# Using Information Technology to Implement Strategic Systems Planning as a Knowledge-Based Group Support Process

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*"Strategic systems planning" has been proposed as a means of achieving the full potential of strategic decision support systems (SDSS) (King, 1983, 1988). It is a systematic method which can be used by strategic managers to explicitly derive a statement of an organization's overall strategy as well as of an organization's SDSS strategy. This paper describes how knowledge-based support for strategic systems planning can be implemented using current information technology and utilized by organizational planning groups. Central to the implementation of this approach is the interaction between strategy set developers (who act as experts in developing strategy statements), a knowledge engineer, and an inference engine. Use of the inference engine to ensure the logical consistency of managers' thought processes is a primary benefit of this approach. In addition, the approach indirectly supports the creative thinking of managers by requiring that underlying assumptions in reasoning be explicitly identified and tested in the context of the organization's planning environment.*

## Knowledge-based Systems and Strategic Planning

In contrast to functional areas of business activity such as accounting and finance, the development of knowledge-based systems in support of the strategic planning activity has progressed slowly, though instances of expert systems development for strategic planners in ill-structured problem contexts have been reported (Goul, 1987; Reitman, 1987). The reason for this slow development is due in part to the nature of strategic planning as a managerial problem domain. Compared to typical expert systems problem domains, managerial problem domains are generally less structured, involve more creativity, and involve evolutionary factors relating to organization-specific contexts (Dhar, 1987). The expertise needed to develop knowledge bases for strategic expert systems must come from the existing management representing diverse interests within the organiza-

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tion, each of which may well reflect only a partial view of what the organization is and where it may be headed in the future. Any attempt to develop knowledge-based systems support for strategic planning must successfully deal with this diversity of organizational interests in the context of a planning environment favorable to formal long range strategic planning.

King (1983) proposed the concept of "strategic systems planning" (SSP) as a means of achieving the full potential of strategic decision support systems (SDSS), i.e., computer-based systems directed at supporting strategic decision making. To ensure that the design of SDSS is consistent with the needs of an organization, SSP requires a fundamental two-step process: (1) an "organizational strategy set" is developed by planning managers which is a statement of an organization's clientele analysis, mission, objectives, business strategies and other strategic attributes; (2) on the basis of the organizational strategy set, a "systems strategy set" is derived which is a statement of an SDSS's mission, objectives, constraints, strategy and design-development process (Figure 1). This two-step process is an instance of the more general process of deriving an organization's information resources and information systems strategy from its business strategy (King, 1988).

SSP is a systematic method which, when properly implemented, results in an explicit statement of an organization's overall strategy as well as of an organization's SDSS strategy. Since a statement of strategy is so critical to an organization's direction and smooth functioning in the pursuit of improved performance, it is imperative that nothing be unclear or ambiguous in the statement of strategy such that the statement could lead to confusion, disagreement, or discord in the implementation of a chosen strategy. This is particularly important in the case of SSP since two strategy sets are involved, one of which is used to derive the other.

It should be noted that prior to the planning managers' group activity of generating a statement of the organizational strategy set, there is no formally stated knowledge base of information concerning future organizational strategy. The "knowledge base" exists only in the minds of the planning managers involved in the group process. Eliciting and organizing this mental storehouse of knowledge to develop the statement of the organizational strategy set is a critical function of managing the group process successfully. The strategy sets represent the pooled expertise of the planning managers, and may be viewed as organization-specific knowledge bases to be used in the development of knowledge-based systems in support of organizational planning (Szewczak, 1988). These knowledge-based systems may be thought of as the basis for expert systems which contain statements of current managerial insight and expertise and which offer logical advice to a group of managers involved in long range planning (Turban & Watkins, 1986).

## Logic and Creativity

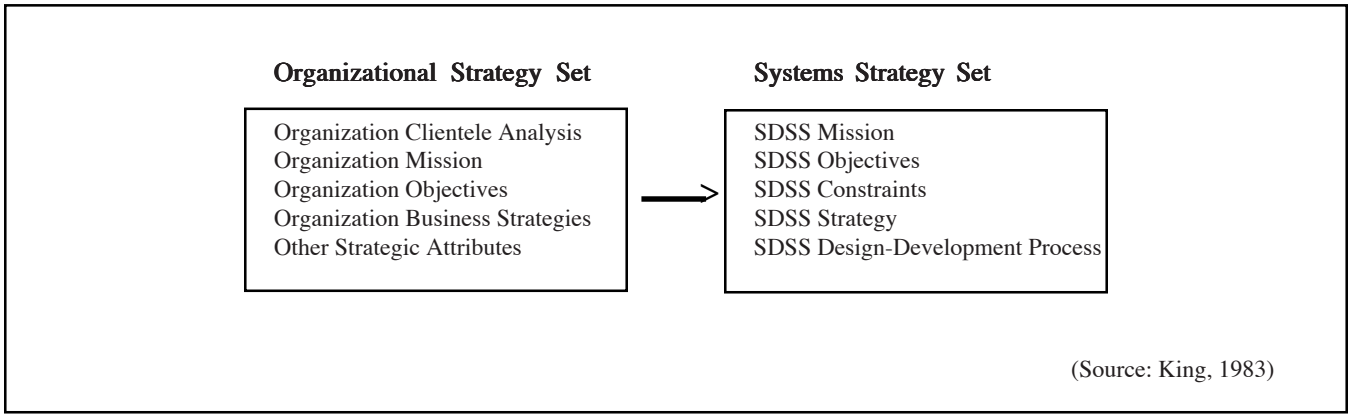


**Figure 1: Strategic Systems Planning**

**Premises**

A. An organizational objective is to increase earnings by 10% per year.

B. An organizational objective is to increase cash flow.

C. An organizational objective is to eliminate vulnerability to the business cycle.

D. An organizational strategy is to diversify into new businesses.

E. An organizational attribute is a recognition of the need for change fostered by poor recent performance.

**Conclusion**

F. To facilitate the identification and assessment of potential acquisition candidates is an SDSS objective.

**Table 1: Example Planning Statements**

**Assumptions**

G. An SDSS objective is to facilitate the identification and assessment of items relevant to strategic choice.

H. Potential acquisition candidates are items relevant to strategic choice.

I. Acquiring an existing business implies that there are potential acquisition candidates.

J. If an organizational strategy is to diversify into a new business, then acquire an existing business.

**Table 2: Necessary Assumptions for Derivation**

There are two fundamental issues which must be addressed in adopting the SSP method. The first issue is logic. If a systems strategy set is to be derived from an organizational strategy set, then the logic of the movement from the organizational strategy set to the systems strategy set must be explicit. Each step of the derivation should be clear and demonstrable. Information technology support for this process may be provided through the use of an inference engine. This point will be discussed further below.

The second issue is creativity. If the systems strategy set is to be derived from the organizational strategy set, then the statements comprising the organizational strategy set should represent the best thinking that the organization can command from its members responsible for the statement of the organizational strategy set. Methods of addressing the creativity issue have been developed for challenging strategic planning assumptions and for conducting strategic analyses of the business unit, of the diversified firm, and of the environment (Grant & King, 1982; Mason & Mitroff, 1981; Mitroff & Emshoff, 1979). Techniques such as alternative futures, scenarios, brainstorming, policy Delphi, and dialectic policy analysis may be adopted to bring to the surface the differing viewpoints and values of the planning managers involved in the SSP group process. These techniques may be especially effective when administered through a skilled group facilitator (Zander, 1982).

From the point of view of methodological procedure, addressing the creativity issue must come before addressing the logic issue in the SSP method, since the organizational strategy set must be developed before the systems strategy set. However this is not to say that the logic issue is cut-and-dry, a mechanical procedure to be performed to merely tie together a few potentially loose ends in organizational reasoning. In moving from the organizational strategy set to the systems strategy set, certain key assumptions may surface in the explicit demonstration of the logic of the movement which did not surface during the development of the organizational strategy set for various reasons characteristic of group process (for example, the tendency of brainstorming groups to focus on only a few issues to the exclusion of others (Delbecq, Van de Ven & Gustafson, 1975)). Thus the logic issue may dovetail back to the creativity issue before both fundamental issues can be resolved satisfactorily.

The following example helps to demonstrate the logical side of SSP. Table 1 presents a small set of planning statements which have been taken directly from King (1983). The premises A.-E. are a subset of statements of a firm's organizational strategy set. The conclusion F. is a subset of the firm's derived systems strategy set.

To move logically from premises A.-E. to conclusion F. requires that certain assumptions be explicitly identified and used in the derivation. Table 2 presents the required assumptions G.-J. needed to complete the logical derivation. (A formal logical derivation using the predicate calculus which shows that the conclusion F. indeed follows from the premises A.-E. and that assumptions G.-J. are required for the derivation is available from the author upon request.)

## Using an Inference Engine

An inference engine can be used to accomplish the same thing as the formal logical analysis. An inference engine is a computer software program which performs logical derivations, i.e., draws inferences (conclusions) from a set of statements or assertions that serve as the basis for an argument (premises). Once the sole property of academic research units focusing on the development of AI-based tools, inference engines are becoming increasingly available to industry and form the basis of much expert system development (Buchanan, 1986; Davis, 1987; Maletz, 1989). The hardware needed to run the inference engine software is also widely available, most recently in the form of personal computer technology (Somsel, 1988; Willis, 1988).

Since the movement from an organizational strategy set to a systems strategy set is a logical derivation, an inference engine can be used to support SSP. The inference engine can work with planning statements which have been cast into "If,then" form. Each statement is composed of an antecedent (the "If" component) and a consequent (the "then" component). Table 3 presents select key statements from Tables 1 and 2 which are necessary to derive conclusion F. and which have been translated into "If,then" form.

In working with the statements in Table 3, a typical inference engine would first seek to arrive at the consequent of statement 6, i.e., "then conclusion is an SDSS objective is to facilitate the identification and assessment of potential acquisition candidates". However in order to derive the consequent, it is necessary to establish the antecedent, which in statement 6 is a conjunction of two statements, i.e., "an SDSS objective is to facilitate the identification and assessment of items relevant to strategic choice" and "the information requirement is that potential acquisition candidates are items relevant to strategic choice". In this case, the inference engine would seek to

1. If premises have been established,
   then an organization strategy is to diversify into new businesses.

2. If an organization strategy is to diversify into new businesses,
   then the implementation requirement is to acquire an existing business.

3. If the implementation requirement is to acquire an existing business,
   then the reality requirement is that there be potential acquisition candidates.

4. If the reality requirement is that there be potential acquisition candidates,
   then the information requirement is that potential acquisition candidates are items relevant to strategic choice.

5. If the information requirement is that potential acquisition candidates are items relevant to strategic choice,
   then an SDSS objective is to facilitate the identification and assessment of items relevant to strategic choice.

6. If an SDSS objective is to facilitate the identification and assessment of items relevant to strategic choice and the information requirement is that potential acquisition candidates are items relevant to strategic choice,
   then conclusion is an SDSS objective is to facilitate the identification and assessment of potential acquisition candidates.

**Table 3: Key Planning Statements in "If, then" Form**

establish each antecedent statement in turn. The first antecedent statement is the consequent of statement 5. Since in order to establish the consequent of statement 5 it is necessary to establish the antecedent of statement 5, the inference engine would seek to establish the antecedent of statement 5. It would continue in this fashion, working backward through the set of statements in Table 3, until it found a statement which is stated to be true.

Eventually the inference engine would find the antecedent to statement 1, which can be stated to be true. Then the process works in reverse. The inference engine will begin to unwind in a forward direction, establishing the truth of the consequents of the statements in Table 3 in turn on the basis of the truth of their antecedents, until the conclusion is reached, i.e., the consequent of statement 6 is determined to be true. Hence the conclusion can be said to follow logically and explicitly from the premises, which include both organizational strategy set statements and assumptions statements.

## Organizational Issues

It should be noted that Tables 1 and 2 present a small set of planning statements which were selected for the purpose of exposition. For an actual firm many more statements would be required to do SSP. However the use of an inference engine to support SSP remains the same and is unaffected by the number of planning statements involved. In other words, it is not the number of planning statements that is the issue here, but rather the firm's commitment to the explicitness and rigorous characteristics of SSP that is essential. Such commitment will be a function of the organizational strategic planning culture of the firm, which may need to be shaped by a conscious step-by-step implementation strategy (for example, a series of internal workshops dealing with the theory and practice of long range planning) (King & Cleland, 1978). In addition, the firm's assessment of the inference engine technology, of the human factors impact, and of its own organizational attributes such as the structure of the decision making process, management style, and level of information technology utilization will influence the acceptance of this knowledge-based group support process (Khosrowpour, 1989).

## SSP Support Process Components

The use of an inference engine to support SSP requires three basic components: the inference engine, strategy set developers, and a knowledge engineer to translate the statements of the strategy set developers into "If,then" form and run the inference engine. The knowledge engineer, who captures and converts a human expert's knowledge into a working computer program (Colgrove, 1989), may simply be a domain expert with knowledge of how an inference engine works (Maletz, 1989). A schematic of inference engine supported SSP is presented in the flow diagram in Figure 2.

As the strategy set developers generate statements to be included in a strategy set, the knowledge engineer translates the statements into "If,then" form. These statements are inputted to the inference engine according to the syntax rules governing the use of the inference engine software package. After the strategy set developers tentatively agree on a set of statements, the knowledge engineer runs the inference engine using the statement set and certain logical inferences are drawn. The outcomes of the run are reported to the strategy set developers in the form of feedback.

At this point the strategy set developers' reaction to the outcomes of the run may take one of three forms.

Form 1: The strategy set developers may be satisfied with the results. The inferences drawn may be consistent with the expectations of the strategy set developers. In this case, the strategy set developers will be assured that the systems strategy set statements follow logically from the organizational strategy set statements.

Form 2: The strategy set developers may be surprised by the results. The inferences drawn may not be consistent with the expectations of the

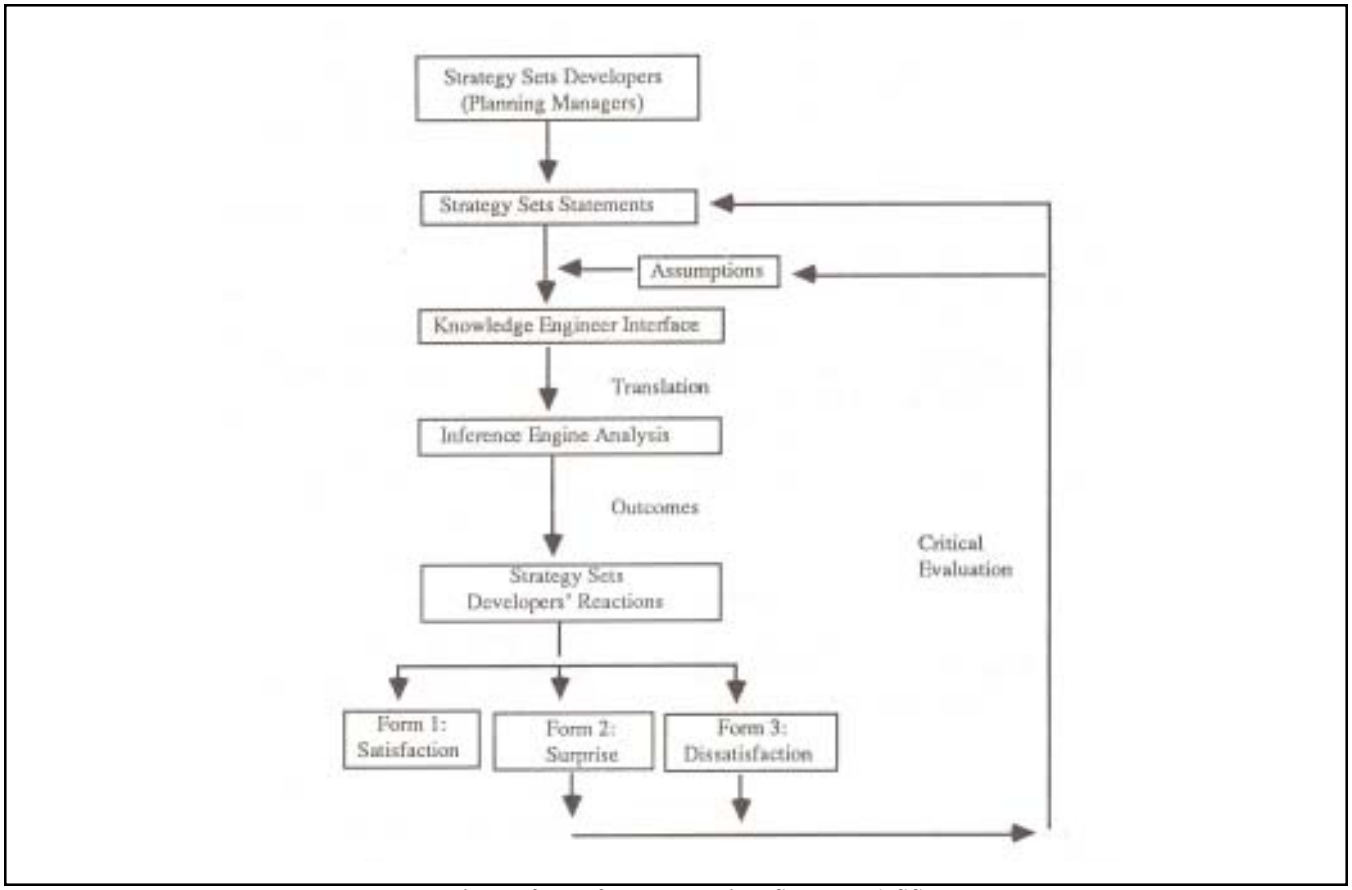


**Figure 2: Inference Engine Supported SSP**

strategy set developers. This situation could be the result of an inadequate set of statements comprising the organizational strategy set. E.g. if premise D. in Table 1 were missing from the analysis, then it would not be possible to explicitly derive conclusion F. Or it may be the result of lacking certain key assumption statements needed in the derivation of systems strategy set statements. E.g. if assumption statement I. in Table 2 were missing from the analysis, then it would not be possible to explicitly derive conclusion F. in Table 1.

In this situation strategy set developers would be forced (by virtue of logical necessity) to revisit either the statement of the organizational strategy set or the statement of assumptions. Further thought would have to be directed at the explicit ferreting out of needed premises or assumptions. In this way strategy set developers would be required to bring out in the open any ideas which have not yet explicitly surfaced in the development of the organizational strategy set or of the set of assumptions. This is one way in which the logic issue supports the creativity issue in SSP.

Once all ideas have surfaced and have been explicitly stated, the knowledge engineer can translate these statements into a form useable by the inference engine and perform a new run. The new outcomes will then be provided to the systems set developers as feedback. The process can be repeated until strategy set developers are satisfied with the results.

Form 3: The strategy set developers (or a subset of strategy set developers) may be unhappy with the results because of a dissatisfaction with some assumptions needed to effect the derivation. This situation can result even when a successful logical derivation has been achieved. In this case the issue to be addressed is not one of logic but one of creativity. In other words, how do strategy set developers know when the assumptions explicitly

identified are the right (or best) assumptions?

While the use of an inference engine cannot provide an answer to this question which requires the generation and evaluation of competing assumptions (Mitroff & Emshoff, 1979), it can provide the impetus to explore fully and explicitly the inferential implications of alternative statements of assumptions. E.g. assumption J. in Table 2 may be viewed as too restrictive. A strategy set developer may choose to argue that if an organization strategy is to diversify into a new business, then the firm may either acquire an existing business or develop an internal firm capability to compete in a new business.

To implement this alternative assumption, the strategy set developer may alter assumption J. as follows:

J'. If an organization strategy is to diversify into a new business, then the implementation requirement is to develop an internal firm capability to compete.

This assumption statement would then be added to the assumption statement set (Table 2). Next other statements needed to effect a logical derivation would be explicitly identified by strategy set developers given the new assumption. All new statements would be translated by the knowledge engineer for use with the inference engine, the run performed, and the new results communicated as feedback to the strategy set developers. At this point, reaction to the outcomes of the run will take one of the three basic forms.

It should be noted that a Form 3 reaction to outcomes will most likely be the result of a failure to fully consider all viable alternative organizational strategy set statements in the development of the organizational strategy set. Use of an inference engine to explicitly identify alternative assumptions for the purpose of effecting a logical derivation of a systems strategy set from an organizational strategy set serves as a tool to complement other methods which may have been employed ineffectively to develop the original organizational strategy set, since it forces strategy set developers to be explicitly logical. In this sense, use of an inference engine in the manner described addresses the creativity issue as well as the logic issue in SSP, though clearly the creativity issue is much larger than use of an inference engine can adequately address.

## Summary

Use of an inference engine in SSP allows strategy set developers to focus on the explicit derivation of a systems strategy set from an organizational strategy set in an effective and timely fashion. Among the advantages of using an inference engine software program in support of SSP is that the program can be run iteratively if need be in quick response to strategy set developers' needs. Though the use of an inference engine in SSP is no substitute for time-tested methods which encourage managerial creativity, it can support creative efforts in strategic planning by forcing managers to be explicitly logical about planning statements and assumptions used to draw strategic planning conclusions. The achievement of such logical consistency is a requirement for any strategic planning effort based on SSP.

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