern among participants that the resulting models might not be correct enough, or detailed enough to be useful. The level of detail and quality of the plans and documents were also not consistent across groups.

Results of the SDP. Given that the documents were inconsistent and that they were too voluminous, technical, and detailed for management, a summary set of documents was prepared, written in a non-technical fashion (eliminating all data models) and focusing on the business area critical success factors. These summary documents were then pulled together into an agency-wide Concept Paper, which addressed business initiatives, data support requirements, and system support requirements.

The SDP effort was considered successful by its participants. However, the cabinet department to which LSA reports, while praising the Concept Paper as the best document of its type it had ever seen, also criticized it as being too big and complex to serve as a basis for a funding request, suggesting it be broken down to make it more manageable. Within LSA, some groups have argued that the plan does not provide enough detailed information

TABLE 2. TIME AND COST ESTIMATES FOR THE SDP EFFORTS STUDIED.

Organization	Number of Participants	Percent of Full Time	Duration	Estimated Cost *
LSA	9 teams of 12-15 each	100%	10 weeks	\$1,900,000
Ventura Finance	15	50-60%	9 months	500,000
Ventura SSD	15	50%	9 months	450,000
Cedar	10	100%	1 year	800,000

*Costs are estimated by assuming an average salary of \$40,000 and overhead and fringe benefits of 100%.

to serve as a basis for rebuilding systems. Within the functional areas, the Concept Paper has been interpreted as a document which sets functional goals and provides overall direction for LSA systems. Each of the functional areas, however, is in the process of designing and implementing modernization efforts in its own area, without any centralized coordination.

Two years after the final Concept Paper was completed, the Policy and Plans group that championed the SDP continues to struggle to keep its vision of totally integrated databases alive, with significant organizational political pressures from a new LSA Modernization project management group. Funding to bring all the data models from the original SDP to a uniform level has not been forthcoming. In an effort to demonstrate the benefits of shared data, the SDP group has focused on a specific project -- a Contractor Information system. After great difficulty with funding and people, they are finally off the ground. However, the fate of the project is unclear, as the champion of the SDP effort is set to retire.

Cases #2 and #3: Ventura Products

Background. Two case studies were conducted at Ventura Products: one at the Finance Division and one at the Support and Service Division. Ventura Products has annual sales exceeding one billion dollars. It manufactures and distributes consumer, health care, and industrial products. Though Ventura is quite decentralized, it maintains centralized control in some areas. Customer accounts and assets are centrally controlled and managed, but the individual divisions are responsible for product development and marketing.

Corporate IS (CIS) supports the centralized functions by maintaining a number of core systems, such as billing, accounting, payroll, and purchasing, which are used by all divisions. The divisions and large departments, in turn, have local IS units to develop and support their local IS activities. There is a formal group within CIS that is responsible for maintaining and facilitating their in-house version of SDP.

Ventura Finance Division (Case #2). *Background.* The Finance Division at Ventura consists of four departments: Tax, Controller, Internal Auditing, and Treasurer. Finance

is large, employing over 1000 individuals, over 60 of whom are IS personnel. The annual budget for IS exceeds \$17 million.

Motivations/Goals for the SDP. The Finance organization had been affected significantly by changes in government regulations, technology, and legal requirements. Partly because of this, the IS organization tended to be reactive to day-to-day crises, rather than to follow a long-term plan. The result was problems with incompatible data across systems and spiralling costs. Finance's IS steering committee, which included key senior managers from the function, realized that they could no longer afford to operate without a long term vision. They were searching for a way to articulate their future needs and at the same time to develop some standards and guidelines that would move them toward a more planned environment where resources could be allocated in a logical manner.

After the SDP group from corporate IS gave a presentation on SDP as a solution, the Finance IS steering committee was at first split on whether to undertake the effort. However, one of the Finance managers on the committee had seen the positive effects of a BSP in his own organization years ago and he persuaded the group to charter the SDP. In sum, the goal of the effort can be described as providing an overall plan and architecture for guiding the systems development process and developing a better way to identify and prioritize new systems projects.

Highlights of the Planning Process. The time and effort statistics of the Finance SDP are shown in Table 2. During the planning effort, the participants quickly realized that the SDP methodology as recommended was problematic for their organization. The Finance division is a staff function that supports the entire organization. Since the division creates and manipulates so much of the organization's data, following the SDP methodology would produce a volume of information the planning participants could not possibly cope with. They tried to manage the scope of their planning effort by limiting the number of business functions analyzed to forty, but they still had to operate at a much higher level of detail than called for by the SDP methodology. As a result, they were not able to identify specific applications for future development, or to create detailed architectures or plans. Instead, they created two products which might be loosely called architectures. The first was the

identification of 11 "logical locations" or groupings of data elements⁴ which provided a conceptual map of the data of the organization, and allowed them to categorize many actual and potential systems projects in a useful and meaningful manner. The second product was a set of 18 high-level recommendations and development guidelines. The generality and level of detail of these guidelines is indicated by the examples reproduced in Table 3. In addition, the final plan describes, on a broad level, upgrades for existing systems and development of new systems that will enable the division to meet their business needs.

Results of the SDP. Below these top level recommendations, the expectation is that each department within Finance will carry out its own modified planning efforts, filling in the details of the Finance SDP by identifying and prioritizing specific applications and constructing a data model for their department. Finance will then consolidate these plans for the entire division.

While they experienced a number of problems with the methodology itself, the Finance team members cite several benefits from participating in the SDP. First, they believe that they will save money over the long run since the development of systems will be managed better as the new "architectural" guidelines are followed. Second, the team members note that communication improved between CIS and Finance, and among individual Finance departments. This helped to decrease feelings of provincialism: "Eight directors found out that they are managing corporate data, not their own data. This was a big change in attitude among the directors." Thus, communication and education benefits were also achieved.

Ventura Support and Service Division (Case #3). *Background.* The Support and Service Division (SSD) is a large service division within Ventura and employs more than 1000 people in the U.S., including fifteen IS employees and twenty-five IS contractors. This division was created from a number of smaller groups, each with its own IS perspective. From 1979 to 1982, Ventura pulled all of these areas into SSD so that service contracts

⁴The 11 logical locations are: consulting, administration, customer related, risk management, auditing, employee related, amortized/depreciated assets, vendor related, inventory, reporting, and finance.

TABLE 3. EXCERPTS FROM VENTURA FINANCE'S STRATEGIC INFORMATION PLAN.

Recommendations:

1. We recommend that a Data Resource Manager (DRM) be appointed for the Finance Organization. The DRM would be responsible for integration of data at the organization level.
2. We recommend that all future system designs in the Finance Organization consider the following features where applicable: mass update capability, upload/download, special reporting, decision support capability.
3. We recommend that documentation and programming standards should be adopted by all departmental I/S support groups if they have not already done so.
4. We recommend that a Post Implementation Plan be adopted to insure the continued progress toward the goals established during the SDP process.

Source: Finance Organization Strategic Information Planning Study Final Report, December, 1987.

could be managed at the corporate level. It required five or six years to stabilize the division and define its business mission. During this period, IS was not a priority.

Motivations/Goals for the SDP. However, once SSD emerged with a clear mission, IS was recognized as a critical success factor. Management saw that SSD must shift from a focus on product models and serial numbers to a focus on customers. They explicitly recognized that easily accessible, accurate information about service requests, equipment histories, etc. was critical if they were to succeed. Their existing systems (pulled from various predecessor organizations) did not support this new focus, and suffered from important data integrity problems. Thus there was strong management agreement on the need for new systems to support the new business context. One individual in particular championed SDP as a means of moving away from a piecemeal development mentality to an environment of planned development, giving SSD the ability to take advantage of strategic opportunities.

Highlights of the Planning Process. The time and effort statistics for the SSD SDP are shown in Table 2. During the SDP, approximately sixty business functions and twenty data entities were identified, and a detailed data model developed. The effort also produced a migration plan for moving from its mixed vendor environment to a single vendor, and a Gantt chart prioritizing the upcoming development projects.

Results of the SDP. Two systems will create the bulk of the data used by the division. Implementation of the first of these, the Revenues system, began soon after the SDP was completed. The Revenues project manager acknowledged the value of the work previously done by the SDP. However, he noted that the development team had to do a substantial amount of rework to create a useable data model because of a number of inaccuracies in the one created by the planning participants. He indicated that a data model at a higher level and more approximate than the one produced by the SDP would have been as valuable: "We are the experts, not the people doing the SDP. We have to sort out and correct the errors made by the SDP people anyway."

During the development of the Revenue System, the SSD division worked hard and long to reconcile the definition and name of each of Revenue's 500 data elements with the several thousand standard data definitions already on Ventura's corporate data dictionary.

This was a major time commitment, and required help from the corporate data standards group. In spite of all of this effort, SSD's data resource manager believes SSD and the corporate data dictionary have some "near duplicates."

Interestingly, SSD is not following this process for the development of its second major system, Logistics, since it required too much time and money for Revenues. SSD does not feel that the inconsistencies between their systems and corporate data standards will cause them problems.

SSD considered the planning process quite successful, and felt the final plan was useful and beneficial. Unfortunately, current business pressures threaten to slow down the implementation of the remaining systems identified in the SDP.

Case #4: Cedar Industries

Background. Cedar markets a wide range of products and services to businesses and consumers. Located in the Southwest, the organization is a major player in an industry that was gradually deregulated during the 1980s. As the industry deregulated, Cedar Industries experienced a major upheaval in its structure, culture, and business.

With the reorganization that followed deregulation, many previously separate divisions needed to coordinate in new ways but incompatible information systems made this impossible. The resulting operational paralysis motivated top management to address the underlying problem as well as to solve the immediate crisis. Both a high level task force and an outside consulting firm strongly advised establishing an information executive and managing the data infrastructure.

Motivations/Goals for the SDP. As part of the recommendations, divisions were encouraged to use SDP in their IS planning efforts. As IS groups were gradually reorganized into a single CIO organization, a special group was established to encourage and assist the divisions in carrying out a new in-house strategic systems planning methodology. This methodology was intended to surface the critical data used in running the business; to provide a framework, or architecture, around which future systems would be built; as well as to identify key strategic systems.

In part because its vice president was sold on the importance of managing data, one

of the first groups to use this new methodology was the consumer services division.

Highlights of the Planning Process. The time and effort statistics of the consumer services division's SDP are shown in Table 2. A very detailed business model was developed with 16 business functions broken down into 88 processes and 530 activities. For each activity, the data entities used as input and output were identified. In addition, 20 to 40 different user types were identified, and both the type and location of users were associated with each of the 530 activities. This business modeling process took six months, or one-half of the total time. Ten projects were identified, four of which were selected for the tactical phase, and three of these were ultimately implemented.

Results of the SDP. The SDP has also provided this division of Cedar with an architecture that will guide its future systems development. The architecture takes the form of 200 or so "business modules" or groupings of the 530 activities, and 40 data entities. Whenever a new business requirement surfaces, this can be located in the architecture, and Cedar can decide where it is most beneficial to place the process. Instead of building it as a separate isolated process, they might fold it into a major enhancement, so as to build a piece of the architecture.

While this SDP effort was considered a success, fewer and fewer other divisions at Cedar are willing to use the approach. Even the business manager who presided over the successful effort admitted that he probably would not spend that kind of money if he had it to do over again. His primary reason is that the process takes too long, costs too much, and does not seem to produce that much better a plan. This sentiment was echoed by several managers responsible for authorizing and funding development efforts in other parts of Cedar.

One such manager suggested that the SDP's biggest problem was that it did not focus on anyone's number one problem, that it ended up surfacing everyone's second priority problems. This manager thought the value might be greater for a firm where the IS function was centralized, and operates in a reactive mode to requests from the business. The educational value to IS in such a firm might make the process worthwhile.

A number of other concerns were raised about SDP. First, the demanding time requirements of the SDP may result in the selection people who take too much for granted

and are not likely to be useful at creatively rethinking and redesigning the business processes. Second, some critical needs surface early in the SDP process and are immediately acted upon unilaterally by functional management long before the plan is completed. Thus, with action in progress on some of the highest business priorities, there are fewer compelling arguments for implementing the total program. Third, the ability to communicate the plan to the systems development department may prove problematic. The several systems analysts interviewed were not aware of any guidance or constraints on their activities that resulted from the SDP. However, it is possible that these analysts were at too low a level in the organization to be aware of the impacts of the SDP.

DISCUSSION

These four cases illustrate that a strategic data planning effort is a major, complex undertaking and that there are many managerial issues to consider. As Table 2 shows, all four were quite expensive, typically costing around half a million dollars, and taking from 6 to 12 months. Their initial planning objectives were different and the outcomes varied, as summarized in Table 4. The outcomes achieved were not necessarily the goals initially aimed for.

The reasons why SDP methods are difficult to implement listed in Goodhue et al. (1988) hold true for these additional companies. (See Sidebar #2.) There are, however, deeper insights to be gained when we use the five "potential outcomes" presented earlier to organize our analysis. What are the lessons to be learned from these companies about using an SDP method to achieve "totally integrated systems" or to "identify business opportunities", etc.? How effective are SDP methods in achieving these outcomes? Based on these cases and the research we have conducted over the past five years on data management, the rest of this paper discusses the issues we see that affect the success of an SDP effort and proposes directions for future research.

Goal #1. Building a Totally Integrated Systems Environment

For most firms, achieving this outcome in the near term implies a nearly total rewrite of all systems. For firms desirous of this outcome and willing to pay the cost, Martin's comment is probably quite accurate: "It would be unthinkable to build a battleship without an overall plan of the whole ship" (1982, p. 1). It can be argued that the SDP methodology is in many respects a *design methodology*, as well as a planning methodology. It rests on an implicit assumption that all systems in the domain are being re-designed, and it actually starts the process of systems design. This is appropriate when all systems in the planning domain will probably be redesigned.

Many firms are not prepared to undertake the cost of a total re-design effort to achieve a totally integrated environment. Where total system re-design is not intended, much effort in an SDP goes into the initial design of systems that will *not* be built. Because

TABLE 4: ORIGINAL OBJECTIVES AND OUTCOMES ACHIEVED

	LSA	Ventura Finance	Ventura SSD	Cedar
Totally Integrated Systems	*		*+	
Data Architecture		*+	+	*+
Identify Systems Priorities	+	*	+	*+
Rethink Business Processes				
Education/Communication	+	+	+	+
Legend: * = original objective; + = outcome achieved				

of this, we argue that the SDP methodology is really tuned best for the very ambitious objective of totally integrated systems.

However, even when a total systems rewrite is intended, the inaccuracies in the data model at Ventura SSD suggest a possible problem:

SDP Spends Too Much Time Bringing Novice Data Modelers Up the Learning Curve. A substantial portion of the total planning time is spent in data modelling, generally by team members who are not expert data modelers. Thus, a time-consuming and complex process is made more so by giving it to people who are not expert in the concepts or techniques required. This may provide useful education to team members, but is not an efficient means of developing an accurate data model.

Although SDP is often sold on the basis of integrating the data of the firm, and two of the planning efforts in our cases explicitly sought this goal, as Table 4 illustrates, only Ventura SSD seems to be succeeding at this goal. What explains the difficulties encountered by the other cases or the success at SSD? Our research to date suggests there are at least three ingredients that are critical to successfully completing an SDP and implementing the resulting totally integrated systems:

Data Integration Must be Critical to Top Management. While many researchers have suggested that top management involvement is critical to the success of an SDP, we argue that involvement alone is not enough. Top management was involved enough in all four case studies to fund the planning effort, and give it at least nominal support. But only at Ventura SSD did management see data sharing between systems as critical to the success of its strategy for the organization. For SSD, strategic data planning, though expensive, was considered essential. Where data sharing is not critical to top management's view of the future organization, they are unlikely to allocate the necessary resources for the major system rewrites required.

Sufficient Control over the Planning Domain is Needed. An organization must have sufficient control over the planning domain to resolve conflicts among the organizational subunits involved. Whether the resolution is achieved through centralized authority or negotiated consensus, agreements must be forged on the tough design issues that may adversely affect some parties. An SDP may well be seen as a threat to decentralized power.

For example, in the LSA organization, the failure of the Agency-Wide Application Development List was at least partially a result of functional areas resisting a loss of local autonomy and control. The later SDP was allowed to proceed, but its results were quickly co-opted, and the organizational-wide effort never gained momentum.

The Scope Must be Manageable. Large organizations may have trouble adapting the methodology to their needs. As suggested at Cedar, when the scope is too large, planners may get lost in the crush of detail. When large planning domains are broken into pieces, as at LSA, uneven quality and level of detail may make it difficult to consolidate separate pieces. On the other hand, using the methodology with a less detailed level of analysis, as Ventura Finance did, may result in relatively superficial plans.

Goal #2. Creating a Data Architecture

An SDP offers the promise of producing a data architecture to guide systems development so that as new applications are built and old systems revised, the firm will gradually move toward a set of integrated applications and databases. The case studies reported here suggest several key issues for the successful use of a data architecture.

The Most Appropriate Form for a Data Architecture is Not Clear. Typically, the architecture produced by an SDP takes the form of a matrix of data entities and processes, grouped into logical systems or business modules. Other possible forms of data architectures (not necessarily developed using SDP) are a detailed corporate data model, or a collection of standard data definitions for critical data elements. Because of a lack of industry experience, it is not yet clear what is the most appropriate form of data architecture for long term integration. Once the most appropriate form is determined, we must ask whether the SDP is the most cost effective means of developing it. At Cedar Industries, though they realized value from an architecture of 200 business modules produced by an SDP, they considered the SDP too expensive to justify its use in other areas. At Ventura Finance, it would seem possible to identify eleven "logical locations" at far less than the cost of the SDP.

An Architecture Must Balance Global Integration and Local Flexibility. To be effective, a data architecture must find the right balance between the value of global data integration versus local flexibility (Goodhue 1989). At LSA, where there is already in place some

"partial" data integration in the form of common definitions and codes for all part numbers and for all contractors, the additional value of more global data integration was not compelling to the decentralized divisions. They preferred rapid local solutions to the issues raised by the SDP, rather than waiting an indeterminate time for a global solution, and possibly losing control of the solution's details. One interpretation would be that the current architecture of "partial" data integration (part numbers and contractor ID's) already strikes approximately the right balance between global and local needs for this decentralized organization.

The partial architecture currently in place at LSA is not consistent with the philosophy of the SDP which assumes that the balance between global data integration and local flexibility is tilted much more toward global integration. Thus using SDP for developing a data architecture may be inappropriate in more decentralized organizations.

Architectures Must Be Enforced. Whatever form the data architecture takes, it must be enforced or systems developers will not conform to it, and it will have no effect on systems. For example, at Ventura the corporate data standards effort defined an architecture of several thousand standardized data elements. However, systems developers in the SSD division decided against conforming to this architecture for their Logistics system, because of the additional local cost.

If the goal of an SDP is a data architecture, a great deal more attention should be paid to the most appropriate form of the architecture, and how that architecture will interact with the systems development process.

Architectures Should Be "Stolen" Not Recreated. Martin suggests that a basic principle of information engineering should be "steal don't reinvent" (1986, p. 68). Where possible, the same should apply to data architectures. To the extent that data architectures are stable over time within a company, they should also be quite similar across companies within an industry. Goodhue et al. (1988) reported that in one company a data model developed in one division was adopted by another division with minor changes and successful results. Though none of the case studies reported here "borrowed" their data model from a similar organization, perhaps companies should consider this as an option.

Goal #3. Identifying Systems Priorities

Totally integrated systems, in either the short or long term, are not the only possible outcome of an SDP. Another goal could be identifying potential systems projects for the organization and prioritizing these for near term implementation. However, we argue that SDP is not an efficient approach for this goal by itself, since it does not narrow its scope fast enough before it begins the time consuming charting of processes and entities.

Return for a moment to Martin's (1982) metaphor of building a battleship without a complete set of overall plans. Suppose that rather than building from scratch, the goal is to repair or modernize an existing ship. It is clear that some overall map of the total ship is critical to understand how the targeted high payoff projects fit into the whole. But if identifying high payoff projects is the goal, relatively less time should be spent on the overall map, so that planners can more quickly focus on critical areas.⁵ For these purposes, the detail and expense of an SDP is overkill -- detailed plans are not needed for major portions of the ship. SDP thus has three problems when used to identify systems priorities.

Too Much Effort is Spent "Designing" for Non-Critical Areas. If the goal is identifying systems priorities, not all organizational processes or data entities are of equal importance. In fact, the more we can quickly narrow our attention to those systems or functions which have a critical business impact, the sooner that impact will tell for us in competitive position, or bottom line⁶. However, since SDP actually begins the design process of building a totally integrated set of systems, it tends to give each process and each entity equal weight. When these systems aren't going to be built, much of this design effort is wasted.

Creativity is Swamped by the Volume of Detail. The volume of detail required by the methodology (on non-critical as well as critical areas of the business) tends to swamp individuals' abilities to see the whole picture, and to fashion creative solutions. At Cedar Industries, the SDP team spent six months analyzing 530 business activities, specifying for each: the data entities needed for input, the data entities produced as outputs, the user

⁵An "80/20" planning approach (Goodhue et al., 1988) which quickly established a rough map of the firm's data would be a far better starting point for targeting critical systems.

⁶"Critical Success Factors" (Rockart, 1979) is one planning approach that far more rapidly identifies high payoff projects.

types, and the locations used. Though the team identified several useful projects after this data modeling effort, user managers felt the projects were "everybody's second priority".

The Time Required by Individuals Self Selects the Wrong Participants. The SDP methodology requires as much as half a year of effort from its participants. Since the time of the most insightful and capable individuals is usually in high demand, the methodology tends to self select the wrong people -- those who can be spared because they are not involved in other critical business issues. The result may be less insightful and less creative solutions.

Goal #4. Rethinking Business Processes

An SDP could potentially engender a new perspective on the business by focusing on the shared data of the enterprise. None of the four cases presented had this as an explicit objective, nor achieved the outcome of rethinking key business processes. We argue that the methodology is not conducive to achieving this goal, for many of the same reasons it is not appropriate for targeting critical systems.

Rethinking critical business processes requires managers with a keen understanding of both the organization and the business environment, and an ability to see beyond current ways of operating -- exactly the kind of person unlikely to be able or willing to spend major amounts of time doing detailed modeling of hundreds of processes or activities. Even with the right participants, the emphasis on detailed modeling across the whole scope of the planning domain may bury the creativity and big picture thinking needed to succeed.

Goal #5. Promoting Education or Communication

Almost every SDP effort seems to have clear benefits to its team members in terms of understanding the business in new and useful ways. This may be one of the most predictable outcomes of the process. However, there are several important concerns here.

The New Understanding Seems Difficult to Communicate. In reviewing and synthesizing the planning literature, Boynton and Zmud (1987) note the importance of an "organizational learning analysis" during the planning process to assess how new technologies will be accepted and institutionalized throughout the organization. The research presented

here suggests that organizational learning is not always a by-product of SDP. In some cases, team members report that their new insight is quite compelling to themselves, but they have great difficulty convincing others, including top-level management and the participants' peers. It is almost as if each person must go through the SDP initiation themselves before they "see the light." If this is the case, SDP is a very expensive technique for organizational learning.

The Cost of an SDP Can Probably Not be Justified by Education and Communication Alone. If the SDP effort can be justified in terms of some combination of the other benefits, then the education/communication benefit may be a bonus. However, from these cases it seems clear that education alone is not sufficient justification given the high cost of the methodology. Put another way, if education and communication are the primary goal, there are probably other less expensive approaches available.

CONCLUSIONS

Tying together some of the above insights, SDP seems more or less appropriate depending on the business environment and the desired outcomes of the planning effort. Because of its expense and its orientation toward total integration, SDP seems most appropriate where large scale data integration is a critical business requirement. It is less appropriate for identifying systems priorities or rethinking the business, because the large time requirements and volume of detailed modeling make it difficult to get the participation of those key managers with a clear understanding of both the organization and the business environment. Finally, the educational benefits of SDP efforts may have limited impact and are purchased at a high price.

This suggests that firms should clarify their goals before beginning an SDP. Unfortunately, as Sinclair (1986) observed, few organizations articulate their planning objectives before engaging in various IS planning approaches. The failure to articulate what is hoped for in a planning effort can result in a mismatch between what the chosen planning methodology can achieve and what the organization wants, and can lead to wasted resources and poor quality plans.

Directions for Future Research

This study also suggests at least three directions for future research. These are briefly described below.

What Are the Most Effective Forms of Data Architectures, and How Can Firms Enforce Them? While there are a few studies reporting successful implementations of architectures (e.g., Brancheau and Wetherbe 1986), there is other literature that suggests that organizations may have difficulties implementing data architectures because they lack experience in this area (e.g., Wardle 1984), because systems development activities are becoming more dispersed throughout the organization making it more difficult to control and coordinate individual efforts (e.g., Gillenson 1985), and because systems developers may resist changing the way they currently build and implement systems (e.g., Goodhue et al. 1988; Gillenson 1985; Shah 1984).

For architectures to successfully move the organization to a desired level of data integration, there must be some mechanism to constrain systems developers to adhere to the standards and policies articulated in them. We propose that organizational units responsible for developing and implementing architectures must have sufficient authority and clout to enforce them. Furthermore, these units must be able to monitor the development process and to reward developers who adhere to the architectures.

Are Large Organizations Too Complex For A Single Integrated Data Model? The results from this research suggest that many planning participants are overwhelmed by the volume of detail in the data modeling steps, in spite of the training and facilitation they may receive. Automated means of storing and manipulating this information (e.g., CASE tools), may be one solution, as many practitioners now suggest.

Even with such automation, however, it is possible that in large organizations the complexity of the data and all its possible interactions are too great to allow a single integrated solution. We propose that as the size and complexity of organizations increase, single integrated data models begin to push against the limits of human information processing abilities. This suggests that some amount of compartmentalization (or hierarchical decomposability, Simon 1969) and non-integration in the design of systems may always need to be maintained.

Are There Important Costs as Well as Benefits of Data Integration? When implemented fully, SDP serves as a mechanism for integrating the data of an organization. However, these case studies suggest that integration may not always be a desirable outcome in organizations. LSA resisted the centralized control implied by data integration. SSD resisted the cost of complying with corporate data standards. Functional managers at Cedar co-opted individual findings and developed unilateral, local systems to address them.

Given the intuitive appeal of the integration concept and the flexible access to organizational data that it promises, how can the limited interest in total integration through an SDP be explained? Are managers in these case studies destructively subverting valid goals of their organization, or could resistance, as Markus (1983) might suggest, be a useful clue to a problem with the total integration approach. Under what conditions is integration desirable? Is the need for global coordination and interdependence somewhat antagonistic

to the need for local flexibility and differentiation, as Lawrence and Lorsch (1967) suggested? How should organizations decide when to integrate, and how extensively to integrate? What are the alternative strategies for achieving integration? Under what conditions might they be more or less appropriate?

We propose that only when relationships between organizational units are characterized by strong interdependence and little need for local flexibility and autonomy will firms quickly embrace implementing an SDP with its implied total data integration. Furthermore it is not the total need for interdependence that operates here, but the additional need. Where existing systems already contain important elements of data integration (such as common item and contractor identifiers at LSA, and common billing, and purchasing systems at Ventura) the pressure for additional integration is much blunted. SDP and total data integration are not the only means available to organizations to address internal interdependencies (Galbraith, 1973), and the basis on which organizations choose between these alternatives is a subject of interest among researchers (Daft and Lengel, 1984; Conger, 1988). Rather than being generally appropriate, the value of SDP and total data integration may depend on many organizational and environmental characteristics.

BIBLIOGRAPHY

- Appleton, D.S. "Data-Driven Prototyping," *Datamation* (29:11), November 1983, pp. 259-268.
- Benbasat, I., Goldstein D.K., and Mead, M. "The Case Research Strategy in Studies of Information Systems," *MIS Quarterly* (11:3), September 1987, pp. 369-388.
- Boynton, A.C. and Zmud, R.W. "Information Technology Planning in the 1990's: Directions for Practice and Research," *MIS Quarterly* (11:1), March 1987, pp. 59-71.
- Brancheau, J.C. and Wetherbe, J.C. "Information Architectures: Methods and Practice," *Information Processing and Management* (22:6), 1986, pp. 453-463.
- Conger, S. "Use of Information Technologies for Inter-Unit Coordination," *Proceedings of the Eighth International Conference on Information Systems*, Pittsburgh, PA, December 6-9, 1987, pp. 133-148.
- Daft, R.L. and Lengel, R.H. "Information Richness: A New Approach to Managerial Behavior and Organization Design," *Research on Organizational Behavior* (6), JAI Press, London, 1984, pp. 191-233.
- Eisenhardt, K.M. "Building Theories from Case Study Research," *Academy of Management Review* (14:4), October 1989, pp. 532-550.
- Finkelstein, C. "Information Engineering," *Computerworld*, series of six articles starting May 11, 1981.
- Galbraith, J. *Organization Design*, Addison-Wesley Publishing Company, Reading, MA, 1977.
- Galbraith, J. *Designing Complex Organizations*, Addison-Wesley Publishing Company, Reading, MA, 1973.
- Gartner Group. "Welcome to the Nineties: It's More Than Applications," *Monthly Research Review*, Gartner Group Industry Service, January, 1990.
- Gillenson, M.L. "Trends in Data Administration," *MIS Quarterly* (9:4), December 1985, pp. 317-325.
- Goodhue, D.L. "The Economics of Data Integration," Working Paper Series, University of Minnesota, MISRC-WP-89-09, June 1989.
- Goodhue, D.L., Quillard, J.A., and Rockart, J.R. "Managing the Data Resource: A Contingency Perspective," *MIS Quarterly* (12:3), September 1988, pp. 373-392.
- Hackathorn, R.D. and Kamiri, J. "A Framework for Comparing Information Engineering Methods," *MIS Quarterly* (12:2), June 1988, pp. 203-220.

IBM Corporation. *Business Systems Planning*, IBM Manual #GE20-0527-3, July 1981.

Kanter, J. and Miserendino, J. "Systems Architectures Link Business Goals and IS Strategies," *Data Management* (25:11), November 1987, pp. 17-22, 25.

Lawrence, P.R. and Lorsch, J.W. *Organization and Environment*, Division of Research, Harvard Business School, Boston, MA., 1967.

Lederer, A.L. and Sethi, V. "The Implementation of Strategic Information Systems Planning Methodologies," *MIS Quarterly* (12:3), September 1988, pp. 445-461.

Martin, J. *Strategic Data-Planning Methodologies*, Prentice-Hall, Englewood Cliffs, NJ, 1982.

Martin, J. *Information Engineering* (1), Savant Research Studies, Carnforth, Lancashire, England, 1986.

McLean, E.R. and Soden, J.V. *Strategic Planning for MIS*, John Wiley and Sons, New York, 1977.

Pyburn, P.J. "Linking the MIS Plan with Corporate Strategy: An Exploratory Study," *MIS Quarterly* (7:2), June 1983, pp. 1-14.

Rockart, J.F. "Chief Executives Define Their Own Data Needs," *Harvard Business Review* (57:2), March-April 1979, pp. 81-93.

Shah, A.D. "Data Administration: It's Crucial," *Datamation* (30:1), January 1984, pp. 187-192.

Simon, H.A. *The Sciences of the Artificial*, MIT Press, Cambridge, MA, 1969.

Sinclair, S.W. "The Three Domains of Information Systems Planning," *Journal of Information Systems Management* (3:2), Spring 1986, pp. 8-16.

Sullivan, C.H., Jr. "Systems Planning in the Information Age," *Sloan Management Review* (26:2), Winter 1985, pp. 3-12.

Wardle, C. "The Evolution of Information Systems Architecture," *Proceedings of the Fifth International Conference on Information Systems*, Tucson, AZ, November 28-30, 1984, pp. 205-217.

Weick, K.E. *The Social Psychology of Organizing*, 2d edition, Random House, Inc., New York, 1979.

Yin, R.K. *Case Study Research: Design and Methods*, Sage Publications, Inc., Beverly Hills, CA, 1984.

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