CREATIVITY IN STRATEGIC PLANNING:
THE INFLUENCE OF TEMPORAL PERSPECTIVE

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ABSTRACT

As organizational environments become more turbulent and complex and as uncertainty about the future increases, reliance on quantitative decision-making approaches for strategic planning becomes less appropriate. Scenario analysis can be an effective qualitative technique for enhancing strategic planning. Typically, scenarios are presented as alternate futures. Some theorists, however, have suggested that forward and backward thinking are different cognitive processes. In this study, we investigate the effect of presenting scenarios retrospectively; that is, as if future events had already happened.

A repeated measures laboratory study compared the performance of professional planners (n = 64) using prospective and retrospective scenarios in two simulated business planning tasks. Measures consisted of objective factors (number of individual planning statements and number of monitoring statements), subjective factors (quality based on an 18-question rating instrument), and subject attitudes concerning their experience with the two treatments.

Results suggest that use of retrospective scenarios do increase the number of planning statements. In addition, plans prepared using retrospective scenarios were rated higher overall than those prepared with prospective scenarios. Moreover, evidence emerged that a subset of subjects were better able to make use of the retrospective technique, suggesting that selection along with training may improve planning performance.

(STRATEGIC PLANNING; STRATEGY FORMULATION; SCENARIOS; STRATEGIC INFORMATION SYSTEMS; DECISION-MAKING; DECISION SUPPORT SYSTEMS; CREATIVITY)

1. Introduction

It is generally acknowledged today that uncertainty is increasing for most organizations. Events such as the sweeping political and economic changes in Eastern Europe and turmoil in the Persian Gulf have been difficult to foresee. The rapid pace of technological change has compressed planning horizons and product life cycles in many industries. Globalization of markets, volatility in currencies, fluctuating raw material and energy prices, industry deregulation, have all contributed to an increase in the complexity of decisions faced by a firm.

In periods of stability, such as during the 1950s and 1960s, the past can serve as a reasonably reliable model for predictions about the future. No competent planner would attempt to project trends indefinitely into the future, but the predicted changes during such periods tend to be evolutionary, not revolutionary. Products will be improved, but their functions will not change radically. Markets will expand, but individual customers and marketing channels will be similar to those of the past.

In the increasingly turbulent environment of recent years, however, the guideposts of the past become unreliable. Planning processes become less formalized; techniques such as "logical incrementalism" (Quinn 1989) become more appropriate. Strategic plans rely less on forecasts, more on being prepared for a range of eventualities. Creativity and innovation are increasingly important for planning.

In many industries, the role of information systems in the strategic planning process has become critical to the development and implementation of effective plans (Lederer and Sethi 1991). Increased environmental uncertainty has encouraged firms to attempt to regain control by becoming more proactive. The need for creative approaches to the design of new systems is both an opportunity and a challenge for information systems executives (Couger 1990). Information technology provides a wealth of opportunities for achieving competitive advantage, and for shaping the environment to the benefit of the firm. Organizations have found also that rapid response to unpredictable events is critical to survival (Allaire and Firsirotu 1989). Well-designed architectures for telecommunications and data base systems can provide the organizational flexibility to change strategic directions as the need arises.

Scenario analysis is a popular method for aiding strategic planners in considering a spectrum of possibilities (Wack 1985a). An industrial scenario is a plausible, internally consistent view of the potential environment an organization may face at the end of its

planning horizon (Porter 1985). Emphasis is generally on events that affect industry structure and the basic competitive position of a firm, such as technological breakthroughs or the entry of new competitors.

A scenario's only purpose is to make the planner aware of possibilities that would not otherwise have been perceived and to promote an understanding of the implications of these possibilities. Scenarios which do not stimulate thinking in some way are of little value in strategic planning. Scenario analysis is thus a technique for stimulating creative thought and one measure of the effectiveness of a set of scenarios as compared to another set is the number and quality of ideas generated by each.

Typically, scenarios are presented as alternative futures (Godet 1990). That is, planners are asked to envision the future environment as it may exist several years hence. We define this as having a forward temporal perspective. Some theorists, however, have suggested that forward and backward thinking are different thought processes (Einhorn and Hogarth 1987; Weick 1979). If this were the case, then the stimulative power of scenarios might be enhanced by retrospective presentation (Crossley and Hooker 1987). In this form, scenarios would be written as if they had already happened and planners would be asked to imagine that they were looking backwards toward events in the past. We consider this a retrospective temporal perspective.

The motivation for the experiment described here was to explore techniques for strategy formulation that rely less on the past and more on the planner's own creative powers. Scenarios of a firm's future industrial environment were constructed, but presented as if these future events had already taken place. Previous experiments have shown that a reversal of temporal perspective causes subjects to provide longer and more precise descriptions of imaginary events. The chief issue in this study was whether the reverse temporal perspective would produce higher quality plans as well as a greater quantity of planning statements, and whether such results would occur in a realistic business setting.

Should retrospective scenarios produce a greater volume of different planning ideas and should these ideas be of higher quality than prospective (or forward) scenarios, it would then be a potentially useful technique for strategic management, and in building planning support systems. Such a finding would call into question the commonly held assumption that the direction of time makes no difference in scenario presentation and it would provide support to those who have suggested that backward thinking is a different mental process than forward thinking (Einhorn and Hogarth 1987).

In information systems, many of the tasks performed by practitioners are design tasks: programs, systems, interfaces, data bases, networks. A designer generally starts with a diagram or at least a mental image of the final output, and then works backward from that image to specify requirements (Turner 1987). If reversed temporal perspective causes a different way of thinking, then it is important for MIS researchers to be aware of this. Retrospective scenarios may be a useful complement to the more traditional data and modeling approaches used in the design of decision support systems (DSS). The technique would also have significance for disciplines such as management information systems (MIS), architecture, and engineering in which a large number of activities are design tasks.

This study evaluates the use of scenario analysis in strategic planning and investigates whether temporal perspective in the presentation of scenarios affects planning performance. An examination of the literature dealing with scenarios in strategic planning is followed by exploration of arguments contrasting differences between forward and backward thinking. Then, an experiment to establish whether different results are obtained in a planning task where temporal perspective was the treatment variable is described. Finally, a research agenda for further investigation is outlined.

2. Literature Review

In this section, we consider first the research literature pertaining to factors that affect strategic planning outcomes. We then review the use of scenarios in planning. Next, notions of time theory are presented, followed by arguments for a difference in planning performance as a result of shifts in temporal perspective. We then explore the literature describing creativity in decision-making. The section closes with a set of research questions.

2.1 Factors That Affect Strategic Planning Outcomes

What are the characteristics of a "good" strategic plan? What quality criteria might be used in comparing one plan with another? The answers to these questions are somewhat different for every organization, because of differences in a multitude of strategic variables -- industry structure, market share, competitor strengths, available markets, etc. However, it is possible to list some general characteristics that good plans should include.

Steiner (1979) and Hussey (1982) have discussed the formulation of an effective strategic plan, and some important attributes can be inferred from their exposition: comprehensiveness, creativity, control, effective matching of resources with opportunities, internal consistency, cost-effectiveness. Plans should be clearly stated and unambiguous, and challenging but realistically achievable.

The industrial environment is much more turbulent today than when these prescriptions were written; are these characteristics still valid? The more recent strategic planning literature is voluminous. We found no studies or discussions which attempted to define desirable attributes of a completed plan, but analysis of this literature provides useful insights. There is support for most of the characteristics implied by Steiner and Hussey, but a considerable difference in emphasis.

The acceleration of change (Toffler 1990) and increased uncertainty (Camillus and Datta 1991) in the strategic environment in recent years has made it less and less appropriate for plans to be extrapolated from prior year trends. Straight line forecasts are less reliable. Consequently, innovation and creativity have become much more desirable planning characteristics. Reid (1989) advocates greater rewards and recognition for idea generation, and to make it a key job requirement for every employee. Small companies with high uncertainty but little potential control may need to devise unique structural adaptations (Allaire and Firsirotu 1989). Seemingly mature products can be revived and stimulated to grow (Hiam 1990). The long term, being more uncertain, requires greater creativity (Carlson 1990).

The desirability of internal consistency has evolved into a critical requirement for integration. The most successful Japanese and Western companies often devote much attention to the formulation of mission statements which serve to move components of a company in a common direction (Reid 1989). Integration, however, can lead to inflexibility, and flexibility is also a prime requirement of strategic planning today (Handy 1989). Determining the technologies to adopt and the information systems to build has become riskier (Clemons 1991). Continuous environmental monitoring (Murphy 1989), attention to opportunities and threats around the globe (Bartlett and Ghoshal 1991), and awareness of emerging strategic issues (Camillus and Datta 1991) require almost instant readiness to change direction, in a coordinated manner.

2.2 Scenarios

In stable environments, trends from the past together with an executive's intuitive

judgments may provide an adequate basis for strategic planning. These judgments are generally based on the executive's past experiences, which provide discernible patterns; in environments of slow or moderate change, such patterns may be reasonably reliable for predicting future events. There may be a good fit between the executive's cognitive map and environmental reality.

In the more turbulent environments that have been prevalent in recent years, however, the past is less useful as a harbinger of what is to come. As Godet (1979) says, "the results of our actions today will occur in a world profoundly different from that in which they were taken" (p. 5). Fewer reliable patterns, and increased complexity makes it more difficult to interpret them correctly.

Scenarios can serve as models of an organization's environment, helping to clarify interrelationships, identify emerging patterns and reduce complexity (Schwenk 1983). Their major value is in the stimulation of imagination and the generation of ideas. Scenarios are expensive to create and expensive to present in terms of time to view them. Methodologies for presentation of scenarios which increase their stimulative impact would be advantageous.

The use of scenarios force planners to recognize that there cannot be precise knowledge about the future; this promotes contingency planning and environmental monitoring (Vanston, Frisbie, Lopreato, and Poston 1977). Scenario analysis encourages consideration of a number of differing points of view, and helps to make executives aware of potential threats as well as emerging opportunities.

Scenarios provide a means for broadening single-point forecasts to encompass several variables rather than just one. They emphasize "what might happen" rather than "what will happen" (Porter 1985). Generally, several scenarios are constructed and presented to management as a set. Leemhuis (1985) defines a scenario as "a coherent story about the business environment with the world of today as the starting point" (p. 30). They are hypothetical, outlines rather than full details, multifaceted and holistic, with a special ability to represent interacting processes and the cross impacts of events and trends (Wilson 1978). They facilitate a long term view and an external focus (Boshoff 1989). Scenarios are abstractions of what is important in a situation.

Linneman and Klein (1983) surveyed the Fortune 1000 companies and found that almost half use scenarios in strategic planning. Wack (1985a, 1985b) describes how the concepts for using and building scenarios evolved at Royal Dutch/Shell during the 1960s and 1970s. He claims that the 1973 scenarios enabled Shell management to recognize the

imminence of the OPEC oil crisis sooner than did other oil companies and to take steps to prepare for a change to a sellers' market. Yergin (1991), in his history of the oil industry, provides support for this contention: prior to the 1973 embargo, "Shell had been campaigning for an intergovernmental agreement to share supplies in a crisis" (p. 620).

2.3 Time Theory

The way one mentally separates time into past, present, and future is critical to our sense of self. Time perception influences behavior, cultural differences, emotions, and many other psychological factors (Gonzalez and Zimbardo 1985). Time exists only because the universe is changing; if it were not, the past would be the same as the future, and time would have no meaning (Gribbin 1986). Entropy, a measure of the disorder of a system, is always increasing in our universe (Von Weizsacker 1971); thus, one way to measure time is by the amount of entropy increase, which implies that the direction of time is always forward. However, physics theory allows for the possibility of entropy decrease, and thus of time reversal (Hawking 1988). Einstein believed that the distinction between past, present, and future is illusory (Rothman 1987).

Neustadt and May (1986) maintain that we should think of time as a steady stream, rather than being made up of the separate components of past, present, and future. They advocate continuous comparison or oscillation from present to future to past and back, using both forward and backward thinking, ready to take appropriate action on the basis of evolving patterns. In commenting on his studies of black holes, Hawking (1988) proposes a concept called "imaginary time" (pp. 143-44). Even though actual time always moves forward, there are no such restrictions for the imagination. In the mind, one can go backward or forward at will, though it may take considerable mental effort to do so.

2.4 Temporal Perspective in Scenarios

Weick (1979) believes that "historicizing an outcome", or pretending that a future event has already happened, facilitates the visualization of the event. He refers to several examples of studies which support his hypothesis. Bavelas (1973) experimented with two groups of subjects; the first group was told: "A professor WILL TAKE a 6-week sabbatical trip in Europe; write out his itinerary." The other group was told: "A professor TOOK a 6-week sabbatical trip in Europe; write out his itinerary." The only difference in treatments was the change in temporal perspective; i.e., whether this imaginary event will occur in the future or has already happened. Bavelas found that the second group's descriptions (that is, those with the retrospective scenario) were significantly richer in

detail than the prospective group; the first group's were "more fanciful, less detailed, less sensible, and shorter." Sevon (1984) reports that, in devising explanations for economic conditions in Sweden, subjects described past events in greater detail than possible future events.

In a field study, Boland (1984) worked with management personnel at a large film lending library. He constructed scenarios, in the form of accounting reports, which depicted the status of the organization several years in the future, based on plausible directions that the library might follow in its future development. In a group meeting, executives were asked to seriously consider that five years had passed and that the reports were actual results of the organization's operations. They were to "look back" over the preceding five years and attempt to understand what they had done to cause these financial results and to explain the results. Participants reported that this exercise provided a unique perspective on their planning problems. One subject felt that the technique improved his ability to "look at the relation of any new thrust to the whole." (p. 878). Another subject reported changing his opinion about activities he had previously favored funding: "I would have been for it looking forward, but looking back, I had a strong emotional reaction. I didn't like what happened." (p. 879).

Why does retrospective thinking produce these differences in detail and emphasis when the only change is time orientation? Weick (1979) provides a speculative answer: In treating a future event as if it is already past, the event seems more sensible because you can visualize at least one way in which it could come about. Also, there is a greater probability that one or more steps in this process will have been performed in the past, bringing to mind past experiences that are similar. It is easier to analyze an event that is projected and thought of as already accomplished. Sense-making is facilitated because the envisioned completion can be related to similar "cause maps" that have previously been enacted.

2.5 Decision-making

A number of authors have argued that authoritative, centralized, rational models of decision making must be replaced by an interactive, dialectic approach if organizations are to deal effectively with ill-structured situations and high levels of uncertainty (Lindblom and Cohen 1979; Susman 1981; Mason and Mitroff 1981). Organizations are evolutionary and organizational "actors" continuously try to make sense of actions they have already taken; they do not know what they are doing until they have done something and evaluated the result (Weick 1979). This is always a retrospective process, a looking backward.

Thus, thinking backwards, as required by the use of retrospective scenarios, may be intuitively appealing.

An unstructured task is one that cannot be programmed (Keen and Scott Morton 1978). A task that is currently unstructured may become structured in the future as our knowledge about how to perform it increases and as technology improves, but there has been little progress in programming "tasks involving judgment, ambiguity, creativity, and volatility of environment" (p. 68). If the design phase of the decision-making process (Simon 1977) is unstructured, we cannot determine the methodologies needed to solve the problem (Keen and Scott Morton 1978). Improved techniques for stimulating creative ideas might be useful in adding structure to the activity design phase of decision-making; Elam and Mead (1990) advocate more attention to the creativity-enhancing features in the design of decision support software. Lack of structure is also a characteristic of strategy formulation (Mitroff, Barabba, and Kilmann 1977).

Hogarth (1987) emphasizes the importance of imagination in making choices and points out that large powers of imagination expand and enrich our choice alternatives. Imagination is closely related to creativity. To think creatively, one's mind must resist "heavily entrenched cognitive habits" and energetically search for "alternative ways of viewing problems" (p. 161). Campbell (1960) proposed a model for creative thought in which the mind goes through a large number of "thought trials", similar to trial-and-error learning, to find problem solutions. Creativity demands more effort than noncreative activities because it requires additional thought trials. Creative solutions are new solutions; they must be visualized (Bandrowski 1990). Hogarth (1983) suggests a methodology for improving one's imaginative powers by looking at a set of potential future outcomes as if they had already happened and then tracing backward to plausible causes (in other words, thinking retrospectively).

Einhorn and Hogarth (1987) contend that every decision involves both forward and backward thinking, and that these two methods of thinking are fundamentally different. Forward thinking is similar to a mathematical algorithm; the decision maker selects available data, evaluates variables, and then predicts an outcome. Backward thinking is more suggestive and intuitive, requiring judgment and diagnostic analysis. "It involves looking for patterns, making links between seemingly unconnected events, testing possible chains of causation to explain an event, and finding a metaphor or theory to help in looking forward." (p. 66).

Would imagining that a potential future event had already happened improve decision making? It might, if the technique can help the decision maker to more clearly envision a desirable potential outcome, and then to fully comprehend all the necessary steps to make it happen (or to prevent an undesirable potential outcome) (Mitchell, Russo, and Pennington 1987).

2.6 Research Questions

Based on the above discussion, there is some reason to believe that plans produced using retrospective thought may be better than those produced prospectively. Specifically, we wish to investigate the following research questions:

1. Would plans subjects prepare from retrospectively presented scenarios be more detailed than those prepared from scenarios presented prospectively?

2. Would plans subjects prepare from retrospectively presented scenarios be considered more effective, more complete, more credible, or more creative than plans prepared from scenarios presented prospectively?

3. Would scenarios presented retrospectively seem more plausible or more likely to occur than prospective scenarios?

3. Research Design

In this section we describe the research approach, design, and measures used in the study along with the threats to validity and how they were handled.

3.1 Approach

Because of the need for precise control, a laboratory experiment was preferable to a field experiment as a research strategy. Prior laboratory studies have tended to use business or psychology students as subjects and relatively simple, artificial tasks. We, therefore, decided to select subjects with substantial business experience and a task which called for strategy development in a realistic business setting.

3.2 Sample

Sixty-four subjects with extensive business experience participated in the study. About two-thirds were employees, in middle level management and professional positions, of a large multinational firm in the information processing industry. The other third were faculty members in schools of business at a number of different universities and who were also educational consultants to the same company. The average level of business experience for subjects was 20.4 years. Fifty of the subjects had a masters degree or doctorate; the remainder had bachelors degrees. Only eight women participated in the study, too few for inferences about gender differences. Further details about the sample are provided in Table 9.

3.3 Design

A repeated measures experimental design was used. Each subject participated in two separate sessions: one looking forward (prospective temporal mode) and one in retrospective mode. Thus, each subject served as his or her own control (Kerlinger 1973). To control for possible order effects, the participants were randomly assigned to one of four treatment groups: combinations of the order of prospective or retrospective temporal mode and the two cases. Each group had 16 subjects.

3.4 Task

Subjects were asked to consider themselves in the role of the Vice President for Strategic Planning of a company and to write a set of planning statements for that company. They were also asked to identify items that should be monitored as the plan was implemented. Stimulus materials included two 3-page cases about small companies in the information processing industry, one a software company and the other a disk drive manufacturer, and a set of three one-page industry scenarios for each case. Excerpts from one of the cases and from two of the prospective scenarios are provided in the Appendix, plus a corresponding excerpt from a retrospective scenario. Subjects were given two treatments: one with retrospective scenarios and the other with prospective scenarios. Each treatment required a subject to read a case and the corresponding three scenarios.

Subjects were given approximately one hour to complete the task, including reading materials. In retrospective sessions, subjects were asked to imagine that six years had passed and that they were looking backward to the previous year of 1993, the year in which the scenarios were said to have taken place. These scenarios were written in the past

tense. Thus, subjects with the retrospective treatment were asked to reconstruct the strategies that had led the company to the successful outcomes described. After completing the plan, subjects were asked to record "monitoring statements": conditions in the environment that should be monitored which might signal a change in strategy. A two-page form was provided for recording the planning and monitoring statements. The form was divided into seven sections to record action statements, such as "Actions that caused revenue growth", and one section for "Conditions Monitored".

Subjects in prospective treatments were given the same task, except that the scenarios were written in the present, and subjects were asked to provide planning statements for strategies they would adopt, along with monitoring information.

For both treatments, all subjects were asked to work hard at envisioning themselves in the strategic planning role.

3.5 Measures

The principal product from each subject was a set of strategic planning statements and monitoring statements. Objective measures recorded were the number of individual planning statements generated, and the number of monitoring statements generated.

In order to evaluate plans subjectively, for quality, statements were rated by two expert planners. The raters were both retired corporate planning executives who were paid for their services. A rating instrument consisting of 18 questions was developed from two strategic planning texts (Steiner 1979; Hussey 1982), based on their description of the characteristics of a good strategic plan. For these authors, plans should be comprehensive, credible, and consistent. Comprehensiveness implies that a complete range of opportunities, threats, and alternatives is considered; a plan lacking this quality would take too narrow a view. Credibility implies strategies that utilize the resources available and the strengths of the firm, avoid weak areas or work to strengthen them, and do not involve unrealistic product breakthroughs or sharp changes in direction. Consistency is required so that the strategies pull the firm in the same direction and toward its goals. Six questions for each of these constructs were developed.

A test of inter-rater reliability (Spearman rank-order), run on one-third of the sample, produced a correlation of .35, significant at better than the .05 level (p = .28). On this basis the rating scores were averaged.

Reliability analysis on the rating results indicates that the reliability coefficient for the six questions related to comprehensiveness is .94, for the credibility questions is .85, and for the consistency questions is .93.

At the end of each treatment session, after performing a planning task, each subject answered 12 Likert-scale questions about their attitudes concerning the experience. These were designed to investigate the subjects' perceptions of the realism and usefulness of the scenarios and their likelihood of occurrence.

3.6 Threats to the Study

Campbell and Stanley (1963) enumerate several threats to both internal and external validity of laboratory experiments. Of their internal validity factors, five were potential threats in this study:

1. History: The period between treatments for a subject varied from one day to several months. Analysis of variance was performed to compare those with a shorter period between treatments to those with a longer period. No significant differences were found.

2. Order effect: This factor, which concerns the impact of the first treatment session on performance in the second, was controlled by the design, in which half of the subjects viewed the retrospective scenarios first, while the remainder viewed the prospective scenarios first. Statistical tests were run to determine the likelihood of an order effect. When none was found the treatment groups were combined yielding two groups (retrospective and prospective treatments). A statistical test was also performed on the order of the cases. No effect was found.

3. Instrumentation: The same judges were used for all ratings. In their evaluations of the planning statements submitted by subjects, judges were not explicitly aware of whether the treatment was retrospective or prospective.

4. Group assignment bias: This was controlled by random assignment of subjects to the four groups. Statistical tests comparing the groups on demographic factors were performed and are reported in the Results section.

5. Experimental mortality: For a few subjects, scheduling of the second session took considerable persistence, particularly for the one subject who was on European assignment. All of the subjects did ultimately complete both

sessions, so mortality was not an issue.

In terms of external validity, all of the Campbell and Stanley factors were potential threats:

1. Reactive effect of testing: The four-group design controlled for any decrease in a subject's responsiveness to the treatment variable in the second session; the sequence of both the treatment variable and of the two cases were varied. No significant effects were found.

2. Interaction effects of selection biases and treatment variable: This threat involves the possibility that those who participate in the study are somehow different from those who do not participate. No one who was asked refused to participate, but four or five people who had agreed to do so proved impossible to schedule and thus had to be dropped (prior to the first session). It was not feasible to select subjects randomly from the total population of employees or from any logical subset. Also, all the subjects were employees of, or consultants to, a single business firm, and this population may be significantly different from other populations. Although we have no reason to believe the population to be unrepresentative of business planners in general, the study should be replicated in other firms and other industries to extend its generalizability.

3. Reactive effects of experimental arrangements: Such effects would limit generalizations about the experiment to persons exposed to the treatment in non-experimental environments. It was particularly important that this study be as realistic as possible within the constraints of a controlled experiment. The cases were based on industries with which the participants were familiar. The scenarios were developed in accordance with generally accepted principles of scenario construction (Porter 1985) and were similar to scenarios used within the firm. The experimental task was carried out in the subjects' own offices.

4. Multiple-treatment interference: This potential threat was controlled by the four-group design.

This section has described the research design for the study. We now turn to data analysis.

4. Results

First we describe tests of the research question dealing with objective factors. Then we investigate subjective factors: whether subjects using retrospective scenarios produce more effective, complete, credible or creative plans than subjects using prospective scenarios. We close with a discussion of the attitudes of subjects about the treatments.

4.1 Objective Factors

The first research question involved the amount of detail produced by planners in the retrospective mode as compared to the prospective mode. This was operationalized as the number of planning statements produced by subjects in each mode. Thus the main independent variable was temporal perspective and the dependent variable was the number of planning statements created. The number of monitoring statements produced in each mode was measured also. Table 1 presents the results for these two measures.

Table 1
Analysis of Objective Factors

Variable	Mode	N	Mean	SS&MS	F	Prob.
STATEMENTS	P	64	13.5	70.5	6.40*	.01
	R	64	15.0			
MONITOR STATEMENTS	P	64	2.6	0.19	0.08	.78
	R	64	2.5			

* $F_{.05}$ (1,63) 3.98

Mode: P = Prospective; R = Retrospective

As can be seen in the table, the number of planning statements was significantly higher in the retrospective mode, thus supporting the notion that retrospective thinking produces more detail. However, there was no difference in the number of monitoring statements.

4.2 Subjective Factors

The second research question involved evaluation of completed plans by expert judges on the basis of comprehensiveness, credibility, degree of proactivity, realism, and creativity. The two raters analyzed all 128 of the submitted plans, scoring them on 18 questions using 5-part Likert scales.

A summary of the average results of the raters judgments is shown in Table 2. In this table, the 18 questions are grouped into three more general classifications: comprehensiveness, credibility, and consistency. Neither the summaries nor any of the 18 specific questions showed significant differences between prospective and retrospective plans.

Table 2
Comparison of Subjective Outcomes: Prospective vs. Retrospective

Variable	Mode	N	Mean	SS&MS	F	Prob.
Comprehen-siveness	P	64	19.44	5.28	0.48	.49
	R	64	19.84			
Credibility	P	64	20.17	2.27	0.02	.91
	R	64	20.19			
Consistency	P	64	18.50	3.12	0.31	.58
	R	64	18.81			
Grand Totals	P	64	58.11	17.26	0.24	.62
	R	64	58.85			

After completing the rating instrument, the two judges provided the following additional data:

1. A count of the "implementable" statements in each plan. Some subjects produced statements that were much too vague to be implemented, such as "reduce costs by 10%", or "increase market share".

2. A numerical rating for each individual planning statement, on a zero to ten scale; the judges were asked to rate each of the relatively few outstanding statements as nine or ten points, with lower scores for the majority. The results are shown in Table 3. Total rating points showed a significant

difference for the retrospective sessions. There was no difference in the average points per statement or in the number of implementable statements.

Table 3
Qualitative Ratings of Judges

Variable	Mode	N	Mean	SS&MS	F	Prob.
NUMBER OF	P	64	9.58			
IMPLEMENTABLE				35.1	3.08	.08
STATEMENTS	R	64	10.62			
TOTAL	P	64	93.42			
RATING				3032	4.62*	.04
POINTS	R	64	103.16			
AVERAGE	P	64	6.86			
POINTS PER				0.02	0.02	.88
STATEMENT	R	64	6.83			

* $F_{.05}$ (1,63) 3.98

4.3 Analysis of Moderating Factors

Additional analyses were performed in order to determine if differences due to demographic or other factors might influence outcomes. Subjects could be differentiated based on years of business experience, type of organizational affiliation, number of years in a planning function, and years in management. It should be noted that any significant findings regarding these characteristics would have to be interpreted cautiously, since the experiment was not designed specifically to investigate them.

Subject Type Differences: Forty-one of the subjects were company employees at the time of the study; the rest were consultants to the same company. No significant differences were found on the basis of subject type as the grouping factor. On two of the rating questions, however, the overall means for each question were significantly higher for the consultant group than for the company employees. The raters found that the plans submitted by the consultants, in both the prospective and retrospective sessions, were significantly more proactive and more creative than those submitted by company subjects. These results are shown in Table 4.

Table 4
Measures Grouped by Subject Type

Proactive Rating:

	Cell Means		
	Empl.	Consultant	Marginal
Prospective	2.92	3.30	3.06
Retrospective	3.15	3.61	3.31
Marginal	3.04	3.46	3.19
N	41	23	64

	Analysis of Variance		
	SS&MS	F	Prob.
Subject Type	5.20	4.52*	.04
P vs. R	2.02	2.92	.09
Interaction	0.05	0.08	.78

Creativity Rating:

	Cell Means		
	Empl.	Consultant	Marginal
Prospective	3.31	3.73	3.45
Retrospective	3.40	3.82	3.55
Marginal	3.36	3.77	3.50
N	41	23	64

	Analysis of Variance		
	SS&MS	F	Prob.
Subject Type	4.99	4.61*	.04
P vs. R	0.25	0.39	.53
Interaction	0.00	0.00	.99

* $F_{.05}$ (1,62) 3.98

The 64 subjects in this experiment averaged just over 20 years of business experience. An analysis was performed on the rating data with years of experience as the grouping factor; there were four approximately equal groups. The results for one of the rating questions, on creativity, shown in Table 5, indicates an interaction. The Neuman-Keuls analysis (Winer 1971) showed a significant difference for retrospective as compared to prospective treatments for the group with the lowest level of experience.

(Place Table 5 about here)

As shown in Table 6, similar results were obtained for the rating question on proactivity. For this question, the Neuman-Keuls test showed significant differences, favoring the retrospective treatment, for both the 0 to 11 and the 21 to 27 year groups.

(Place Table 6 about here)

Table 5

Creativity Rating, Grouped by Years of Professional Experience

Question: THE PLAN IS CREATIVE. IT CONTAINS INSIGHTS DERIVED FROM THE SCENARIOS OR THE CASE BACKGROUND BUT NOT CLEARLY SPELLED OUT IN THEM (EVEN THOUGH I DON'T LIKE THE PLAN).

* Neuman-Keuls Test: P vs. R for 0-11 years significant at 1%; none others significant
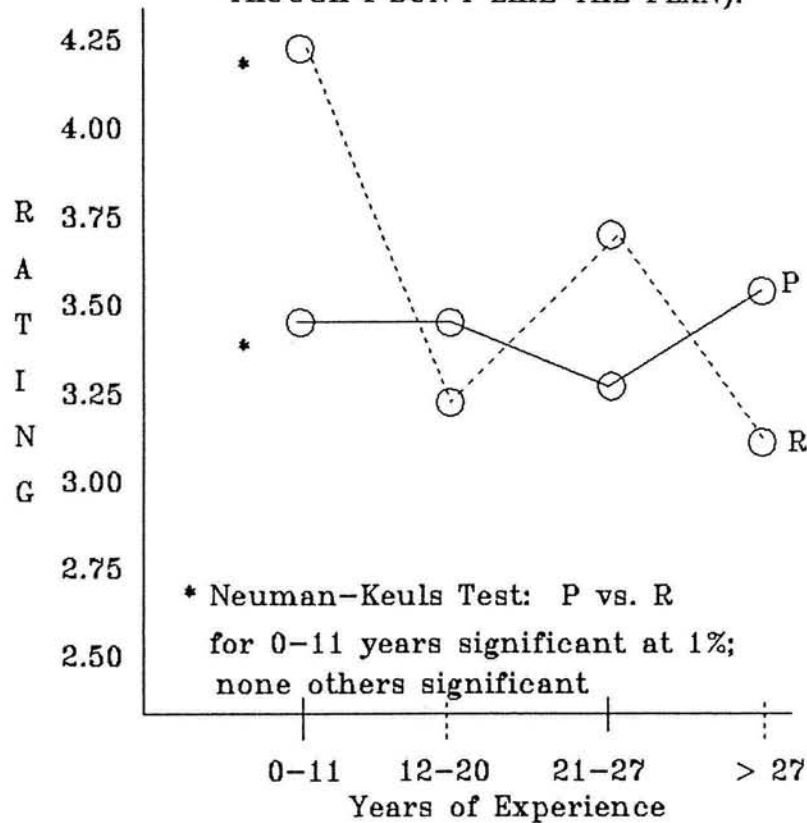
CELL MEANS

| | Years of Experience | | | | |
	0-11	12-20	21-27	> 27	Marg.
Prosp.	3.47	3.47	3.31	3.56	3.45
Retro.	4.20	3.24	3.69	3.12	3.55
Marginal	3.83	3.35	3.50	3.34	3.50
Count	15	17	16	16	64

STATISTICS

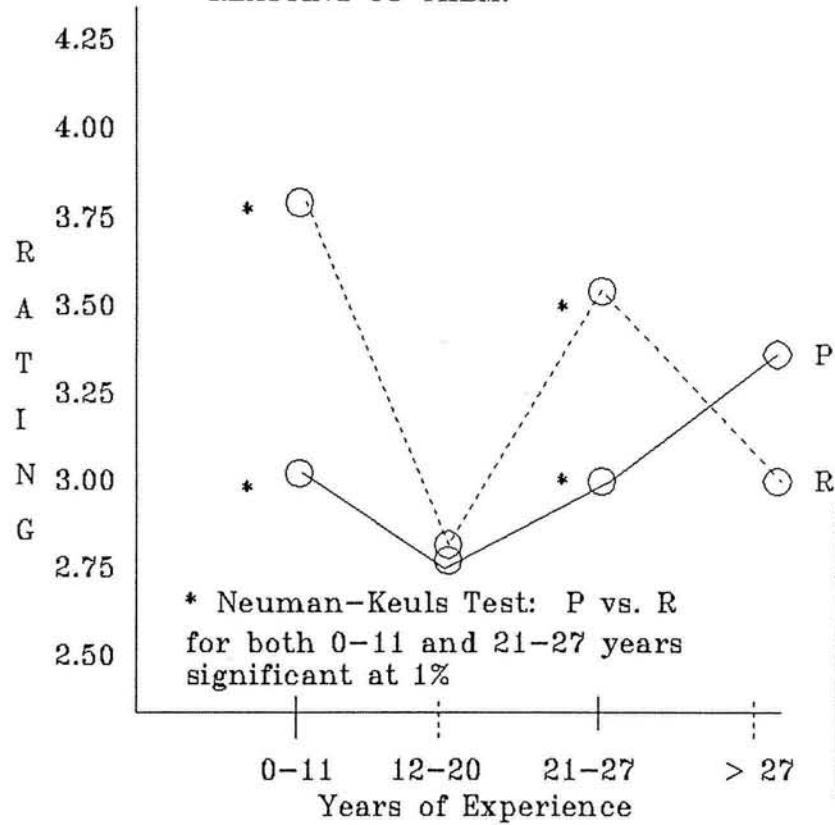|	SS	MS	F	Prob.
Years	4.85	1.62	1.44	.24
P vs. R	0.38	0.38	0.69	.41
Interact	6.88	2.29	4.19	.01

Table 6

Proactive Rating, Grouped by Years of Professional Experience

Question: THE PROPOSED STRATEGIES ARE PROACTIVE. THE PLAN PROPOSES TO CHANGE, INFLUENCE OR TAKE ADVANTAGE OF CONDITIONS IN THE ENVIRONMENT, RATHER THAN JUST REACTING TO THEM.

CELL MEANS

| | Years of Experience | | | | |
	0-11	12-20	21-27	> 27	Marg.
Prosp.	3.07	2.82	3.00	3.38	3.06
Retro.	3.87	2.88	3.56	3.00	3.31
Marginal	3.47	2.85	3.28	3.18	3.19
Count	15	17	16	16	64

* Neuman-Keuls Test: P vs. R for both 0-11 and 21-27 years significant at 1%

STATISTICS

	SS	MS	F	Prob.
Years	6.42	2.14	1.83	.15
P vs. R	2.19	2.19	3.59	.06
Interact	6.49	2.16	3.55	.02

Since retrospective thinking takes some discipline and mental effort, it is possible that some subjects, while instructed to think retrospectively, were actually thinking prospectively. In order to test this notion, an assumption was made that subjects, effectively thinking retrospectively, would use the past tense in writing their statements.

Data were collected, for the retrospective mode sessions, on the number of statements submitted by subjects which were phrased in the past tense. The use of past tense statements might indicate that subjects had succeeded in the role they were given, that of imagining themselves as the chief strategist for the company in the case, and were actively playing that role. If so, these subjects might show the largest differences between the prospective and retrospective treatments. According to Weick (1979), they should also produce the most plausible and detailed plans.

The data presented in Table 7 provide support for this interpretation. This analysis was performed for two equal groups: the high past tense group submitted from 9 to 32 statements in the past tense, the low group from 0 to 7 statements. Twenty of the low group had no past tense statements. The results were significant using the Neuman-Keuls test for two of the individual rating questions at 1%, and for two additional ones at 5%. The six questions designed to measure consistency showed significance at 1%, and the grand total measurement at 5%.

(Place Table 7 about here)

Table 7
Analysis of Past Tense Submissions

Rating Question	N	Means Pros.	Retro.	Interaction F	Prob.	Neuman-Keuls Signif.Diff. @1%	@5%
Proactive							
Low	32	2.97	2.84				
				7.25	.009		
High	32	3.16	3.78			X	
Clear, Precise, Implementable							
Low	32	2.68	2.44				
				3.67	.060		
High	32	3.12	3.56				X
Realistic in Terms of Capital Provided							
Low	32	2.94	2.72				
				4.35	.041		
High	32	3.06	3.38				X
Acceptable Plan in Terms of Cost							
Low	32	2.75	2.56				
				4.23	.044		
High	32	2.97	3.38			X	
Total of 6 Consistency Questions							
Low	32	17.97	17.13				
				4.56	.037		
High	32	19.03	20.50			X	
Grand Total, 18 Rating Questions							
Low	32	56.37	54.47				
				3.43	.069		
High	32	59.84	63.22				X

Another difference between these two groups was that the total average score on a large number of measures (adding the prospective and retrospective sessions together and dividing by two) was significantly higher for the high past tense group. Table 8 summarizes this finding.

Table 8
Past Tense Analysis with Average Total Scores

Variable	N	Mean Ave. Low	High	F	Prob.
Proactive	64	2.9	3.5	9.46**	.003
Clear & precise	64	2.6	3.3	16.77**	.000
Creative	64	3.2	3.8	14.68**	.000
Total Comprehensive	64	18.3	20.9	13.39**	.001
Adequate resource	64	3.2	3.5	4.50*	.038
Adequate capital	64	2.8	3.2	5.45*	.023
Acceptable cost	64	2.7	3.2	6.51*	.013
Acceptable profit	64	2.4	2.9	9.20**	.004
Total Consistency	64	17.6	19.8	8.46**	.005
Grand Total Ratings	64	55.4	61.5	9.39**	.003
Number of Statements	64	12.7	15.8	10.82**	.002
Implementable Stmts.	64	8.3	11.9	13.75**	.000
Average Points/Stmt.	64	6.6	7.1	7.34**	.009

$\quad$ * $F_{.05}$ (1,62) 3.98
$\quad$ ** $F_{.01}$ (1,62) 7.08

Clearly, the group which phrased most of their statements in the past tense produced more statements and, in the opinion of the raters, their plans were of higher quality.

A profile of the high and low past tense groups and of the total sample is given in Table 9. It should be noted that the high group contained a higher proportion of outside consultants as compared to company employees, a higher proportion of doctorates, and a lower level of business experience.

Table 9
Subject Profile: Producers of Past Tense Statements

		High Pasts	Low Pasts	Total Subjects
N		32	32	64
Affiliation:	Company	17	25	42
	Consultants	15	7	22
Sex:	Male	29	27	56
	Female	3	5	8
Education:	Doctorate	18	8	26
	Masters	9	14	23
	Bachelors	5	10	15
Experience:	0 to 11 years	11	4	15
	12 to 20 years	7	10	17
	21 to 27	8	8	16
	Over 27	6	10	16
	Average Years	18	22	20.4
Position:	Director	1	5	6
	Mid-level management	6	6	12
	Program manager	10	14	24
	Univ. professor	15	7	22

4.4 Attitudes of Subjects about Treatments

These questions addressed the third research question, whether scenarios presented retrospectively would be more plausible to subjects or more likely to occur. Would subjects be aware of differences among scenarios presented retrospectively and prospectively, or does this operate below their level of consciousness?

None of the 12 post-session questions showed a significant difference between the prospective and retrospective modes. Thus, for example, the subjects did not perceive that the retrospective scenarios were more realistic, nor helped them visualize the future better, nor were more likely to occur.

5. Discussion

This paper has investigated whether the temporal perspective of scenarios used in strategic planning, and indirectly the temporal perspective of strategic planners, would affect the detail and quality of the plans produced. It was found that subjects generated more statements when the scenarios were presented retrospectively, as if they had already happened, than when they were presented prospectively. This supports the results of Bavelas (1973), as well as other studies cited by Weick (1979), in reporting greater detail in the retrospective mode of thought.

This study extends the generalizability and the external validity of those previous experiments. Those studies all used college freshmen, generally psychology students, as subjects, whereas we have used professional business people with an average of 20 years in industry and a high level of management experience as subjects. The other experiments used simple stimulus materials of a sentence or two, while this experiment used tasks and materials comparable to an actual business problem (six different full page scenarios and two 3-page cases depicting realistic companies and business terminology). A repeated measures design was used which provided better control over subject variability than had previous experiments.

These findings provide confirmatory evidence for Weick's (1979) theory that the retrospective mode produces "richer detail" (p. 196). Weick's explanation for this phenomenon is that retrospection provides an anchoring for the mind which makes it easier to think in logical causal paths. The mind is freer and thus more creative.

Campbell (1960) and Hogarth (1987) both discuss the phenomenon of creativity, and Campbell's exposition of "thought trials" which, in his view, are the basis for all creative outputs. Campbell's model holds that the sheer number of thought trials is consequential, and that more trials will result in greater creativity. Quality is important as well, but the significance of quantity is not dependent on quality. Hogarth stresses the importance of an active imagination as a necessary requisite of creativity. In this experiment, we believe subjects engaged in more thought trials (mental effort) while in retrospective sessions than in prospective ones. The evidence for this is that they produced significantly more statements in the retrospective mode. This implies, according to the Campbell model, more potentially creative ideas. This would have application in brainstorming and in design tasks, including product design or system design (Turner 1987; Couger 1990).

Stubbart (1987) discusses the greatly increased complexity of a crisis situation that adds to the difficulties of making intelligent decisions; advance planning and the retrospective approach may reduce this complexity. Keen and Scott Morton (1978) have noted that it is often useful to add structure to the design phase of the decision-making process, and that approaches for the stimulation of an increased volume of creative ideas would be helpful in this regard. This suggests a new structure for decision support systems (DSS) and group decision support systems (GDSS) whereby participants would be given retrospective scenarios, or perhaps provided with tools for generating their own scenarios, as part of the decision-making process (Elam and Mead 1987). It should be noted that the cost of applying this approach to an existing DSS/GDSS is quite low.

The objective measure which was not significant was the number of monitoring statements. There is a logical explanation for this outcome: if participants produced more planning statements in the retrospective mode because they imagined they were looking backward on events that had already happened, their minds would have had to switch into the prospective mode in order to construct monitoring statements since, by definition, a monitoring statement operates in a forward direction. The spell was broken at that point. It would make little sense to construct statements to track events, when at the same time one is trying to imagine that those events have already occurred.

The results of this study suggest that, in terms of the overall population represented by the sample, there is evidence of a greater quantity of ideas produced in the retrospective mode, but little indication that the quality of those ideas is enhanced by thinking backwards. However, when the sample is partitioned, evidence emerges that quality is improved for a subset of the sample, raising some intriguing possibilities that warrant further investigation.

The experiment was not designed to differentiate between subjects on the basis of cognitive characteristics, but an analysis performed on subject type and past tense statements suggest that there may be significant differences between individuals in their capacity to adapt to this method. It was noted during the study that some subjects expressed pleasure in participating in the retrospective sessions, while others found it uncomfortable. One individual whose career had been in forecasting said that he had gotten so accustomed to focusing on the future in his job that the exercise of looking backward was quite disagreeable. This phenomenon may be analogous to hypnosis - some people are easily hypnotized; some require greater skill and manipulation on the part of the hypnotist; and some seem completely resistant to hypnosis. It is likely that some

people, perhaps unconsciously, resist letting their minds go free enough to enter, comfortably, an imaginary role.

The data suggest also that the retrospective mode had more effect on the performance of the subjects with the least business experience (who also, of course, tended to be the youngest) and on those subjects who submitted a high proportion of their retrospective planning statements phrased in the past tense. The result for the least experienced subjects seems to contradict Campbell (1960) that a more varied life produces more creativity. Does a life encompass more variety as it ages? Cumulatively, the longer the life, the more different experiences will have been undergone. But, it is likely also that the proportion of new experiences to those that have been encountered previously will decrease as a person ages. The first few years in a business career provide many new experiences, but the variety drops off rapidly. It could be argued, then, that a person who has completed college and has a few years of professional experience would be at the most creative stage of life. He or she would also typically have a higher energy level than an older person, an advantage in engaging in the hard work of thought trials.

Is the retrospective mode easier for less experienced people? Bavelas (1973) and others who have studied this phenomenon used college students as subjects. Perhaps it is more likely to occur with people with less experience and likely to be younger. This experiment was an exercise in imagination, and it is possible that our imagination gets weaker as we become set in our ways and as we grow older, particularly if we use it less. Mumford and Gustafson (1988) report that many studies have found that major creative contributions are most likely to occur in young adulthood.

In a large number of rating measures, the group with the highest number of past tense statements was rated significantly better in retrospective mode than in prospective. The participant questionnaires did not indicate that subjects were aware they were performing at a higher level while looking backward. This suggests that, in accordance with Weick's (1979) argument, whatever happens in the retrospective mode to cause increased output is largely subconscious; the subjects did not seem aware of any differences.

These results support the notion that retrospective thinking is effective for some people in stimulating a greater volume of creative ideas and that those ideas will be of higher average quality. In this view, the subjects who submitted statements in the past tense were the ones with the most adaptable or unresistant minds and who managed successfully to imagine themselves in the retrospective mode. Those who performed best retrospectively were the ones who were most involved in the imaginary setting. Thus, for

this group, Weick's theories hold. The outcome was real for them; the company had achieved its goals due to their good planning, and they were merely reconstructing the strategies that led to those results. They had less uncertainty than in the prospective mode because the time dimension was fixed and stable. They wrote statements in the past tense because their minds were operating in the past. The judges rated the high past tense group to be higher in creativity; this is consistent with Hogarth's (1987) view that imagination is an important component of creativity.

5.1 Findings for Information Systems

The findings of this study have implications for information systems in a number of ways: for strategic planning, for project planning, for systems design, and for problem diagnosis. It may be desirable to design executive information systems (EIS) so that potential future scenarios can be depicted as if they had already happened, in order to force consideration of an unbiased or proactive view of the potential future environment and to enhance the strategist's powers of imagination. Volonino and Watson (1990-91) advocate such an approach: identify objectives first, then work backward through the processes. Mitroff, Barabba, and Kilmann (1977), noting that people who can think boldly and creatively about the future are in short supply, advocate training programs and "an environment that will do everything in its power to encourage those who are able to think about the future" (p. 47).

The increased volume of ideas produced in the retrospective mode should be useful in crisis planning (Perrow 1984) and with failure-prevention efforts in any type of long-range project. In large systems projects, planners might be asked to imagine that a system has already been implemented, but that it is a failure. The results of the current study indicate that these planners will envision more ideas that might cause problems by using this reverse brainstorming technique than if they simply try to plan in a forward direction, and that the ideas will be more detailed. It should help them develop causal links between the current situation and potential future events, possibly avoiding pitfalls. This increased benefit would be achieved with virtually no additional cost.

The information systems function is constantly involved in long-range planning, to evolve the firm's infrastructure and to support organizational strategies. Future processing volumes must be estimated, data base needs must be envisaged, new technologies must be prepared for, new skills must be provided and, most important of all, the future direction of the corporate organization must somehow be anticipated. The

results of this study indicate that the technique of retrospective thinking may be a useful and low cost way to improve the formulation of such strategies.

Much attention is now being focused on GDSS, and in their potential for enhancing group creativity (Nunamaker, Applegate and Konsynski 1987). It seems very possible that the use of retrospective scenarios might affect performance in that domain. This study may also be of value in providing insight to cognitive processes. Several authors have suggested that it will be difficult to build effective GDSS until we acquire a better understanding of the decision-making process (Kraemer and King 1988; Borch and Hartvigsen 1991; Mockler 1987). The individual differences found in our study in subjects' ability to adapt to the retrospective mode supports the view of Vessey and Galletta (1991) that cognitive fit is an important GDSS design variable.

Finally, in the design of experiments or in construction of theories involving the cognitive processes of decision-makers, researchers need to be aware of the potential lack of symmetry in forward and backward thought. It is important to determine whether it is necessary to control for the retrospective effect in order to avoid confounding of research results.

5.2 Lines for Further Investigation

This study was designed to yield information that would facilitate future research in temporal perspective. It has extended the generalizability of previous experiments by using subjects with a high level of business experience and by using a realistic planning task. However, the subjects were drawn from a single U. S. company, one with a unique culture. The study should be replicated in other organizations, industries, and countries.

This study was a laboratory experiment; there is a need for field studies to determine whether these findings can be generalized to an actual planning situation. The scenarios might be designed to be more company-specific than in this study (such as in Boland 1984), and more proactive (Crossley and Hooker 1987). The task could involve either corporate strategic planning or functional planning (e.g., Information Systems). Some specific studies suggested by these analyses are summarized below:

1. To test the notion that subjects with stronger imaginations would have a more pronounced retrospective effect, group subjects based on an instrument designed to distinguish this characteristic. The design should be repeated measures. More demographic information, such as, age, sex, IQ, and

nationality should be captured. The results of this study would give insights into selection of employees to work in strategic planning.

2. If the first study above confirms the imagination hypothesis, another study could be designed to determine whether creativity-enhancing techniques could be used to strengthen weak imaginations and whether this might increase the retrospective effect in such subjects.

3. A field study in crisis prevention. The participants would envision a potential future crisis, imagine that it had already happened, then devise techniques for preventing it.

4. A study utilizing a group decision support system (GDSS). The software for brainstorming would be modified to include a retrospective mode for presenting scenarios. This should be a controlled experiment designed to answer the question: does the retrospective effect occur in a GDSS environment?

5. A study to determine whether aspects of small group process might enhance the effect.

6. Studies of the effect of providing retrospective scenarios, with realistic pictorials and graphics, in executive information systems and decision support systems.

5.3 Research Issues Raised

This study supports the contention that cognitive processes involved when one is looking toward the past are somehow different than when the perspective is forward. Researchers who investigate cognitive questions should be aware that temporal perspective is a variable that might confound the results of an experiment. They may reach erroneous conclusions in some cases if they do not control for this variable.

It is difficult to devise a suitable task for a controlled experiment in temporal perspective. The manipulation must be strong enough to induce the subject to envision him or herself in the imaginary role, but not so strong as to influence outcomes.

This study utilized subjects with substantial business experience, but the results obtained were similar to those researchers who used psychology students. Given the

similarity of findings to previous studies, some support is provided for the notion that results of studies using students may be extended to other populations.

6. Conclusions

Using scenarios of realistic future industrial environments and subjects with substantial business experience, this study investigated the impact of temporal perspective on the generation of ideas in the strategy formulation process. It was found that retroactive presentation of the scenarios increased the volume of strategic planning statements generated. Subsequent analysis indicated that the retroactive mode enhanced creativity for some subjects, but not for all. It appears that the individuals most positively influenced by the reverse temporal perspective are those with the strongest imaginations. This conclusion is based on the finding that the subjects with significant increases in ideas generated while in the retrospective mode were those who phrased their statements in the past tense, and who might therefore be assumed to be imagining that they are thinking in the reversed time perspective.

The planning statements generated by the participants were evaluated by two experienced planning executives. The overall sample did not show any evidence of increased quality of the statements while in the retrospective mode. However, for that portion of the sample noted above who phrased their statements in the past tense, there was some evidence of a greater level of quality in that mode.

In periods of high environmental turbulence and uncertainty, when the past becomes increasingly unreliable as a guide to future developments, strategic planners require methods and tools which enable them to view the future as free as possible from the constraints imposed on their thinking by their past experiences. Churchman (1968) has said that "good planners are continuously asking the most searching, radical, and ridiculous questions" (p. 164). This study indicates that the presentation of scenarios retroactively is a promising technique for encouraging planners to formulate a greater volume of ideas; thus it can be said to enhance creativity. If designers of DSS and GDSS for strategic planners can build the capability to generate retrospective scenarios into their systems, perhaps using graphics to enhance the visualization of the scenarios for the planners, a greater volume and variety of planning ideas might be forthcoming. The finding that some participants are influenced by this technique and some are not makes it

advisable to use it selectively.   Additional research is needed to determine more precisely the personality types that are most receptive to this approach.

Appendix

Excerpts from the cases and scenarios are provided below. There were two cases: MicroByte, Inc., a rapidly growing computer software company, and DoverDrive, Inc., a successful disk drive manufacturer. Each case was three pages in length. There were three scenarios for each case, approximately one page each. The scenarios described the environment for the industry, not for individual firms.

Excerpts from MicroByte Case:

Congratulations! You've just been named the Vice President for Strategic Planning of MicroByte, Inc. ... You will report directly to the CEO ... MicroByte now has more than 1,400 dealers worldwide who have become the core of its distribution network . . . MicroCAD is still the principal product, providing about 70% of the revenues in 1987 ... The most appropriate PCs for MicroCAD are the most powerful ones ... Other products include CAD/Camera, which translates photos into drawings, and a $95 hobbyists version of MicroCAD. ... Programmers are considered the company's most important asset. .. There is as yet no significant penetration of Fortune 1000 firms. .. It is estimated that 5% of U. S. architects and 2% of other architects have used MicroCAD or a similar product.

Excerpts from MicroByte Scenarios (Prospective):

I. "Intensive Research" Scenario:

By 1992, most companies in the software industry will have to invest much more heavily in research and development than in 1987. Architects, draftsmen, and other potential users are becoming much more sophisticated and will demand more sophisticated applications. .. a CAD software product will have to incorporate the latest techniques in artificial intelligence and expert systems. .... Programmers will be in very short supply; the best ones will command high salaries ...

II. "Programmer Productivity" Scenario:

The most important development in the PC CAD industry in the early 1990s will involve significant breakthroughs in programmer productivity. .... breakthroughs will come from the application of artificial intelligence and expert systems techniques to the production of new software. .... fewer programmers will be needed ... However, since CAD applications can be expected to be considerably more complex, some must have advanced skills. .... R&D investments will increase, but emphasis will be on development rather than pure research .. Large software firms will be attracted to this market as its growth potential is perceived, putting downward pressure on prices."

<u>**Excerpt from a Retrospective Scenario (Intensive Research):**</u>

By 1992, most companies in the software industry were forced to invest much more heavily in research and development than in 1987... Architects, draftsmen, and other potential users had become much more sophisticated...

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