The J.of MIS
Research
Vol.3,No.1,Jun 1993

전략정보시스템 계획수립을 위한 상황모델

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A Contingency Model of the Strategic Information Systems Planning

The information revolution is sweeping through the global economy. Information technology is transforming the structure of competition. The successful implementation of information technology is dependent on the effectiveness of information systems planning. However, it is very difficult to select an appropriate methodology for information systems planning given an organization situation. A contingency model is proposed on the selection of an appropriate approach depending upon the organizational situation. Although the contingency framework is not yet theoretically proved, the approaches suggested here turned out to be of benefit to the cases of the two real world projects studied. These approaches attempt to combine Business Systems Planning of IBM and Critical Success Factors in two different manners to make planning process more efficient and effective.

I. Why to plan IS

Traditionally, information systems(IS) have been regarded as tools for facilitating operational and managerial functions. More recently, organizations have begun to create information systems that can provide a strategic impact and earn substantial competitive advantage. It is becoming recognized that the installation of hardware alone can not carry out such a role of information systems in the organization.

While it is clear that management needs understandable and action-orient ted information, it is still unclear how to identify this information and implement information systems that provide it in an easy-to-use form. Managers in many organizations complain that while they are receiving more information than ever before, the quality of that information is lacking.

To be able to provide appropriate information to managers, the planning process must be well executed when developing information systems. Even though the value of planning is well understood in the development of information systems, many organizations do not plan or do it poorly. Thus, information systems have been developed in a piecemeal fashion rather than under an organization-wide master plan; each business unit developed and operated its own system. Although the individual systems carried out similar functions, they could not be used interchangeably and could not communicate with each other. The result was high cost in processing data and low performance in providing appropriate information: data redundancy, inappropriate information, incompatibility of systems, high maintenance cost, and so on. Little coordination was possible to help the organization integrate individual systems scattered over the organization. A case study of a steel company shows a similar result as seen in Figure 1 [Park et al., 1989].

Those problems described above can be prevented through effective inform-

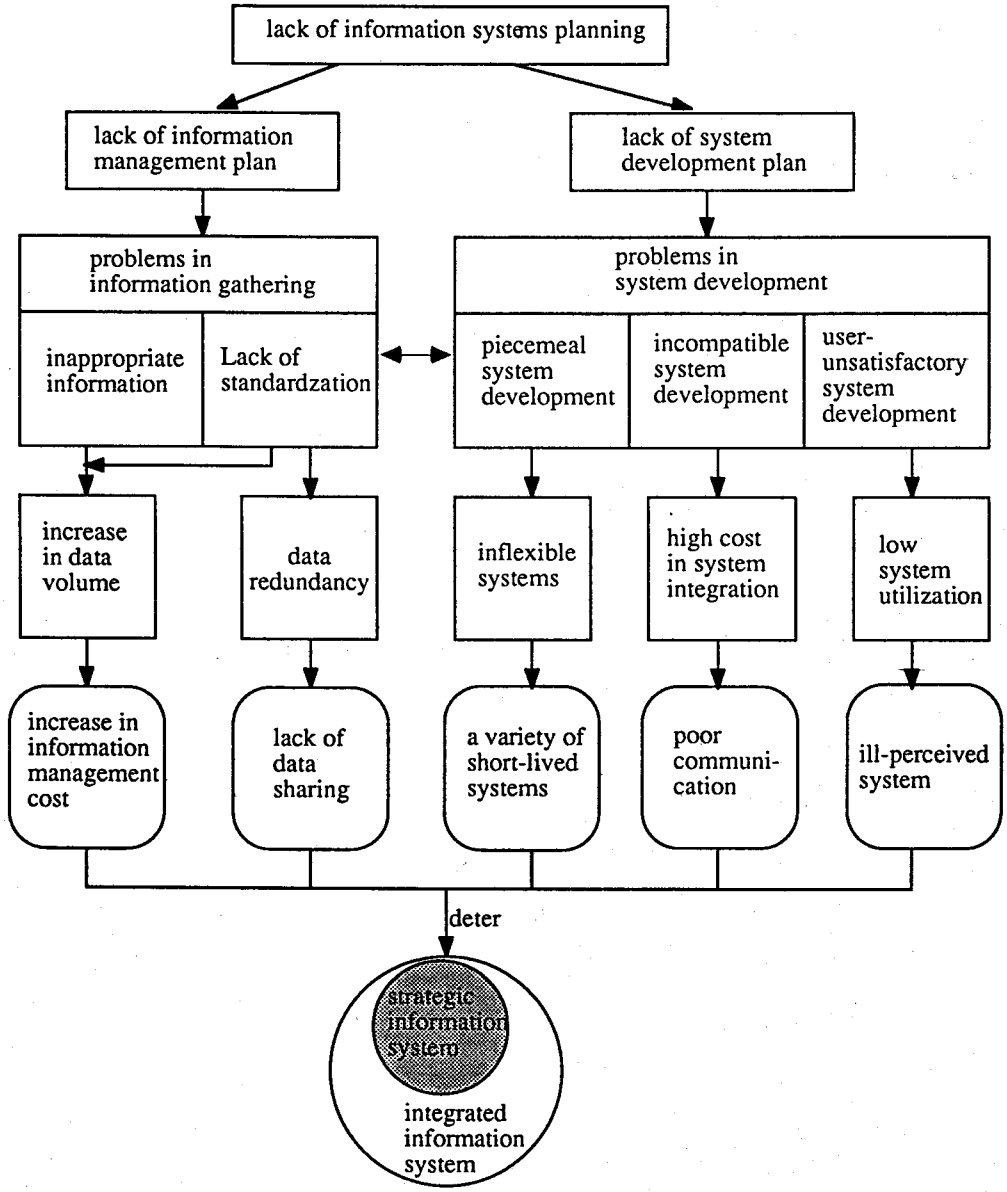

Figure 1. Impact of lack of information systems' planning

ation systems planning process:

- data architecture can be developed to improve information flow,
- a portfolio of computer-based application systems can be identified to assist an organization in executing its business plans and strategies, and
- resource requirements for the computerization can be forecast to allocate organization's resource more effectively.

Various approaches to information systems planning have evolved [Bowman et al., 1983 ; Carlson, 1979 ; Holland, 1986 ; IBM, 1984 ; Martin, 1989 ; McFarlan, 1981 ; Shank et al., 1985 ; Sullivan, 1985 ; Wetherbe et al., 1982]. Some of these are documented and employed in the development of information systems in the real world. Recent issues in IS planning say that information systems planning should be carried out strategically so as to make information systems more effective and strategically useful.

II. Strategic Information System and Planning

Strategic Information Systems (SIS) can be defined as information systems that changes the way a firm operates with competitive forces in the environment [Senn, 1987]. Thus, Management Information Systems can be conceived to be SIS when they are used to support the organization in accomplishing organizational objectives and strategies more effectively and efficiently. In this sense, the definition of SIS can include an effective Management Information Systems(MIS) as Emery put in [Emery , 1990].

In addition, new information technology (IT) has made it possible to broaden the definition of SIS to application systems with a high impact and with ability to create an advantage over competitors [Rackoff et al., 1985] [Wiseman et al, 1984]. These SIS can help organizations use information technology in innovative and creative ways such as building entry barriers, chang-

ing the basic structure of competition, generating new products, and/or gaining bargaining power against suppliers. The successful applications of information systems for the strategic use are classified to this category.

While the strategic use of IT discovers externally the competitive edges of the organization, the former conventional perspective can still serve well to identify opportunities to improve the competitive advantage internally. In order to achieve the strategic benefits from the systems, however, it would be necessary for the organization to integrate its information systems [Kim et al., 1990]. Effective integration of information systems requires effective planning process. In a survey of information management trends, those firms who had engaged in either long range planning or strategic planning of information systems, reported a variety of benefits such as figure 2[Earl, 1989]. It is concluded that the planning process is vital to success of the SIS [Kim et al., 1990] even though another natural formation of the SIS can come through a long-term adaptive process [Emery, 1990 ; Vitale et al., 1986].

Rank	Benefits experienced
1	Improved top management support
2	Improved resource forecasting
3	Improved business planning
4	Improved user communication
5	Better understanding of the organization/business

Figure 2. Benefits experienced in IS planning

There are a number of methodologies for the planning SIS which can be classified into two categories by their primary focus [Lederer et al., 1988]: data-oriented approach and decision-oriented approach. Business Systems Planning(BSP), Strategic Systems Planning(SSP), and Information Engineering(IE) belong to the first category while Critical Success Factors(CSF), Ends/Means(EM) are classified to the other. Let BSP, SSP and IE be "BSP--like" approach since they are similar in its contents as well as philosophy. To be consistent, let CSF and EM be "CSF-like" approach since they have

similar approaching principles. In next section, the existing methodologies are briefly described, focusing mainly on BSP and CSF.

Ⅲ. Previous Methodologies

1. Business Systems Planning (BSP)

Business Systems Planning (BSP) [IBM, 1984] is a comprehensive and structured methodology developed by IBM establishing the direction of systems planning toward a set of organizational strategies to integrate information systems and to assign responsibilities for the development of systems.

This approach addresses the operational, functional, and general management needs for information through better management of information system resources.

The basic concepts of BSP is top-down information system planning with bottom-up implementation (see Figure 3). With this strategy, information systems can be implemented without possibly causing the many problems associated with a "bottom-up" evolution of systems such as data inconsistencies, nonintegrated system design, expensive resystemizing and priority difficulties.

The top-down part of BSP focuses on developing a broad overall understanding of the organization and identification of business processes requiring information systems. Then, a long-range plan is developed for the design, development, and implementation of a set of information systems for identified business processes. The bottom-up part of BSP is the process which implements the plan designed in the top-down part.

The fundamental thrust of the BSP approach is toward identifying the information necessary to run the organization. Information concerning the organizational processes is obtained via observation and interviews. The information requirements are finally summarized in *Information Architecture* by mapping the business processes to the associated information requirements in

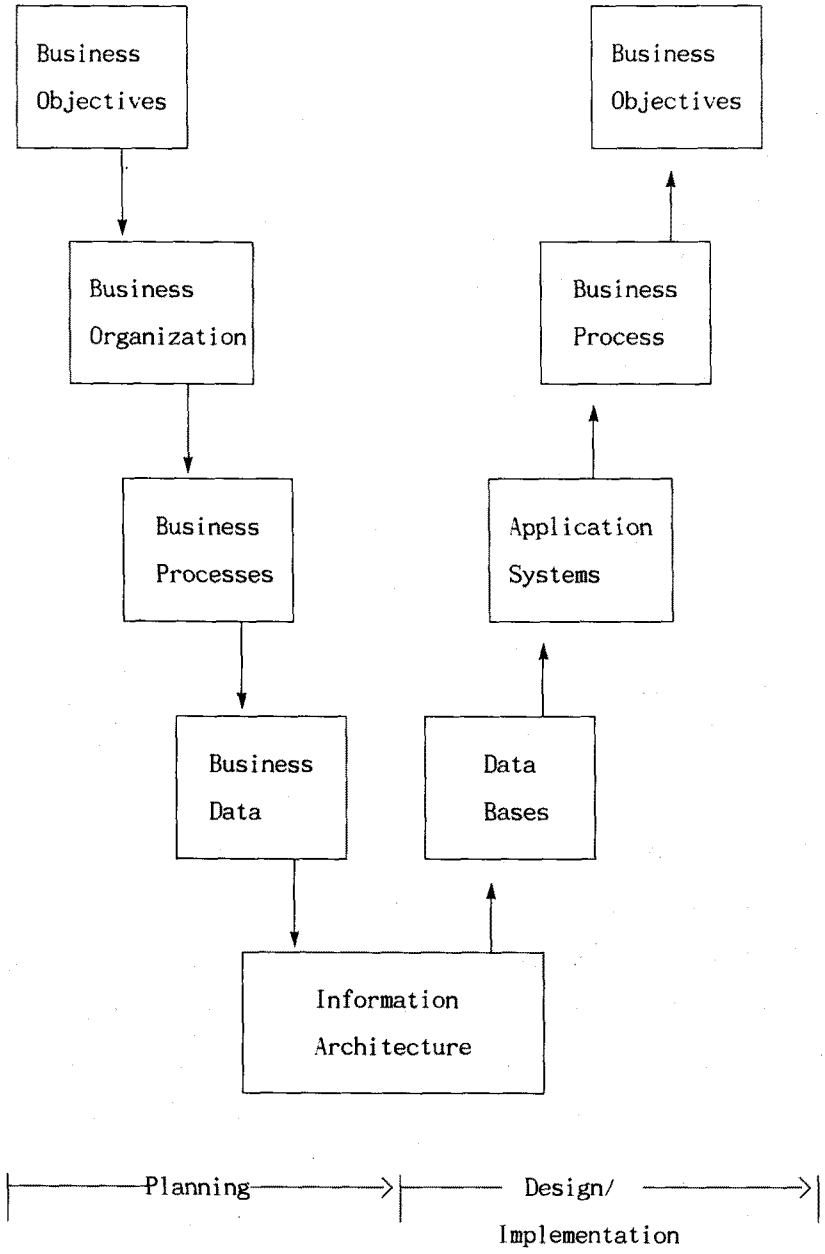

Figure 3. Top-down analysis with bottom-up implementation

matrix form. Information Architecture enables the evaluation of data sharing within the organization. The architecture also provides the foundation for resource allocation strategy which enables the orderly implementation of information architecture into application systems as well as subject databases. However, extensive information collection and analysis can be achieved through interviewing a sizable number of managers, which requires a lot of time and effort and thus makes IS managers hesitate to apply BSP to their organization.

2. Critical Success Factor Analysis (CSF)

Critical success factors are the few areas of activities that must go well to ensure the success of an organization. Because these areas of activities are critical to organizational success, the manager should have the appropriate information to allow him to determine whether events are proceeding sufficiently well in each area. The CSF approach is designed to provide a structured technique which can be used by an interviewer to assist managers to identify their critical success factors and to determine the resulting information needs.

The CSF concept was developed by Daniel who identified CSFs in the U.S. automotive industry [Daniel, 1961]. Later, it was first introduced as a methodology for Management Information Systems (MIS) Planning by John Rockart [Rockart, 1979]. The CSF approach has been continuously refined while being applied to a number of case studies [Bergeron et al. 1989 ; Bullen et al. 1981 ; Jenster, 1987 ; Martin, 1982 ; Munro et al, 1980 ; Shank et al, 1985].

The CSF approach first visualizes the strategy, objectives, and goals of a corporation. The strategy, objectives, and goals developed of the corporate level lead to the development of a particular set of critical success factors for the corporation. Given its strategy and objectives, as well as the other factors in its specific environment,

each corporation develops a set of CSFs unique to its own circumstances. In turn, corporate CSFs become an input into a similar CSF determination process for each sub-organization in the corporation. The process can be continued for as many levels of organizational hierarchy as exist.
(see Figure 4)

The CSF approach can be summarized into the following five major activities:

(1) understand (or identify if do not yet clearly exist) business unit objectives,
(2) identify Critical Success Factors to achieve those objectives,
(3) identify specific performance measures and standards to evaluate CSFs,
(4) identify data and information required to measure performance, and
(5) identify necessay application systems to provide information required.

3. Other Methodologies

Besides BSP and CSF, firms might choose Method/1 [Arthur Andersen, 1985], Strategic Systems Planning[Holland, 1986], Information Engineering [Martin, 1989], Business Information Analysis and Integration Technique [Carlson, 1979], or Ends/Means Analysis [Wetherbe et al., 1982].

The steps in the Strategic System Planning (SSP) procedure are similar to those in BSP. A major difference from BSP is SSP's automated storage, manipulation and presentation of the data collected during the planning process.

Information Engineering (IE) provides techniques for building enterprise models, data models and process models. These form a comprehensive knolwedge base which can create and maintain information systems.

Business Information Analysis and Integration Technique (BIAIT) is distinct from other methodologies. Most planning approaches tend to use open-ended questions that allow managers to articulate their information needs.

However, in BIAIT seven close-ended

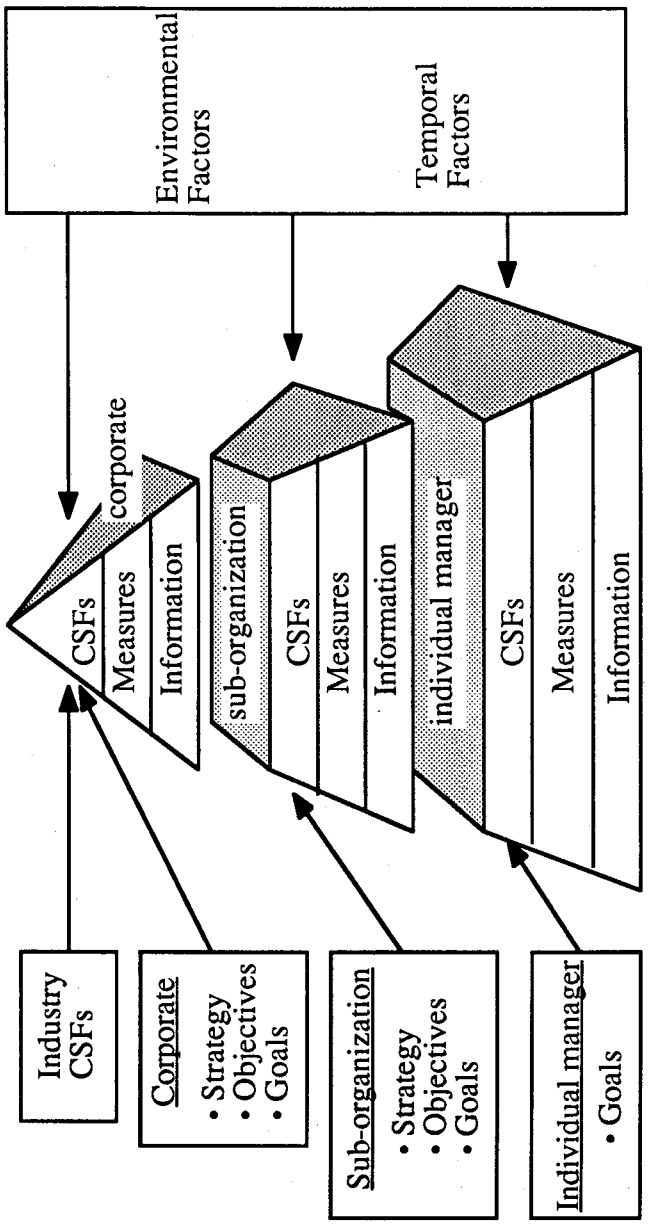

Figure 4. Hierarchical view of CSF approach

questions are used to determine a normative set of information requirements. These questions require only a binary (yes or no) response from managers. From the responses to these questions overall information requirements can theoretically be defined. This procedure works independently from organizational characteristics.

Ends/Means Analysis (E/M), developed by Wetherbe and Davis, focuses on the ends (goods, services, and information) generated by an organizational process and the means (inputs and processes) used to accomplish the ends. The ends from one process can be fed to other processes as the input(or means). The required information produced by E/M is of two types: effectiveness information and efficiency information to evaluate effectiveness for outputs and efficiency for inputs and processes.

Each methodology has its advantages as well as disadvantages and different characteristics. For more explanation on their comparison, [Lederer et al., 1988] is a good entry reference.

4.A Contingency Model

The importance of planning was well emphasized earlier. Good planning results from selection of the right methodology. Unfortunately, no research has been reported on the comparison of one methodology, or combination of methodologies, over sanother considering organization's information systems environment.

Lederer and Sethi have compared planning methodologies in terms of their characteristics and problems [Lederer et al. 1988]. However, from our experiences in real world projects it was recognized that some of organizational factors seem to affect the performance of the methodologies.

Two factors seem to be important: the size of the organization and the level of IS. The size of the organization affects the efficiency of planning process while the level of IS influences the objective of the planning and eventually the effectiveness of the planning process. The size of the organization is hardly defined quantitatively

(even though it is worthwhile studying the criterion). Thus, we use the terms of relative concept such as "small" and "large". In our cases, we had two steel makers for the projects. One of them is about a tenth of the other in its number of employees and the production capacity.

The level of IS is also defined qualitatively: "low" and "high". From the Nolan's stage model of the growth in computerization [Nolan, 1979], the organizations in "Initiation" or "Contagion" stage can be classified as "low" in their IS level since they do not have organization-wide plan and control for the computerization. Only at third stage, organizations start looking over their organization-wide computer environment. Managerial information requirement is about to be formed by using data generated from IS infrastructure.

With the two factors, a 2x2 matrix can be drawn for the contingency model like Figure 5. For the upper left and lower right quardrants, two complementary approaches are proposed as following by combining BSP and CSF.

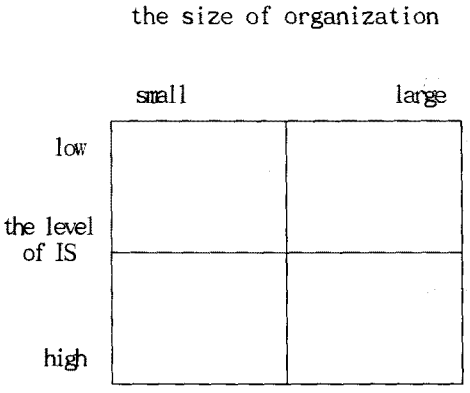

Figure 5. A contingency matrix for strategic information systems planning

1.Complement aryapproach I

Development of the first complementary approach was motivated by the need for strategic information systems planning(SISP) at the Pohang Iron and Steel Co., Ltd. (POSCO), a large and well established steel company in South Korea. POSCO has already developed a number of application systems to support various business processes which enabled to improve the efficiency of the business. Top management in POSCO, however, wanted to obtain more

information about business not inoperational level but in managerial and strategic level.

In the SISP project of POSCO we had to find:

(1) what information is needed for top and middle managers to execute business strategies,

(2) by what business processes the business data are generated and used most frequently, and

(3) how to provide managers with the information summarized from business data.

In selecting an appropriate methodology for the project, BSP seemed appropriate for the second problem while CSF looked more effective for the first. However, no methodology seemed to deliver the output for all of the above problems. Thus, a practically more comprehensive approach needed to be developed. At first, CSF analysis was performed to identify the critical areas of activities that must go well to ensure the achievement of POSCO's strategy. BSP was, then, employed to identify data needed to generate information defined by CSF Analysis and to define information architecture.

An attempt has already been made to combine planning methodologies [Wetherbe et al., 1983]. Wetherbe and Davis used BSP, CSF, and E/M to develop a framework for the information requirements interviews. Three different types of questionaires from each methodology were combined into one. Our approach to combining planning methodologies is different from that of [Wetherbe et al., 1983] in that one methodology is used as a complement to the other, not like just combining questionnaires. That is, in this complementary approach the output of CSF guides BSP in the sense that the output of CSF should be used as an input to BSP. This approach keeps the BSP approach from requiring too much effort in information collection and analysis and focuses on only the information defined by CSF.

Our new complementary approach is

portrayed in Figure 6. The complementary approach basically consists of "supplemented" CSF and "shrunk" BSP. The original CSF Analysis may be vulnerable since it completely relies on the capabilities of interviewers [Bullen et al., 1981] as well as responses of managers[Davis, 1979], [Davis, 1980]. The subjective (managers' responses) and hard-to-judge (capabilities of interviewers) characteristics of CSF Analysis need to be supplemented with a more objective verification process. In [Bullen et al., 1981] it is stressed that

" *The two most important ingredients in successful CSF interviews,* however *are the preparation and skills which the interviewer brings to the* interview *itself.*"

Furthermore, information required may be insignificant from the corporate point of view and biased by personal interest. The possibilities of failure with the CSF method also center on the abilities of managers to respond with CSFs that are correct, complete, and sufficient. Davis insists that possible failure is caused by at least three phenomena:

(1) bounded rationality,
(2) human ability to evaluate probabilities and to identify causality, and
(3) biasing effect of the availability of data.

To avoid those possible problems of CSF, past reports to managers are to be reviewed and analyzed. This process is called Report Analysis. Since it can be assumed that the contents of past reports can represent a fair amount of the information needed for management, the responses of managers can be validated by comparing responses of managers with the contents of past reports. The result of the comparison is fed back to managers in the second interview. The information defined from CSF can be said to be significant if a large portion of it is a subset of the contents of report. For example, in the case of POSCO, about 80% of information required in CSF turned out to be provided by reports. Utilization of the output of CSF as the

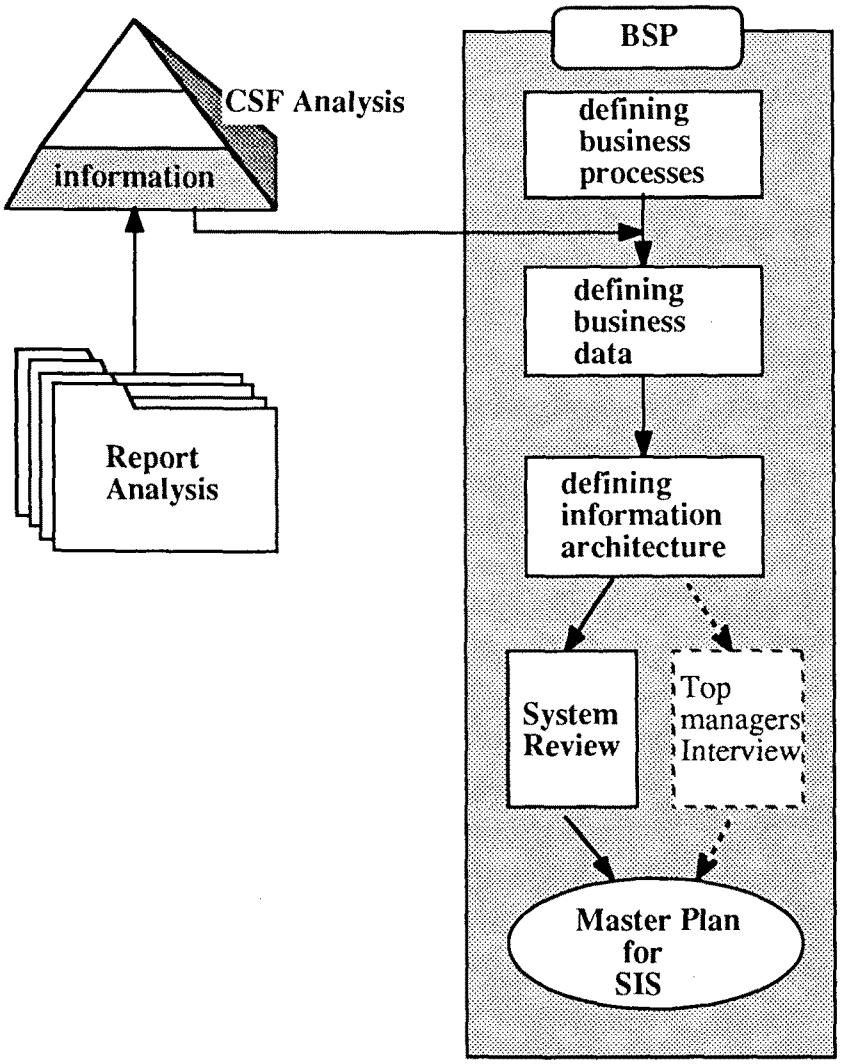

Figure 6. Complementary approach I
(dotted box is skipped since executive interview is already done in CSF)

input of BSP is the most beneficial issue in this approach. Information defined in the CSF hierarchy may be either the result of processing complicated models or just a set of aggregated data which can be generated from each low functional area. As figure 6 shows, instead of defining corporate wide organizational information requirements, information needs required by CSF are identified. The data classes identified by the above process may not be sufficient to draw a complete organizational information architecture. However, it seems to be an efficient way of developing information architecture with less effort.

Business processes and data classes (different from those of the original BSP) are then associated to define Information Architecture. The relation between a business process and a data class is one of "CREATE" (the business process creates the data class), "USE" (the business process uses the data class), and "NEED" (the data class is needed for the business process). This enables to evaluate the function of data sharing within the enterprise. Then, development plan of applications and databases can be prepared by initiating process modelling like Data Flow Diagram and data modelling.

2.Complementary approach II

The second complementary approach was motivated by a project for the Kang-Won Industrial Co., a minimill in South Korea. Kang-Won has approximately 2,000 employees while POSCO has more than 20,000 employees. Kang-Won plans to quadruple its production capacity and to introduce a manufacturing-by-order system. Some fine steel products are also to be added to the current product mix. All of these mean that the managers of the corporation are going to require more appropriate information on time than ever before. It is recognized that the value of information can not be overemphasized.

However, current IS infrastructure Kang-Won is just in their infancy.

Not all the functional areas are supported by computer systems. Even in the departments which have computer systems, summarized data reports are out of date by a month or so. In these circumstance, the top executive initiated the project with the hope of its great impact on the corporate performance.

A new complementary approach as an alternative to the Approach I was suggested : to switch the order of BSP and CSF. That is, BSP is used to develop a corporate information architecture and then the information architecture is tuned to align the organizational strategies by utilizing CSF.

In the case of POSCO, the efficiency aspect of information planning was emphasized. Since POSCO has already been establishing transaction processing systems very well and currently developing MIS, top-down planning of SIS enables POSCO to develop a corporate picture on information structure quickly at little cost to effectiveness. Since the information systems of TPS(Transaction Processing Systems) level were not well established, it could not be expected that the information required by top executives could be provided through the current computer systems. A corporate guideline, first of all, had to be suggested to restructure TPS scattered over the corporation. In addition, information systems should be developed to be able to support the strategies that the corporation might pursue.

To accomplish such requirements, we designed the planning process shown in Figure 7. Since TPS are not well established in the Kang-Won, BSP was used as the basic framework for the planning methodology. BSP provides a wide view of the corporate information system structure using information architecture to guide the development and integration of TPS. The outputs of BSP such as business processes, data classes, and information architecture, are used to review and analyze the TPS of the corporation. They are then fed into the CSF analysis in defining necessary inform-

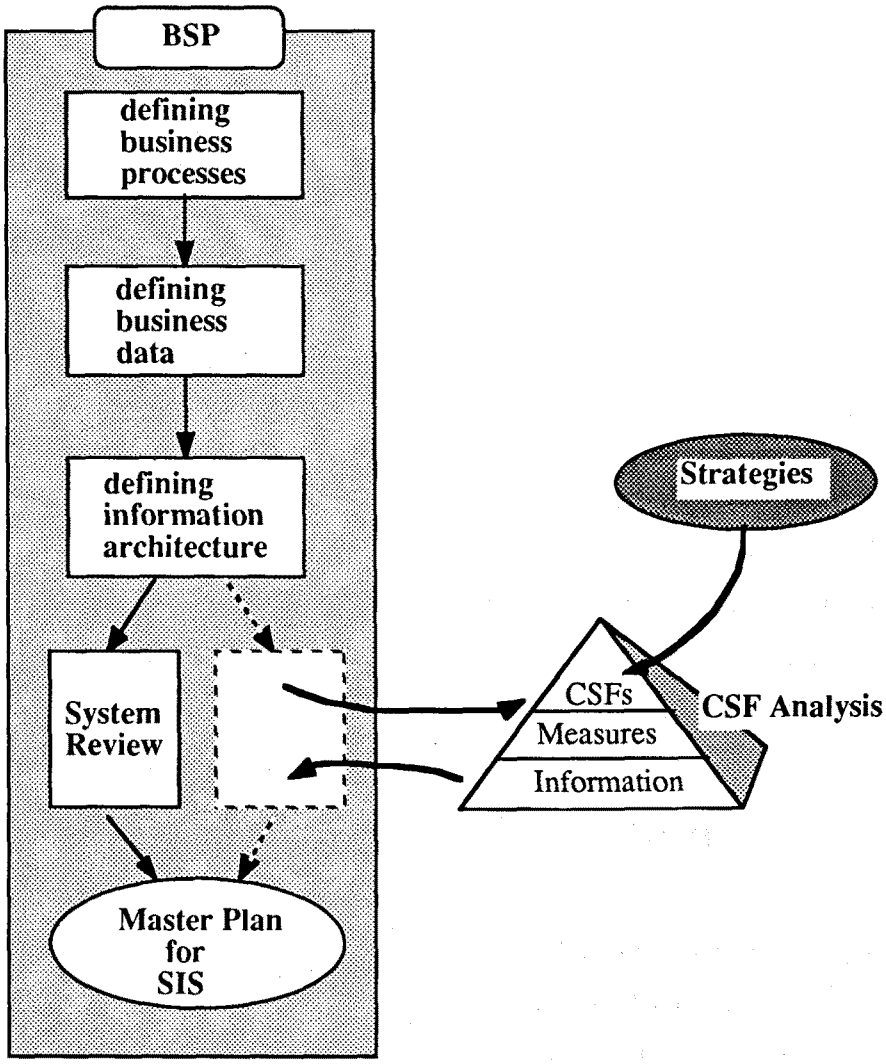

Figure 7. Complementary approach II

ation for strategic management.

Two approaches are compared and summarized in figure 8. Managerial implications we can get from the above cases are :

(1) In selecting a planning methodology, it needs to consider the efficiency and effectiveness criteria such as organizational size, culture, IS level, etc.

(2) Not one methodology may be appropriate to your organization. Then it's better to think about our approach : complementary approach (but at some cost of possible imcompleteness).

V .Conclusions

Improving IS planning methodologies is one of many major challenges facing IS researchers today. Effective planning is to identify and maximize strategic opportunities, thus it is essential to the realization of the potential strategic impact of computer-based information systems.

Introduced as a IS planning methodology by Rockart[Rockart, 1979], the CSF is now being utilized to define information needs for the success as an information requirements analysis method in a growing number of organizations. However, it does not provide any specific mechanism for the implementation of information required through computerized systems. Meanwhile, BSP-like approaches provide the basis for the corporate information structure with much more effort than CSF-like approaches.

In this paper, we defined SIS as information systems that support an organization in accomplishing the organizational objectives and strategies more effectively and efficiently. A contingency model was suggested to guide intuitively the selection of the appropriate approach to planning SIS. We also proposed two complementary approaches to planning such SIS in two different corporate situations: one was for a large size corporation with well-established TPS and the other for a small one with low level of IS

CASE	POSCO	Kang-Won
Objective	- To define information needs of top management - To identify information resources within organization	- To restructure information systems infrastructure - To provide better managerial information
Status of IS	- Well established TPS - Poor information resource management	- Poor IS infrastructure - Lack of IS support to basic business processes - Data reports from IS are out of date
Planning Process	- CSF Interview with management to define information needs - To identify business process and data entity to support critical areas - To analyze reports to find out information resource - To assess current IS - To prepare SIS master plan	- To identify business processes and data entity - To develop corporate information architecture - To assess current IS - To prepare SIS master plan
Approach Method	CSF leads BSP	BSP leads CSF

Figure 8. Summary of two complementary approaches

infrastructure.

Since all the assertions we made here are based on real world experiences, terms and criteria are not accurately defined. More case studies are required to prove the above assertions in the contingency model. The criteria for the classifications of the organizations in the size and the level of TPS must be clearly defined. Hopefully, all these shortcomings will be studied more in further research.

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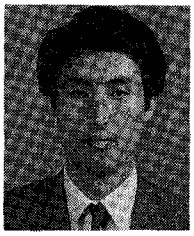
◇ 저자소개 ◇



공동저자 한재민은 81년 고려대학교 무역학과를 졸업하고, 88년 미국 University of Iowa에서 경영정보학으로 경영학 박사학위를 받았다. 학위취득 이후 귀국하여 RIST 경영경제연구소 경영전략연구실에서 주임연구원으로 재직하며, 정보기술의 전략적활용, MIS 계획 및 설계에 관한 연구등을 수행하였으며, 91년 부터 고려대학교 경영학과 조교수로 근무하여 현재에 이르고 있다. 주요 관심분야는 인공지능의 기업활용, 전문가시스템의 설계와 계발, 정보기술의 전략적활용 등이다.

공동저자 문태수는 86년 한국외국어대학교를 졸업하고, 88년 동대학 경영정보대학원에서 MIS로 경영학 석사학위를 취득하고, 현재는 고려대학교대학원 경영학과에서 MIS 박사과정에 있으며, 고려대학교 기업경영연구소 연구원으로 있다. 87년부터 93년까지 RIST 경영경제연구소 경영과학연구실에서 주임연구원으로 재직하였으며, MIS 계획수립 및 방법론 개발, 통합 데이타베이스 설계 및 개발연구 등을 수행하였다. 주요 관심분야는 정보시스템의 평가, MIS 계획수립 및 설계 방법론 연구이다.