A Methodology for Identifying Strategic Opportunities for DSS

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1. Introduction

The concept of decision support systems (DSS) and its evolution over the last decade provides a useful model to think about many management issues associated with end user computing. In many ways, DSS is a design concept. That is, it is a combination of computer technology and design methodology that is intended to significantly restructure the relationship between the user and the analyst. Since the DSS user may also adopt the role of the builder, there is a direct analogy between the concept of DSS and that of end user.

Given this participatory emphasis, DSS design methodology drew upon theories that recognized and encouraged new roles for the user. The Lewin-Schein change process model (22) and the representation oriented design methodologies (23) dominate current approaches used to build and implement DSS today. Current DSS technology with its command driven emphasis and importance given to the interface also support these methodologies.

Embedded in this design concept is a strong view of the user as a learner. Traditional benefits of DSS are often linked to improved understanding and task learning. Several researchers (8) have pursued the notion of DSS as a learning support system. One justification for this perspective lies in the ability of a DSS to influence fundamental beliefs or assumptions held by the user as well as to improve their capability to take effective action (behavior). For example, a DSS may be used to support choice in a complex and uncertain environment. The "what if" capability, perhaps coupled with a powerful normative model, can aid the decision maker in reaching a "better" (ideally optimal) decision. But does the DSS aid the user in challenging the appropriateness of making that decision in the first place? Better stated, is the decision maker focusing on the right problem or decision? Has the user established the appropriate context or frame of reference for the decision?

Methodologically, a pragmatic means to cope with the need for learning has been to prototype the design of the DSS. While this methodology does provide for increased participation of the user and has been shown to help users converge to a system they feel meets their needs, there is nothing explicit in the approach that challenges the fundamental belief structures of the users. As Henderson and Schilling (10) point out, the lack of a divergent thinking process induced by prototyping could lead to a poor DSS design.

Peter Keen[1] has argued for a shift in DSS research from facilitating the development of systems to a focus of directing investments into the "right" systems. He argues that users must build upon a strong foundation relating to the "how" and begin to focus on "decisions that matter." While this emphasis seems quite appropriate for the DSS field, it is also relevant to an increasing number of line managers responsible for managing end user computing.

Such a concept is counter to the support and facilitating role carved out in the early days of DSS. Review of the literature suggests the strategy for success in DSS centered around choosing the "right" user, concepts of cherry picking, and the notion of start small and evolve. These strategies are

1 Discussions with the Nolan and Norton DSS Working Group, 1984.

based on the notion that DSS technology, both computer-related and design-related, are sufficiently poorly understood to justify accepting the risk of failure associated with working on complex and messy decisions.

This paper supports the concept that the end user community in general and the DSS community in particular must begin to address "decisions thatmatter." The "how" of DSS is no longer the dominant barrier to success. Further, widespread end user computing has transferred many of the DSS roles from a core of DSS professionals to the entire organization. As this transfer continues, the issues of DSS will become increasingly management oriented rather than engineering oriented. As these investments in DSS and end user computing move toward strategic decisions, new, more complicated problems will have to be addressed. Defining the future directions for DSS technology and design methods lies in this new strategic domain.

The focus of this paper is to provide a design approach that will allow users to build DSS and end user systems for "decisions that matter." The methodology enhances DSS design techniques in two fundamental ways. First, the proposed approach will incorporate design techniques that focus on beliefs or assumptions as well as those that concentrate on behaviors or critical processes. Secondly, the proposed approach will raise the level of the design context. Both of these extensions can be accomplished within the current framework used to develop DSS. Again, the issue is not that we need to radically alter our concepts of how to build DSS, but that we need to better direct our DSS investments.

Section 2 discusses how current DSS planning and design methodologies can be extended using critical success factors and assumption surfacing techniques. Section 3 provides a further extension to the planning process that uses concepts relating to competitive advantage to identify further opportunities for investing in strategically important end users systems. Section 4 provides a brief summary and conclusions.

2. DSS Planning and Design

The distinction between planning and design for DSS is often blurred. Planning tends to focus on a long time horizon and issues of desired states, availability of resources, and constraints. Design is short-term with a focus on creation, building and commitment. However, if the DSS planning and design process is evolutionary, this distinction becomes difficult to articulate. As one reviews DSS design methodologies, the design steps that focus on project selection and prioritization tend to be underemphasized. That is, what to do is a given. For example, Keen and Scott Morton (14) build upon the change process model of Lewin-Schein to suggest a DSS design methodology. Their approach has two phases, one corresponding to selecting an appropriate DSS application, the second concentrating on building the system. The selection process recognizes the need to link a DSS application effort to the goals of key individuals. However, their methodology approaches this issue from an implementation perspective, not a strategic perspective. That is, the intent is to ensure that the DSS designer manages the expectation of the user, defining a project that will receive the necessary political, technical, financial and human resources support. Given an appropriate commitment, the decision process is examined, beginning with a descriptive model, articulating a normative model and eventually settling on a consensus model. While the goals of individuals and perhaps the organization are examined, they are only indirectly used to determine the best "DSS." Further, the descriptive-normative-consensus model used by Keen and Scott Morton and others for defining a decision process only indirectly examines the assumptions as to why this decision process or the nature of the decision process is appropriate. Obviously, the skilled DSS professional will raise many of these assumptions as to why this decision process or the nature of the decision process is appropriate. However, the methodology itself does not systematically surface and challenge assumptions.

Rockart and Crescenzi (21) use Critical Success Factors (CSF) to address the issue of criticality. Given the goals of the individual(s), CSF's are those processes that must go well in order to achieve success. Thus, the priority areas for technology investment are directly linked to CSF. Rockart and Crescenzi (21) suggest a prototyping approach be used to identify the DSS — requirements necessary to support a given CSF.

Henderson, Rockart and Sifonis (9) propose an extension to the CSF process shown in Figure 1. This methodology uses the CSF analysis to provide the planning context in three critical domains: information, decision and assumption. The critical information set (CIS) defines those measures and associated data necessary to monitor, analyze and control the CSFs. This is the traditional product of a CSF analysis.

The Critical Decision Set (CDS) defines those decision processes that will most effect the successful achievement of a CSF. For example, if the CSF is to retain highly skilled employees, the CDS might include the hire, promotion, merit raise, job assignment or other decisions that directly effect a high skilled employee's decision to remain with the firm. While the critical information set (normally the major product of a CSF analysis) might include monitoring and control information such as employee turnover rate, the CDS identifies decision processes that could be supported with a DSS. A traditional process-based DSS analysis, e.g., descriptive-normative-consensus process model, could be used to design a specific DSS. To the extent that the CSF is tightly linked to the goals and the goals are tightly linked to the strategy, this DSS could have strategic impact. Thus, introducing a DSS planning exercise linked through CSF to a strategic information system planning process could allow management to systematically direct DSS investments toward "decisions that matter."

The concept of Critical Assumption Set (CAS) addresses the issue of beliefs. Each CSF has, underlying it, a set of assumptions about one's organization, competition, industry and so on that leads the individual to believe a particular factor is critical to success. For example, Henderson, et. al. found the CSF of retaining highly skilled employees was based on the assumption that expert systems technology would not reduce the organization's dependency on a particular category of skilled employees. Is this assumption appropriate? At another level, Rockart and Crescenzi (21) point out that CSF are temporal. How does one examine or validate the appropriateness of the CSF? The process of surfacing and examining assumptions is a means to explicitly address the validation issue in planning process (17). In an applications context, Henderson, et. al. (9) suggest that one definition of executive support systems is a support system built to monitor, analyze and adapt to changes in critical assumptions. This would be an example of an end user system designed to address the beliefs of decision makers directly rather than indirectly.

Finally, Figure 1 illustrates the concept of using a high level data model as a mechanism to understand how the various support systems interrelate. A significant trend in the systems design literature is the recognition that a data modeling effort must parallel a process modeling effort. The process modeling helps to identify the people, policies and rules that form the basis of organization. The data modeling effort maps these processes into an equivalent information representation. The data model is a tool that can provide one means to coordinate investments across the range of support systems. Perhaps more to the point, addressing strategically important decisions will often require integrating sources of data that cross organizational boundaries (both internal and external). The strategic data model provides a way to identify critical sources of data and articulate data policies that affect its availability. Extending this sense of criticality from process to critical data classes is an important requirement.

While the extended CSF methodology provides one means to identify "decisions that matter" and begins to address beliefs as well as behaviors, success in terms of creating strategically important DSS is still problematic. Success depends on a series of planning efforts with the DSS investment decision made at a relatively low level. One must envision the future for the organization, propose strategies to move the organization toward this vision, articulate goals for these strategies, identify CSF for these goals and then address the issue of strategically important support systems. Needless to say, success becomes quite contingent on a lengthy planning process. The following section moves the concept of both process support and assumption challenging to a higher conceptual level and thus, an earlier stage in the planning process. To the extent this move can be achieved, the opportunities to build strategically important support systems could be clarified.

3. Strategically Important Support Systems

There has been an increasing number of researchers who are exploring the question of how information technology can be used to effect the competitive position of the firm (22). Many of these researchers build upon the strategic planning framework proposed by Porter (20). This framework expands the domain for strategic planning from one that examines only the firm and its rivals to one that also considers the customers, suppliers, and how the firm can create barriers to entry or substitute products within a competitive market. Rockart and Scott Morton (22), Porter (20) and others use the concept of a value-added chain to articulate how information technology can affect the competitive positioning of the firm (Figure 2). As summarized in Table 1, technological impacts can occur through (1) improved efficiency or effectiveness of a critical function, (2) links between critical functions, (3) altering the switching costs of customers (customer lock-in), (4) decreasing switching costs for suppliers (electronic marketplace), or (5) creating new products or services.

This framework can also be used to raise the conceptual level of planning with respect to strategically important DSS. That is, rather than focusing on CSF's, one could use the criticality of the value-added function as the planning frame. However, many DSS and end user systems effect processes and decisions that fall under the category indirect value-added via administrative services. To label these efforts as indirect value-added obscures the impact of many DSS. Figure 3 shows an expanded value-added chain that differentiates between product/service flow and information support flow. In this model, the information flow associated with key support areas are expanded and linked conceptually to the physical product value-added flow. Thus, the parallel to research and development for marketing is market research; the parallel to production is forecasting and so on. This expanded view permits the planner to examine opportunities to affect key product stream functions by concentrating on parallel information support functions. For example, just-in-time manufacturing control (a system directly effecting the physical product flow) depends on the capability to generate reliable forecasts (a function normally found in a support or indirect function). In order to achieve the benefits of just-in-time manufacturing control, supporting the forecasting decision process may be strategically important.

Opportunities also occur through better linkage of the information support function to the product function (e.g., linking forecasting to production scheduling may be critical to just-in-time manufacturing) or integrating between value-added functions at an information level. Extending our forecasting example in the high technology industry, a critical need is to adapt the forecast, and hence the master production schedule, to new product offerings, delays in new product offerings and so on. Since the market forecasting and product development functions are often located in separate organizational units, this critical coordination requirement offers an opportunity for a multi-user DSS.

DSS can be used to affect the impact of customer switching costs or supplier switching costs. A good example of this is a distribution company that provided independent dealers with a micro-based DSS that generated cost estimates, equipment sizes, and so on. The DSS provides solutions in terms of model numbers carried by the distributor. It also provides inventory levels, permits on-line entry, allows analysis of substitutes, and so on. The result is a significant lock-in of independent dealers and, thus, competitive advantage. To the extent that this DSS system helps to achieve customer lock-in, it is a strategically important system.

The DSS can also provide opportunities for new products or services. Embedding inventory control, forecasting or financial planning models into standard data processing application packages is a current strategy in the software business. While such an effort is in the early stages, the advent of expert systems technology and improved interfaces could create a significant market for model-based DSS.

Perhaps most importantly, the strategically important DSS can be used to alter the organizational decision process. The impact of DSS has traditionally been viewed at an individual level. The field, however, has long recognized the role of DSS as a catalyst for change. A strategic impact could be achieved by using DSS to systematically change the participation and level of influence of individuals in a critical decision process. There has been much attention given to the concept of flattening the organizational structure. In many ways, this corresponds to reducing the number of individuals (levels) participating in key decisions. With effective DSS, the quality and risk of decisions can be managed at a lower level in the organization with a limited review process.

The issue of beliefs or assumptions can also be pursued at this higher level. The interpretation that Porter's framework expanded the strategic planning domain to include customers and suppliers coincides with the strategic planning methodology developed by Mason and Mitroff (17). Using the planning frame of key stakeholders, Mason and Mitroff surface assumptions concerning these stakeholders and use these critical assumptions to examine strategy (or, in the case of information systems, information requirements). Their application of stakeholder analysis results in not only customers, suppliers and rivals becoming a focus but also stakeholders such as regulators, internal organizational groups and key public sector influence groups; e.g., the relationship of the AMA to drug manufacturers. This methodology can be used to pursue both the identification of systems that could monitor or analyze these key assumptions and to explore the organizational assumptions that must be confronted in order to alter a decision process. For example, when a consulting firm's product is viewed from a decision perspective, the decision to include a specific recommendation in a report is critical. Further, the level of detail relating to this recommendation is also a critical decision. Most consulting firms have an elaborate review process to control the quality and risk associated with recommendation in a report. This is a time consuming and expensive process. Further, the reviews often introduce influences and bias that could be inappropriate. This decision process could be examined from the perspective of all stakeholders involved and the assumptions that underlie their involvement. Challenging these assumptions could result in opportunities to change the process and simultaneously reveal critical information flows that must exist if a new, improved process is to be introduced.

Ultimately, challenging these assumptions and focusing on new organizational decision processes will affect the relationship between data processing and the DSS builders. Henderson and Schilling (10) have argued that successful DSS results in increasing interdependencies between the DSS user and the traditional MIS function. It would seem reasonable to expect that these interdependencies will be more critical for strategically important DSS. While it is possible that a DSS used by a single individual, or small group could have strategic impact (by virtue of the improved decision), an organization decision process view implies a significant role for information and model sharing. The importance of managing the data resource related to this DSS will be important. Extending data and model accessibility to decision points geographically dispersed (i.e., down the channel of distribution) will likely be important. If such is the case, strategically important DSS will result in a need for close partnership between the user and the DP professional. This may well be the most radical assumption facing the DSS and end user community.

4. Conclusion

There are two basic conclusions one can draw from this framework. First, there is a need to address both beliefs and behavior. DSS and end user computing has long been engaged in assumption testing. The infamous "what if" capability addresses this need to test beliefs. And yet, I believe the tendency is to test assumptions on a narrow definition of the problem domain. To ask "what if" we raise our percent of merit increase? Will such a change positively affect our ability to retain highly skilled employees (assuming we had such a model)? While this is testing an assumption, there is a strong assumption set already embedded in our model. The assumption we tend not to test is "Do we really need highly skilled employees?" This type of belief directly affects our planning frame and is related to the need for second order learning. To affect decisions that matter, we must be capable of addressing such fundamental beliefs, as well as supporting our ability to take effective action within a relatively well-defined assumption set.

Secondly, the impact of a strategically important DSS is likely to be linked to adjustment of an organizational decision process. If the organization implements a market forecasting DSS to improve the performance of a market analyst, but does not adjust the level of participation and influence of this individual in the overall decision process, the organizational impact may fall substantially short of its potential. Again, adjusting an organizational decision process will likely require changes in our beliefs about that <u>process</u> as well as belief about the accuracy or reliability of any source of information (e.g., market analysis).

In summary, the proposed framework attempts to recognize value-added information support functions and their associated decision processes, and relate these to the value-added chain for the product or service. This provides a starting point to identify strategically important decision processes and support activities. It provides a means to examine both beliefs and behavior at varying levels of abstraction. Hopefully, such a framework can aid the process of investment in DSS that have strategic impact.

Figure 1

Extend CSF Methodology

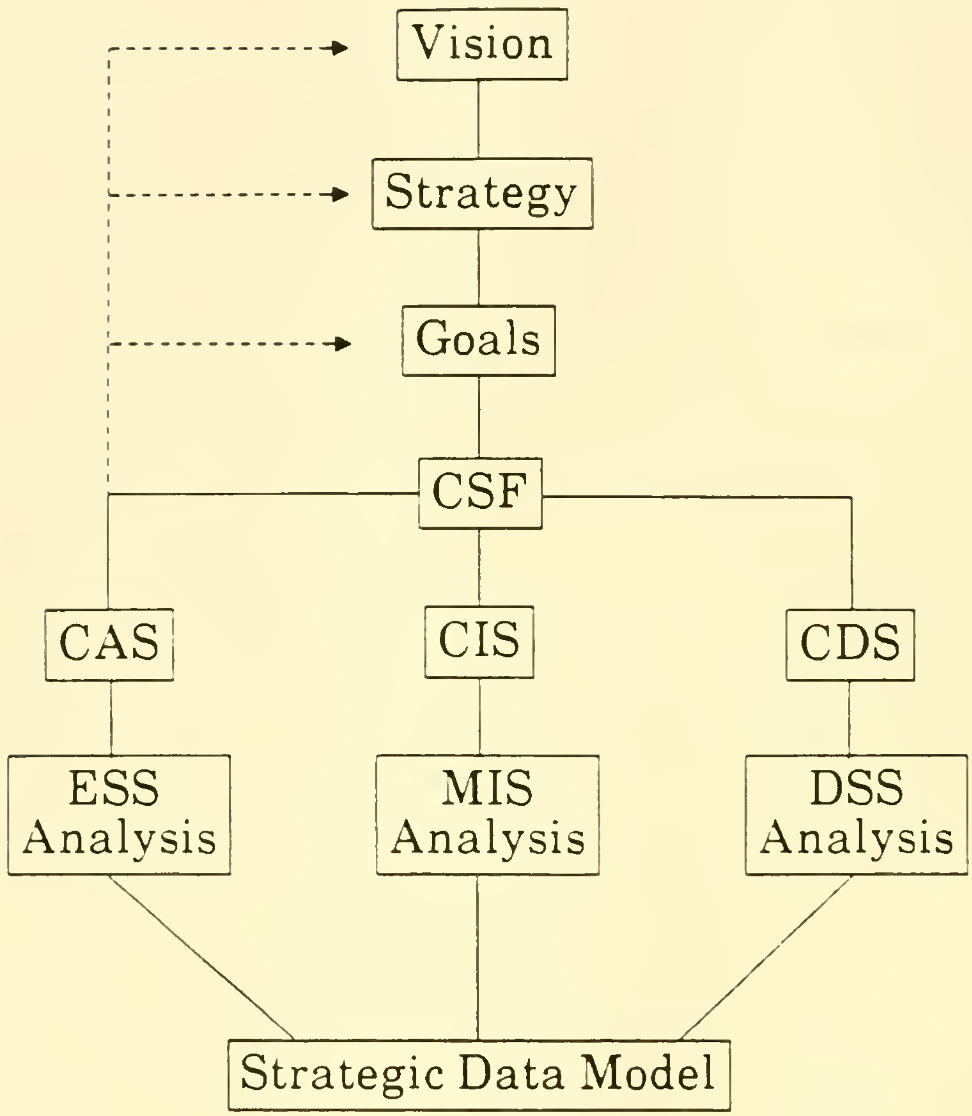

Figure 2

Value Added Chain

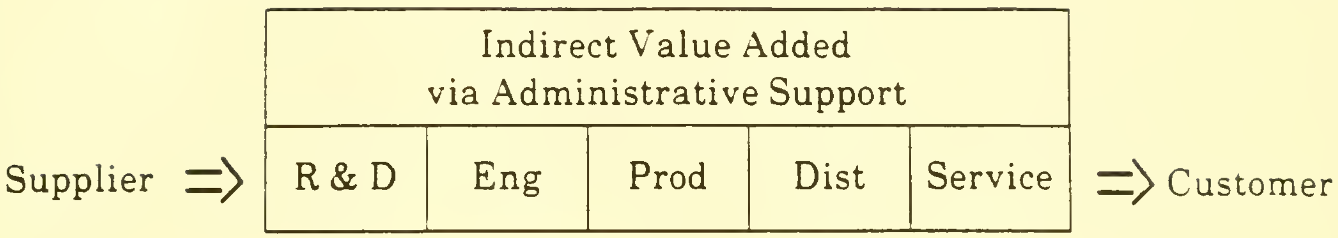

Figure 3

Extended Value Added Chain

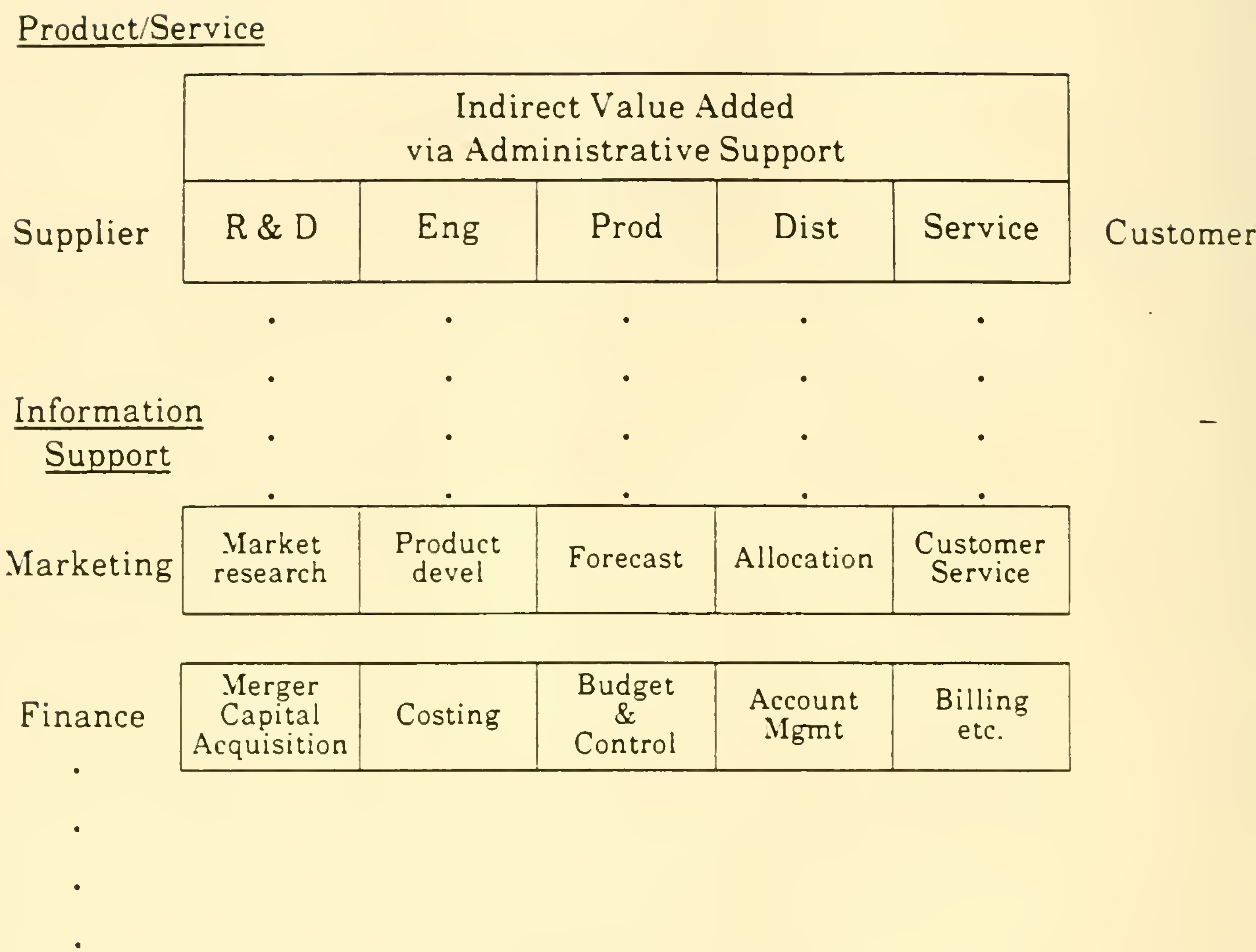

Table 1

Opportunities for Information Technology to Affect Competitiveness

Opportunity	Example
Within function efficiency or effectiveness	Use IT to implement just-in-time manufacturing control
Linking critical function	CAD/CAM design changes flowing directly into BOM
Customer lock-in	Providing on-line order entry at customer's site
Supplier distancing	Using financial service firms to access wide range of services
New products or services	Embedded systems into products

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