A PROCESS FOR THE RAPID DEVELOPMENT OF SYSTEMS IN SUPPORT OF MANAGERIAL DECISION-MAKING

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During the past three decades, innumerable systems have been computerized to improve efficiency in accounting and operational activities. In the past few years, decision support systems (DSS's) have come into their own and flourished in many companies. Recently, with the advent of the personal computer, computer-based assistance for all functions of the business is becoming widespread in a number of companies today.

In the midst of this computer-based explosion, one significant ingredient has been noticeably missing. For the most part, top management of the corporation has stood -- uninvolved -- at the sidelines. In well-managed companies, top executives have given their approval to information systems budgets, blessed long-range plans, and reviewed very major projects and hardware decisions. Yet, for the most part, they have been spectators, essentially uninvolved in the very vital process of information systems planning and use. Of real significance, with a few notable exceptions, senior executives have given little thought to improving corporate effectiveness through their own direct computer-based use of corporate data. Almost total responsibility for information systems has been delegated to an information system director or vice-president.

Until very recently, this posture made some sense. Information systems were essentially paperwork-processing systems. They accounted for a relatively small percentage of the budget. Although some systems were vital to the day-to-day operations of the company, their functions were well-defined. As such, they could be designed and implemented by personnel far beneath executive rank.

Today, however, there are a number of factors which make greater top management understanding and involvement increasingly critical. Not the least of these factors is the ever-growing budget for hardware, software, and

personnel at all levels in the organization, which has become an increasing source of managerial concern. Equally significant is the outpouring of new information systems technology. This new technology provides a potential for any corporation to beneficially invest in computer-based systems to a much greater extent than any corporation can fully finance in the next few years. And there appears to be wave after wave of new technology coming. The development of priorities for systems development has become crucial.

In addition, the movement of information system hardware and software capabilities from merely facilitating the automation of clerical tasks to providing direct on-line support for decision-making and other managerial processes, has opened up the potential for top corporate executives to focus on their own information needs. Finally, and perhaps most significant, the new information/communication technology is having a significant impact on business strategy itself. As has been demonstrated by companies such as Merrill Lynch, American Hospital Supply and Foremost-McKesson, significant competitive advantage can be gained through judicial use of the new technology.[1,2]

Today there is a clear need for top management to get off the sidelines. Although the need is felt to differing degrees, there is a heightened awareness in almost all senior executives that they must drop their passive role with regard to information systems. There is a clear need to link information systems to business strategy and, especially, to ensure that business strategy is developed in the context of the new information technology environment. In short, there is an increasingly felt need for senior executives to become informed, energized, involved, and engaged with regard to information systems. There is an increasing desire on the part of corporate executives to feel comfortable that their organizations are

proceeding along appropriate lines in utilizing the technology in the best interests of the corporation.

We believe that developing this active engagement of top management with information systems is highly desirable in organizations of every size. One means to accomplish this is the three-step process illustrated here. In this paper, we describe the experience with, and results of, this process at Southwestern Ohio Steel (SOS), one of the top ten steel service centers in the United States, with sales of approximately $80 million.

The process illustrated here was carried out at SOS under the direction of Thomas Heldman, Chief Financial Officer. The work was shared by Index Systems, a consulting organization, and SOS personnel. This paper is based on data from SOS, Index, and a two-day evaluation interview process carried out by personnel at the Center for Information Systems Research (CISR) of the Sloan School of Management at MIT.

The process involved is based on three major concepts. These are:

- critical success factors
- decision scenarios
- prototyping.

The remainder of this paper describes the company involved, the process itself, and an evaluation of the process' ability to engender managerial understanding of information systems needs and to produce managerial action in appropriate directions. As the impact of the process on the understanding of top management can be evaluated best through their own perceptions, this narrative will be laced with the commentary of the managers involved.

Southwestern Ohio Steel - A Changing Environment

Southwestern Ohio Steel is one of the major forces in the steel service center industry in the United States. Located in Hamilton, Ohio, with a

processing plant in Middletown, Ohio, it employs more than 400 people. Steel of differing quality, including primes and seconds as well as overruns, are purchased from major steel companies and merchandised directly to hundreds of customers throughout the Midwest and contiguous states. By far the majority of the steel is processed to some extent (e.g., slitted, sheared) before shipment to an SOS customer. Through close attention to both merchandizing and manufacturing processes, SOS has developed an image of quality and service to both its customers and suppliers. A key factor in this is SOS's capability of providing customized products quickly, through extreme flexibility in its production schedule.

In early 1982, SOS utilized its existing computer installation only to perform routine accounting functions. At that time, however, management was becoming convinced that several factors indicated a major review of information systems capability. These factors were:

- The company's planning process clearly indicated that, despite possible stagnant growth in the steel industry, SOS could be expected to continue to grow significantly. Steel service centers were becoming an increasingly accepted and utilized service by American industry. Service centers' share of the steel end market had grown from 17% in 1960 to 23% in the early 80's and was expected to be in the high twenties by 1990. Two competitive advantages facilitated this. First, the steel centers' ability to hold and pre-process steel vastly decreased the inventories needed to be maintained by their customers. In addition, a growing trend toward "just-in-time" delivery, as more firms turned to the essentials of Japanese management, was providing a competitive edge over the less delivery-oriented steel manufaturers.

These very positive factors, however, were, in turn, making the steel service center business increasingly complex. The complexity of inventory and manufacturing management at SOS had grown significantly. With customers maintaining lower inventory levels, a vastly increased number of "hot orders" (overnight or next day delivery) were complicating plant operations. In addition, the growing use of MRP systems by a number of firms was providing a call for smaller lots and more frequent deliveries.

- At SOS, it was also clear that information systems capability was strained. Existing systems, installed by the company's accounting firm, were doing a superb job of providing the accounting personnel with data, but all key managerially-oriented information remained manual.
- Finally, the management team was changing. The first-generation management of the family-owned organization was giving way to a newer, younger mangerial team, two of whom were sons of the original top management. There was a need to pass on knowledge and build into systems some of the expertise and perspective which had been gained over a number of years by the departing key executives.

An Unsuccessful First Attempt

Management's first instinct was to turn once again to the company's accounting firm. The solution they proposed came as a shock to the senior executives of the steel firm. It was a series of on-line computerized information systems based on "tried-and-true" conventional systems design and implementation processes. The cost was estimated at $2.4 million over the

course of four years. Furthermore, major results and benefits were forecast not to be apparent until after the fourth year.

Management rejected this approach. All members of the management team felt quite uncomfortable with the pricetag, timeframe, and overall risk associated with the project. Perhaps most important, the exact tie between the systems proposed and the real needs of the business was unclear.

At this point, Tom Heldman, the chief financial officer, embarked on a search. "I wasn't quite sure what I wanted. But I knew there had to be a more creative approach toward assisting top management to understand its systems needs and to bring up systems more quickly, with reduced risk and cost." Heldman found what he wanted in a process, described below, developed by Index Systems, a Cambridge, Mass. based consulting firm.

A Three-Phase Process for Managerial Involvement

Exhibit 1 outlines the three major phases of the process used at Southwestern Ohio Steel. Each phase has two or three sub-parts (or steps) and a particular "key" technique associated with it. Taken in turn, the three techniques assured managerial involvement from the earliest planning stages through a very interactive implementation process. The three phases were:

- A "linking" phase utilizing the critical success factors technique. During this phase management developed a clear definition of SOS's business and came to agreement on its most critical business functions. In addition, it took a first cut at stating its information systems needs in these critical areas.
- The second or "confidence building" phase consisted of developing managerial understanding that the priority systems defined above

would deliver the necessary information to support key decisions. In this stage, decision scenarios were utilized.

- Finally, in the "development" phase, systems were built utilizing a prototype approach. In this approach, initial, partial systems were brought up very quickly at low cost. In working with these systems, management was able to more fully grasp their usefulness and to authorize, with significantly greater comfort, continued system development. As a by-product, initial benefits from these systems were received very rapidly.

THE FIRST PHASE - LINKING TO THE BUSINESS

Emphasis in this phase is on understanding the business, focusing on the few factors which drive the business, and in engaging management actively in the process. Only at the very end of this phase is the initial link to information requirements for the key areas of the business made. As Exhibit 2 shows, the first phase is divided into three steps. These are an introductory workshop, critical success factor (CSF) interviews, and an all-important "focusing workshop" in which the results of the interviews and their implications are thoroughly worked through.

Introductory Workshop. Participating in this initial workshop were the five key members of the management team. They were William Huber, Chairman of the Board; Joseph Wolf, President; Tom Heldman, Vice President of Finance; Jacque Huber, Vice President of Sales; and Paul Pappenheimer, Vice President of Materials. William Huber was the last active member of the original SOS founding management.

In this first session, with their introductory "homework" about the company already accomplished, the consultants presented their approach to the

determination of systems needs -- the process described in this paper. They described the critical success factors method and the prototype concept (both of which will be discussed in later sections of this paper). In a major substantive step, company objectives were discussed and clearly agreed upon.

The workshop had four benefits:

- The consultants established a managerial perspective for systems development, one of linking information systems priorities to the most important business activities.
- There was an initial step toward establishment of business priorities through the definition (essentially a redefinition) of corporate goals.
- Active involvement of the key member of the executive team, the Chairman of the Board, was obtained.
- SOS executives were educated in the techniques to be utilized.

During the session William Huber found the approach described very much to his liking. He had previously told Heldman, "Don't let anybody ask me what information I need. People don't know what they need." The approach of developing information systems based upon the understandable information imperatives of critical business functions, not vaguely guessed at information "needs," caught his attention. He was an active and influential participant throughout, passing on in this and later sessions to the younger management team much knowledge which had been gained in his several decades of managing the business.

CSF Interviews. The critical success factors (CSF) method is a technique designed to help managers and systems designers, working from a business or managerial perspective, to identify the management information necessary to

support the key business areas. Critical success factors for an individual manager are the few key areas in which successful performance will lead to the achievement of the manager's objectives. In effect, critical success factors are the means to the objectives -- which are the desired ends. On a corporate level, the CSFs are the key areas on which the company must focus in order to achieve its objectives. The CSF interview process is designed to have each manager interviewed explicitly state those things which are critical, both in his own job and for the corporation. By voicing these CSFs, managers sharpen their understanding of the priority areas in which information is necessary. The ways in which these might be measured are also focused upon.[3,4] The five key executives and ten other key managers in SOS were interviewed. In addition to further communicating the desire to link all systems development strongly to the needs of the business, the interviewing process also provided the consultants with a significantly clarified understanding of the business, the role of each individual, and the culture of the organization.

The Focusing Workshop. In this workshop, the consultants present a "strawman" or corporate mission, objectives, and CSFs constructed from their analysis of the prior workshop and the interviews. This working document provides a basis for extended, often intense, discussion. This "strawman" is a key to uncovering varying perceptions and disagreements among the management team. This is the most significant and difficult step in the first phase. In any organization, the agreement process faces a set of different individual perspectives, different managerial loyalties, and differing desires. Leadership by corporate management in untangling the myriad of differences and focusing on the core elements of the business is essential.

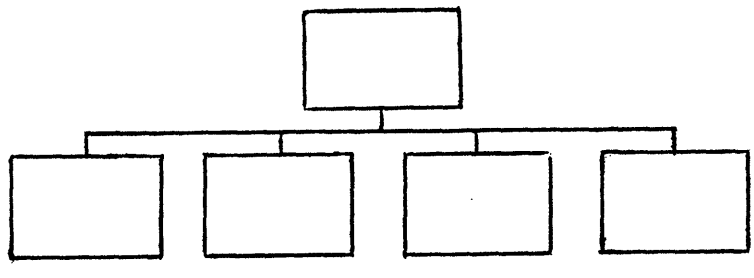
At SOS, corporate objectives developed in the earlier session were reaffirmed. Most related to financial and marketing objectives. A set of 40 initially suggested potential critical success factors obtained through the interviews were refined and consolidated into four. These were:

- Maintaining excellent supplier relationships
- Maintaining or improving customer relationships
- Merchandising available inventory to its most value-added use
- Utilizing available capital and human resources efficiently and effectively

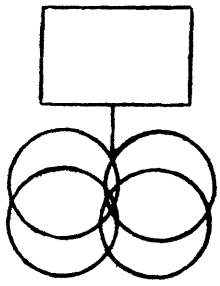
As Tom Heldman notes, "This is the key meeting. The interviews are merely a preliminary, a 'softening up' process in which managers get an initial opportunity to think deeply about the corporation as well as to develop relationships with the consultants."

During the workshop what had previously been implicit was made explicit -- sometimes with surprising, insightful results. In Jacque Huber's words, "We all knew what was critical for our company, but the discussion, sharing, and agreeing was really important. What came out of it was a minor revelation. Seeing it on the blackboard in black and white is much more significant than carrying around a set of ideas which are merely intuitively felt."

Another SOS executive portrays the managerial insights gained from focusing on an organization's CSFs in a somewhat different way. He says, "During the meeting, our concept of our organizational structure went from an organizational chart that looked like this:



to one which looked like this:"



"This was important. It affected our system's design enormously. More importantly, it has affected the way we manage the business."

The interpersonal skill set of those persons running the "Focusing Workshop," in this case the consulting team, is very significant. Business knowledge and interpersonal skills are critical. However, the technique itself easily engages the attention and involvement of the management team, and eases the seminar leadership job. Again, in Heldman's words, "Focusing on 'what makes the company a success' intrigued almost all of top management. It appealed to a group of good managers, allowing them to engage in a discussion of what they knew best and what seemed important to them."

Also developed in this workshop were the set of measures for CSFs, a sample of which is given in Exhibit 3. Finally, initial steps were taken at assessing, from management's viewpoint, the implications of the set of objectives, CSFs, and measures for information systems priorities.

PHASE TWO -- DEVELOPING WELL-UNDERSTOOD SYSTEMS PRIORITIES

The second phase, as Exhibit 2 illustrates, has two major steps. These are concerned with the development of systems priorities and the gaining of managerial confidence in the expected efficacy of the priority systems to support their needs.

Development of Systems Priorities. As the consultants reviewed the results of the interviews and the working sessions, they turned to a period of studying the business in more depth in the areas in which priority information systems were indicated. At the end of this period, they identified three distinct systems which would support the fundamental managerial processes. The three key business systems necessary were those in support of the buying and inventory management process, the marketing of steel, and the production scheduling process.

An analysis of these three proposed systems showed that each significantly affected the critical success factors of the firm. Inventory management affected all of the critical success factors, most particularly supplier relationships and efficient use of resources. The proposed marketing system directly impacted customer relationships and merchandising. Finally, production scheduling was significant with regard to the critical areas of efficient and effective use of resources, merchandising and customer relationships.

At SOS, as elsewhere, the transition from a business focus on objectives and critical success factors to systems definition is not a straightforward simple process. It is more an art form than a science. This business-systems transition relies heavily on the technical expertise, systems knowledge, and all-around consulting expertise of the design team (whether external consultants and/or internal consultants are involved). But at SOS, as in other cases in which we have been involved, the signficant systems needs were strongly indicated from the preceding managerial discussion of goals, CSFs, and measures.

Workshop on Decision Scenarios. While observing the key managers in their daily activities, the consultants took note of recurring decisions and the

questions the managers asked of themselves and others while making these decisions. From these "decision situations" a set of "decision scenarios" was developed. Each of the decision scenarios concerned a particular managerial event and the questions which might be asked in formulating a decision. Included were all relevant questions, both those which could be answered by computer-based data and those which could not.

In a third working session, the three proposed, but as yet unbuilt systems (all prototypes) were outlined to the managerial team. This third working session, however, centered around the "decision scenarios." One of these is presented in Exhibit 4. Working through a series of these scenarios, enabled the managers to gain a much greater familiarity and insight into the workings of the three proposed systems. They were able to see which questions would be answered by the new systems, which would be left unanswered, and the way in which data would be presented through "paper models" of proposed screen formats.

In this session, the technical environment necessary to support the systems, the necessary data in the system, and the source and frequency of data collection were also discussed. With the voiced conviction of SOS management that the systems were appropriate, detailed design was commenced.

PHASE THREE - Prototype System Development

As Exhibit 2 shows, the final phase of the process contains two major steps. These are the creation of an initial detailed prototype design and actual systems development.

Prototype Design. Even after systems are agreed upon, the exact method of prototyping must be decided. The right type of prototype must be selected.

Thus far, it appears to us that there are three significantly different types of prototypes. Interestingly, one of each was called for at SOS. Prototypes may be developed either in the form of information data bases, pilot systems, or classical prototypes. The systems at SOS illustrate this. They are:

- An "information" data base for marketing support. By their very nature, information data bases -- collections of data made accessible to users -- are prototypes. No matter how careful the initial systems design, it is impossible to have any manager define the exact information he or she will use in making decisions. Most decision-making processes are tenuously understood at best, and knowledge of the data needed for them previous to automation is incomplete. What is more, as a manager uses a data base, he gains further insight into both the data he really needs and the methods of access that he desires to get to and utilize that data. At SOS, sales support was provided by an information data base originally designated to include information on customers, potential customers, open orders, and accounts receivable. The majority of the CSF measures stated in Exhibit 3 were included in one form or another. This prototype was, in current parlance, a DSS.
- A "pilot system" for inventory management. Pilot systems and pilot plants have been built in the research and development process for decades. These are systems which are a miniature replication of the final production plan. Functionality is complete, tests are made using the pilot to make sure that everything works. If so, the process is then expanded in scale to the full production system. The "pilot" class of prototype is exactly similar. It takes a piece of an entire system and develops it completely with all functions. At

SOS, the inventory management system developed was a pilot. One separable segment of the inventory, approximately 15%, was put on the computer.

- Production scheduling -- a "classical prototype". Prototype systems (systems which the dictionary tells us "exhibit the essential features of a later type"[5] (emphasis added) are built with an initial fundamental, yet not complete, set of functions. The prototype systems are then exercised to illustrate what such a system can do. Further functionality is expected to be added later.[6] At SOS, the production scheduling prototype was designed to provide the initial functionality necessary to allow managers to queue work at machines, generate schedules based on job priorities, and minimize setup time. In DSS mode, the computer performs some functions automatically, while interacting with schedulers for others. Increased functionality is being continually added.

A major feature of each of the prototype systems which were developed at SOS was the ability to provide some data for all levels of management. Most of the systems which are routinely developed today emphasize either operational control, management control, or strategic planning.[7] At SOS, taking a top-down managerial approach -- a "vertical slice" philosophy as shown in Exhibit 5 -- the systems contain the relevant data for operational purposes, but they also provide the raw material for managerial reporting for both management control applications and for partial input to strategic planning. Emphasis is placed on the last two -- as implied by the heavy wedge of the "slice" being at the top.

The prototyping process -- as opposed to full systems development -- is important. Executives in the 1980s react to information systems proposals

from the perspective of a lot of baggage carried forward from past experiences during earlier days, when the technology had less capability, systems design and development processes were significantly less facile, and software development tools, as well as concepts of managerial involvement, were more primitive. A lack of understanding of the new technology and an associated fear on their part that the new computer systems will interrupt a smooth, well-functioning managerial process, are highly understandable.

At SOS, not all of the key executives were "on board" until the prototyping concept was fully evident. Although most of them became intrigued, even excited, during the CSF phase (with the thought of actually linking systems to business needs), Paul Pappenheimer for one was not. He remained skeptical. "I had heard of a great number of computer horror stories," he recalled. He was fearful that control of the inventory would be lost in the conversion process and that the computer could not support his somewhat unique inventory needs. (Each item of inventory is different at SOS -- varying in quality, size, and many other attributes. Each steel coil needs a full description.) It was not until decision scenarios were utilized and early prototype design was well underway that Pappenheimer fully understood the prototype approach and felt comfortable. He finally perceived the prototype concept as a means of lowering the company's (and his) risks to an acceptable level. As Heldman points out, "We're not just talking about monetary risk here, although this is certainly a factor. Managers at all levels are also concerned about the risk in the development of a non-viable system to which the company is committed because of the expenditure. For some, it is only when they realize that they can get their hands on the prototype at an early stage and assess its utility before going forward that they can relax." In short, a prototype:

- reduces monetary risk
- reduces business risk
- allows a manager to inspect, work with, and shape the product as it is being developed -- thus becoming comfortable with it in all dimensions.

In recalling his experience, Pappenheimer says, "I would have slept better at night if they (the consultants) would have fully communicated the prototype concept from the beginning. Once the idea finally struck me, it really turned me on. I went from negative to highly enthusiastic."

Systems Development. Actual development of all of the prototypes was done on an IBM System 38, utilizing RPGIII. The system now has 28 terminals with additional terminals on order. The final detailed design and programming were performed by SOS staff with the aid of an outside programmer proficient in RPGIII. The initial prototype development period was short for all systems. As an example, the initial inventory prototype was up in two months. After three months of operation, a significant redesign added new functionality. This redesign process was repeated again after an additional six months, illustrating fully the concept of "evolutionary design."[8] Other systems were developed in comparable amounts of time.

The systems are now used by operational personnel and managers at all levels. Some standard reports are issued, but most of the interaction is through menu-based interactive processing. More significantly, today a number of SOS personnel at all levels are learning the available query language for the System 38 to allow them to interrogate the files on their own. One of the first persons to attend query school and to use the facility

actively was Jacques Huber. "If I could tell a staff person what I wanted in the past, I can write my query today. I get my answers faster," says Huber.

Process Summary

Exhibits 1 and 2 summarize, in differing levels of detail, the three-phase process as perceived by SOS management. The exhibits do not, however, show the considerable "backroom" effort put in both by the consultants and the systems developers. It should be stressed that there is a need for the consultants to gain some background knowledge about the company before the first phase. There is also a need for significant effort to understand the details of some activities before the prototypes can be sketched out. The creation of data bases and the development of control procedures to assure the appropriate refreshing of data must be carried out by operational personnel during the prototype system development stages. But these behind-the-scenes processes have always been necessary. They remain a necessary backdrop to the managerially-oriented process.

What has been accomplished through the use of this process? At one level, all three systems are now up and functioning and all the usual advantages of computerizing marketing data, inventory control, and production scheduling are evident. Included among these are:

- Immediate access to order status. "Now," says saleswoman Brenda Grant, "you can check exactly where your order is in the production system while keeping the customer on hold. You don't have to check with the plant and then make those long-distance calls back." Both internal and external telephone tag is avoided. Another salesman comments, "With the new system, what used to take an hour now takes only a minute or two."

- A significant increase in the number of sales calls that can be made per salesperson. Time which used to be "wasted" in answering customer queries as above, and in searching for raw material inventory status, has been eliminated. In addition, customer and prospect data available in the marketing information data base enables salespeople to prepare for "cold calls" more efficiently.
- Improved understanding of customers. By using the available query system, Jacque Huber and the sales personnel are analyzing customer buying patterns to improve production efficiency.
- Improved management of slow-moving inventory. Both visibility into the entire inventory status and analytic capability make this possible. Pappenheimer cites the ability particularly to get to past usage data which "previously was only in my head."
- More accurate inventory control. John Antes, manager of inventory and material assignment, says, "The computer is faster and more accurate. There are controls and validations. There were some errors before, with the manual system."
- Improved production scheduling. Greg Parsley, manager of the first shift in the plant, notes, "The system allows us to foresee problems and to react to them sooner. Before, we never knew where we would be in the future until we were there."
- Reduction in plant personnel. With the introduction of the system, plant management has reduced staff while maintaining its workload. In addition to improved scheduling, noted above, this has been made possible by a reduced need to interact with sales personnel (also noted above), the reduction of time searching for or correcting lost

or inaccurate paperwork, and improved visibility into aspects of the plant.

On a more significant level, the CSF-decision scenario-prototype process has strongly affected the management team in a very positive way. In system evaluation, one asks three questions:

(1) Did it work, and was something beneficial accomplished?

(2) What is management's attitude?

(3) With this experience, are they moving ahead?

The answer to the first question is given in the section above. As to the second, there is a clear sense of both success and comfort in the top management team at SOS today. As Wolf, the President, notes, "Our good feelings today come from an approach to information systems which is based on managing the business." Jacque Huber says that the SOS management team, initially highly nervous that it would "mess with something that works," and "lose control," was able to "come together," through this process, on a systems plan. In addition, he says, "We have achieved in nine months at far lower cost what we expected would take six years under the previously proposed plan." Managerial attitude also appears to have been affected by four other results of the process. These are:

- A sharper focus in the minds of all top managers on the few important things to which they must direct their attention.
- As noted on page 10, an increased understanding of the interdependence of the various parts of the business and the ability, through the computer system, to take advantage of this knowledge.
- The transfer of a sizable segment of his knowledge from the retiring Chairman to the younger management team made possible through the multiple workshops in which various aspects of the business,

particularly those most critical, were discussed. For Heldman, the newest member of the management team, "the insights gained into the company" were extremely useful. He further notes, "I would believe, that for any information systems officer who may have been slightly on the 'outside,' this process would provide tremendous insights into the company and the ways in which top management thinks."

- The direct terminal-based access that management now has to data on various aspects of the status of the company. Huber and Pappenheimer rely on this daily.

It is also clear that the process will have a continuing future effect on the company. Among the signs of this are:

- The three existing prototype systems are being continually given additional functions or expanded in scope.
- Wolf, the CEO, has just commissioned a prototype system to develop a "cost model" for SOS -- a system which he will be able to access directly.
- Additional personnel are being sent to "query" school. CSF use is being extended. Jacque Huber states, "A good manager and his team can use CSFs in all phases of business activity. What is needed is a broad educational program to introduce and promote the concepts of CSF. I plan to introduce CSF to my sales managers soon."

Why did it work?

Is the process replicable in other companies? SOS is a medium-sized company in a single industry with a capable management team. Good management is necessary. No consulting team can assist inadequate management to develop a clear focus. However, size and single-industry status are not constraints on the process. Index has utilized the CSF and prototyping phases many times

with management teams in half-billion dollar companies and divisions of multi-billion dollar organizations. Decision scenarios, the newest input into the process appears to work well in other situations also. At the corporate level of multi-division, billion-dollar conglomerates, the process is somewhat different -- primarily in its end products. At this level, information data bases are the primary prototype developed.

It should be stated that we are convinced this process will not work at all times in all companies. Timing is key. Management must be ready to be involved. Competitive pressures, a felt need to rethink computer priorities, or sheer awareness of the increasing strategic importance of information systems are all among a long list of enabling factors which make a successful exercise possible. Given this, and we believe that these conditions are increasingly evident in many organizations today, the success of the process appears to arise from the following factors:

- The process makes an easy and quick link to top management and the way it thinks. As Jacque Huber notes, "The businessman can relate to CSFs. They make sense. They are a natural extension of objectives and the planning process."
- The process focuses managerial attention on the business things that are important -- thus providing a sense of comfort about building information systems to support these areas. Huber, again, "The businessman needs to be reminded to focus on the means after the ends have been determined. The CSF process is the best focusing device I have ever been exposed to."
- The process engages real management involvement. As Heldman notes, "Most top executives really only provide token 'support' for information systems. In this process, management spent considerable

time talking about its own business. They were involved. And a great amount of energy of the executive group went into the process. Token 'support' is not enough. One winds up with systems that do not affect the guts of the business."

- The consultants (whether internal or external) gain significant insight into the business and therefore are more effective. This process, in addition to providing managerial focus, enables the system designers to better understand management and its needs. Several days of managerial interaction centered around the business itself provide a wealth of company-specific knowledge. As Pappenheimer notes, "The accountants (who submitted the $2.4 million bid) never grasped the business. They were working from an information technology and sytems capability viewpoint, rather than from a business perspective. Index grew to know us."
- Finally, managers recognize that risk is lower. There is a strong managerial bias, in all companies, against committing vast sums of money in areas which one does not fully understand. The CSFs provided the knowledge as to why the systems should be developed. Decision scenarios convinced management that the particular systems would provide the information they needed to ask major questions at all levels of management. And the prototypes made it possible for management to see significant system capability before committing all funding.

In summary, Heldman states:

"The organizational impact and change as a result of the systems has been profound. In a year when our marketplace is collapsing we have been able to stay ahead, respond, and serve our customers better. This is a complete success story."

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[3] Rockart, J.F. "Chief Executives Define Their Own Data Needs," Harvard Business Review, March-April 1979, pp. 81-93.

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[7] The typology is taken from Anthony, R.A. Planning and Control: A Framework for Analysis, Division of Research, Harvard Business School, Cambridge, MA 1965.

[8] Henderson, J.C. and Alavi, M.A., Management Science, Vol. 27, No. 11, November 1981, pp. 1309-1323.

Exhibit 1

A Three-Phase Process for Managerial Involvement

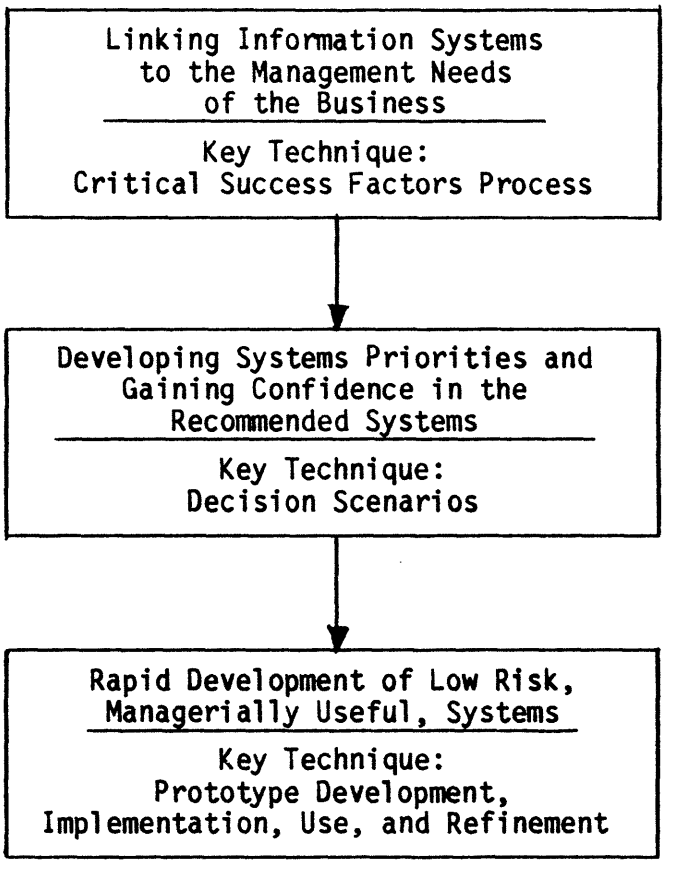
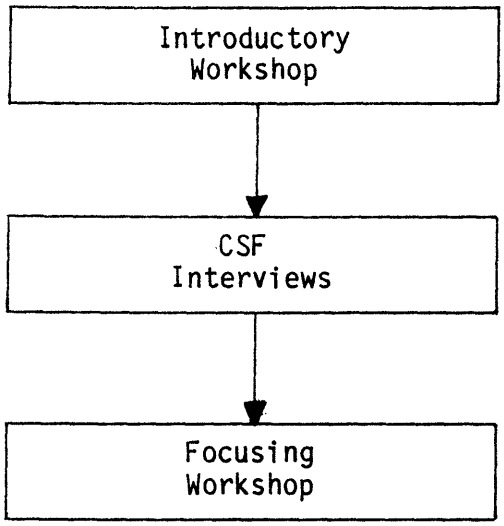


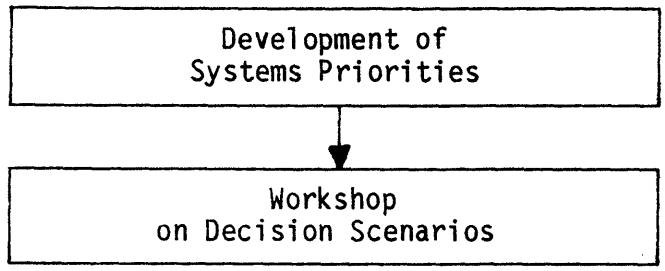
Exhibit 2

A Three-Phase Process for Managerial Involvement

Phase One - Linking to the Business



Phase Two - Developing Well-Understood System Priorities



Phase Three - Prototype Systems Development

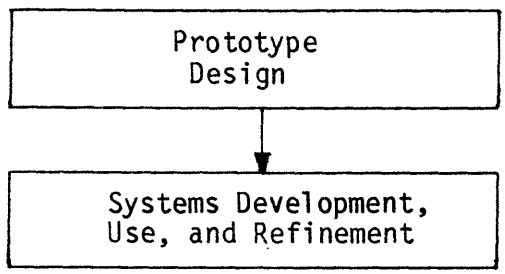


Exhibit 3

Measures of one CSF

CSF	MEASURES	DATA TYPE	CURRENT MEASURE
CUSTOMER RELATIONS	-Volume	H	M
	-Inquiries	H	M
	-Order/bid ratio	H	M
	-Complaints and/or rejections of material	H	M
	-Customer turnover or lost accounts	H	M
	-Decline in volume with customer	H	M
	-Program account actual volume vs. customer and SOS forecasts	H	A
	-New accounts	H	M
	-Conversions to program accounts	H	U
	-On-time delivery: to first promise date to final need date	H	A
	-Trends in credit rejections	H	U
	-Tone of voice (esp. during late delivery calls	S	A
	-Finance and credit "handling" feedback	S	A

DATA TYPE: H = Hard
S = Soft

CURRENT MEASURE: M = Measured
A = Data Available
U = Data Unavailable

Exhibit 4

Sample Decision Scenario

Decision Scenario 1: PURCHASING

SITUATION

The Inventory Manager receives a call from a supplier offering an extremely attractive purchase opportunity: A 1500 ton slab which can be rolled to any width from 57 1/4 to 59 3/4 in either cold rolled or galvanized prime coil. The price is .19 per pound.

QUESTIONS ASKED

-What does the economy look like overall?

-How have orders been keeping up?

-Are contract customers meeting expectations/using their reserves?

*-What was last week's order volume in prime cold roll?

*-What are prime cold roll inventory levels?

-Are we particularly low in any gage?
-Have we been too high in this area?
-What can I expect to use in the next two months?

-What is the supplier's situation?

-Is this a "once in a life time" situation?
-How badly do they need us here?
-Is this price likely to be offered again?

*-What have I paid for this item in the past?

-Who will get it if we refuse it?

* DENOTES QUESTIONS THAT CAN BE ANSWERED BY THE SYSTEM PROPOSED

Exhibit 4 (continued)

(PAPER MODEL OF OUTPUT)

INVENTORY LEVELS

TO REVIEW COLD ROLLED STEEL
INVENTORY LEVELS:

PRODUCT DESC CR

GRADE SOS

GAGES *1 ALL

*2 GAGE	(OH) ON HAND	(O.ORD) ON ORDER	TOTAL	*3 AVAILABLE TO PROMISE	% AVAILABLE TO PROMISE	LAST MONTH SALES	*4 WEEKS OF SALES
,022	232	51	283	35	12	50	25
,026	636	0	636	101	16	135	20
,032	1540	474	2014	234	12	328	27
,044	6213	1352	7565	945	13	1324	25
,055	5769	1256	7025	939	14	1229	25
,068	192	87	279	0	0	41	30
,097	143	0	143	0	0	31	20
,112	67	0	67	0	0	14	21
TOTAL:	14792	3220	18012	2250	12.5	3152	--

*1. A specific gage i.e. .031,
Range of gages i.e. .031, .044
All gages ALL

*2. Gages without inventory do not appear

*3. Neither reserved for program account nor assigned.

*4. (on Hand plus on order less open orders)
(last month's sales / days in month * 7

Exhibit 5

Vertical Slice Prototypes