The Effect of Decision Style on the Use of a Project Management Tool: An Empirical Laboratory Study

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Abstract

Managing a software development project presents many difficulties. Most software development projects are considered less than successful, and many are simply cancelled. Ineffective project management has been cited as a major factor contributing to these failures. Project management tools can greatly assist managers in tracking and controlling their projects. However, their structured and analytical nature does not necessarily match the decision-making styles of project managers.

This paper presents the results of an empirical laboratory study that examined the influence of decision style on a project manager's use of the project management tool, Microsoft Project. Project managers from eight companies participated in the study, and generated an interesting pattern indicating that significant differences exist with respect to the use made of a project management tool when the project manager's decision style is taken into consideration. The results clearly indicate that when completing certain tasks, such as developing an initial project plan, project managers preferring a more directive or analytical approach to decision making significantly outperformed those project managers preferring a more conceptual or behavioral approach, both in regard to the time taken to complete the plan, and the accuracy of the plan.

ACM Categories: K.6.1, K.6.3

Key Words: Project Management Software, Project Managers, Decision Making, Decision Style

Introduction

Software development projects are notorious for being completed behind schedule, over budget, and often failing to meet user requirements. Examples are plentiful where millions of dollars have been spent on projects that simply do not work, and worldwide, researchers estimate that between $80 billion and $500 billion is wasted each year on information technology projects that are never implemented (Bicknell, 1995; Bozman, 1994; Gibbons, 1997; King, 1997; Parker, 2002). Where does the blame lie? All too often the answer is poor project management (Hauschildt et al., 2000; Purvis & McCray, 1999; Brown & Eisenhardt, 1995). Effective project management is seen as crucial to successful software development, and an important key to effectiveness is the ability to track and control the progress of the project.

Considering the increasing complexity of software development projects with thousands of inter-related tasks and dependencies, tracking and controlling a project's progress is highly dependent upon an appropriate selection of project management tools. The question then becomes, "What is an appropriate tool?" It has been suggested that a structured, systematic approach to project management is not only preferred, but essential (Rook, 1986).

Examining the nature of various project management tools indicates that the tools indeed support a structured, systematic approach. However, the decision to design project management tools in this manner promotes the assumption that all project managers are cut from the same mold, and all prefer a structured, systematic approach to solving problems and making decisions. This is not necessarily the case. Project managers who are not structured, systematic individuals may thus be at a disadvantage when required to use these types of tools. The focus of this paper, and the research question examined, was therefore: Does a project manager's decision style impact the use of a computerized project management tool?

The organization of this paper is as follows. A review of the literature examines various project management issues, including tools. Our discussion then turns to the research framework, the methodology employed in this study, and the results. The subsequent section discusses the findings and limitations, and offers suggestions for further research. The final section presents the conclusions.

A Review of the Literature

Effective project management is seen as crucial to successful software development. Far too often, the cause of an unsuccessful software development project is determined to be poor project management (Smith, 2002; Hauschildt et al., 2000; Purvis & McCray, 1999; Wilder & Davis, 1998; Brown & Eisenhardt, 1995). A key to effective project management is the ability to manage the triple constraint of quality, schedule, and budget, and to track and control the progress of the project (Mantel et al., 2001; Rook, 1986; Zmud, 1980). Kirsch (1997) discussed the concept of controlling the project from several perspectives, and noted that formal control mechanisms—those that assist in coordinating project tasks—are necessary in every project. Additionally, Nidumolu (1995) stated that "project coordination and control are of paramount importance" (p. 211). The observation is offered that the lack of proper tools and techniques may be the prime cause of problems in project management (Wingrove, 1986). Furthermore, regardless of which project management methodology is employed, computerized project management tools are beneficial (Ware, 1991).

Having effective project management tools is a crucial ingredient in guiding a project manager toward successful completion of his or her tasks (Fox, 2002; Gelbard et al., 2002; Globerson & Zwikael, 2002; Smith, 2002; Swink, 2002). The tools can help determine the realism of a preset schedule and identify the need for additional resources. They can allow for analysis of various alternative approaches and identify various mixes of staff skills and experience levels. They can also assist in managing an ambitious schedule by identifying if a particular schedule is unrealistic and/or if additional resources will be required (Ware, 1991). Swink (2002) noted that computerized project-scheduling tools simplify the management of a development process and are shown to generate time-based performance improvements. Finally, selecting and installing the right tool set is necessary for effective software development (Rook, 1986). An error made in putting together an initial project plan or in subsequently interpreting the impact that a change in scope might have on a project could have a serious and detrimental effect on the ultimate success of the project. Having the appropriate project management tools available, and making effective use of them, can be considered to be a critical ingredient for successful project management.

The project management tools currently available appear to have been designed to support the previously-mentioned notion that a structured and systematic approach to project management is essential. However, a recent study of project managers revealed wide diversity in their preferred approach to decision making and problem solving. Collectively, project managers tend to prefer unstructured approaches to their work as often as structured approaches (Fox & Spence, 1999). The notion of a "whole-brained" approach to project management has been discussed further in the literature (Brown & Hyer, 2002; Webster, 1994). Because of this evident diversity in the manner in which project managers prefer to make decisions and solve problems, the currently available selection of project management tools may not be appropriate for every project manager. Moreover, Vessey and Glass (1994) specifically call for the expansion of this "one method" approach for tools supporting the software development domain so that task requirements more clearly match the cognitive abilities of developers.

Cognitive Issues

This section presents an examination of brain dominance as a basis for establishing the foundation

Left Hemisphere	Right Hemisphere
Logic	Spatial/multi-dimensional
Reasoning	Imagination
Analytical (taking things apart)	Synthetic (putting things together)
Linear (step-by-step)/logical	Holistic (grasping relationships in one step)/intuitive
Verbal	Visual
Abstract	Concrete
Mathematical	Musical
Center for science and technology skills	Center for artistic and creativity skills
Right-side sensory and motor functions	Left-side sensory and motor functions

Adapted from Sodan, 1998; Vernon, 1984

Table 1. Brain Dominance Characteristics*

of cognitive differences. This is followed by a discussion of the cognitive issues, primarily decision style, addressed in this study.

Brain Dominance. The study of the human brain has been an on-going activity for centuries. Functional laterality (variously identified in the literature as "left-brain/right-brain," cerebral dominance, or hemispheric specialization) had its impetus based on the examination of brain injury patients. The bi-polar nature of the human brain might be best illustrated in Table 1, which designates the principle functionality attributed to each hemisphere (Sodan, 1998; Springer & Deutsch, 1997; Vernon, 1984).

The importance of this dichotomy is underscored because it represents the foundation of many of the better known measurement instruments (used in information systems research) purporting to assess human cognition, such as the Meyers-Briggs Type Indicator (MBTI), the Visualizer/Verbalizer Questionnaire (VVQ), Rowe's Decision Style Inventory (DSI) (Shiflett, 1989), and others.

It has been hypothesized that if an individual possessing heightened left-brain skills is provided with a task requiring significant left-brain activity, their performance would be superior to those not possessing heightened left-brain skills. Of course, the same would apply to right-brain skills and activities (Benbasat & Taylor, 1978). Based on these observations, one might initially assume that persons performing project management activities would perform in a superior fashion if they had superior left-brain skills because of the analytical and linear aspects of analysis and design activities. However, management, per se, requires significant synthetic (integration) and holistic skills. Thus, at issue is whether the task of project management is more significantly related to analysis or management (or a relevant blending of both) (Mintzberg, 1976).

It has been observed that project management tools are designed to be very logical, structured, and analytical. However, tools that are designed to support *only left-brained* activities (those of a logical, structured, and analytical nature) are inadequate when consideration is given to the fact that a significant number of project managers prefer a non-structured (right-brain) approach to decision making (Webster, 1994; Fox & Spence, 1999). Therefore, an examination of the congruence of a project manager's decision style and his or her ability to use a project management tool is warranted.

Decision Style. In a study that described the various functions of a project manager, the element of decision making was identified as *the* most important aspect, the responsibility for which rests with the project manager (Rook, 1986). As such, the effect that a project manager's preferred style of decision making has on his or her ability to use a project management tool needs to be examined. The manner in which a manager makes a decision is important to understanding how effective he or she will be in a given situation or in using a particular decision aid, such as a computerized project management tool.

Rowe's Decision Style Inventory (DSI) was designed to measure the influence of four forces—personal needs, environmental pressures, group demands, and task requirements—on the way a decision maker responds to a situation (Rowe & Mason, 1987). Individuals' cognitive complexity (tolerance for ambiguity) and their value orientation (focus on task and technical concerns or human and social concerns) are also identified and used to determine their propensity towards one of four decision styles: directive, analytical, conceptual, and behavioral. Each of these styles is described below (Rowe & Mason, 1987).

- ***Directive***: This style has low tolerance for ambiguity and is oriented towards task and technical concerns. A person with this style implements operational objectives in a systematic and efficient way. This style is characterized by its practical orientation and its emphasis on the "here and now." People with this style tend to use data that focus on specific facts and to prefer structure. They are action-oriented and decisive, and look for speed, efficiency and results.
- ***Analytical***: This style has a high tolerance for ambiguity and is oriented towards task and technical concerns. Performance is achieved by means of analysis, planning, and forecasting. This style is characterized by a tendency to over-analyze a situation or to always search for the best possible solution; the individual periodically enjoys solving problems, searching for complete and accurate facts, and studying facts carefully to see what possibilities exist; they respond well to new requirements, and are good at detailed planning.
- ***Conceptual***: This style has a high tolerance for ambiguity (considerable complexity) and is oriented towards people and social concerns. Performance is achieved by exploring new options, forming new strategies, being creative, and taking risks. The individual preferring this style is characterized by creativity and a broad outlook, may rely too much on intuition and feelings, is good at getting along with others, enjoys having discussions, and is willing to compromise. They tend to be curious and open-minded, prefer independence, dislike following rules, are perfectionists, want to see many options, and are concerned about the future. They also tend to be creative in finding answers to problems and can easily visualize alternatives and consequences. They tend to value praise, recognition, and independence, prefer loose control, and are willing to share power.
- ***Behavioral***: This style has a low tolerance for ambiguity and exhibits the strongest orientation towards other people. These individuals are interested in others, are good listeners, and enjoy being involved with them. People preferring this style tend to be very supportive, are receptive to suggestions, enjoy exchanging views, show warmth, use persuasion, accept loose control, and prefer verbal to written reports. They also tend to focus on short-run problems and are action-oriented.

Of the four decision styles described above, the directive and analytical styles are hypothetically best suited to reflect the structured, systematic focus of currently available project management tools. The directive style prefers a highly structured approach to decision making; both directive and analytical styles prefer to focus on tasks; and the analytical style tends to be good at detailed planning—all characteristics not only supported by, but also required by computerized project management tools. Rowe and Mason (1987) report that the DSI has been used over 10,000 times in studies of managers in a variety of settings, and published research continues to employ this instrument (Rowe & Mason, 1988; Bowman, 1992; Leonard et al., 1999; Fox & Spence, 1999).

We further acknowledge those who have been identified as detractors to the use of cognitive style as the basis of research in this arena. A number of criticisms have been rendered by Huber (1983) in his often-cited article "Cognitive Style as a Basis for MIS and DSS Design: Much Ado About Nothing?". However, a closer inspection of this paper suggests not so much an indictment of cognitive style per se, but rather that Huber made a series of recommendations for enhancing our understanding of the construct. He further suggested that we seek measurements that are more rigorous *vis a vis* the construct and to more appropriately deploy those that are available. In addition, Huber suggested that mandatory use of a DSS whose features only support a cognitive style that is contrary to that preferred by a manager may result in lower performance, and that if choices are presented among DSS features, personal characteristics such as cognitive style should be considered.

Robey's (1983) response to Huber also supported research into the effect of cognitive style on information systems design and use. Robey stated that cognitive style research can contribute substantially to the development of truly flexible DSS—supporting all cognitive styles, and that a DSS designed to support a user's preferred cognitive style could enhance job satisfaction. Varying perspectives were presented, arguing that while one approach is to design a DSS that supports a decision maker's preferred cognitive style, an opposing perspective is that the DSS should complement decision makers, supporting them in the style that is contrary to their preferred method of decision making. The conclusion was that abandoning cognitive style research will certainly do nothing to advance the design of decision support systems (Robey, 1983). Huber and Robey both confirmed their positions in a later paper (Rao et al., 1992). To this end, we investigated the potential of the decision style construct and its assessment to broaden our comprehension of the large (cognitive style) construct.

Project Management Tools

As discussed above, having and using effective project management tools is a crucial component for a project manager attempting to successfully manage a software development project. In order to address the research question and enhance the generalizability of the results, Microsoft Project®, the most widely used project management tool, was selected (Fox, 2000; Fox & Spence, 1998; Levine, 1995).

Research Framework

The primary focus of this research is a project manager's personal decision style and how well he or she uses a computerized project management tool. The decision style of a project manager is presumed to have an impact on the methods employed to manage a project, and ultimately, on how well they use this tool. Thus, how well a project manager uses a computerized project management tool is examined with respect to the project manager's preferred decision style.

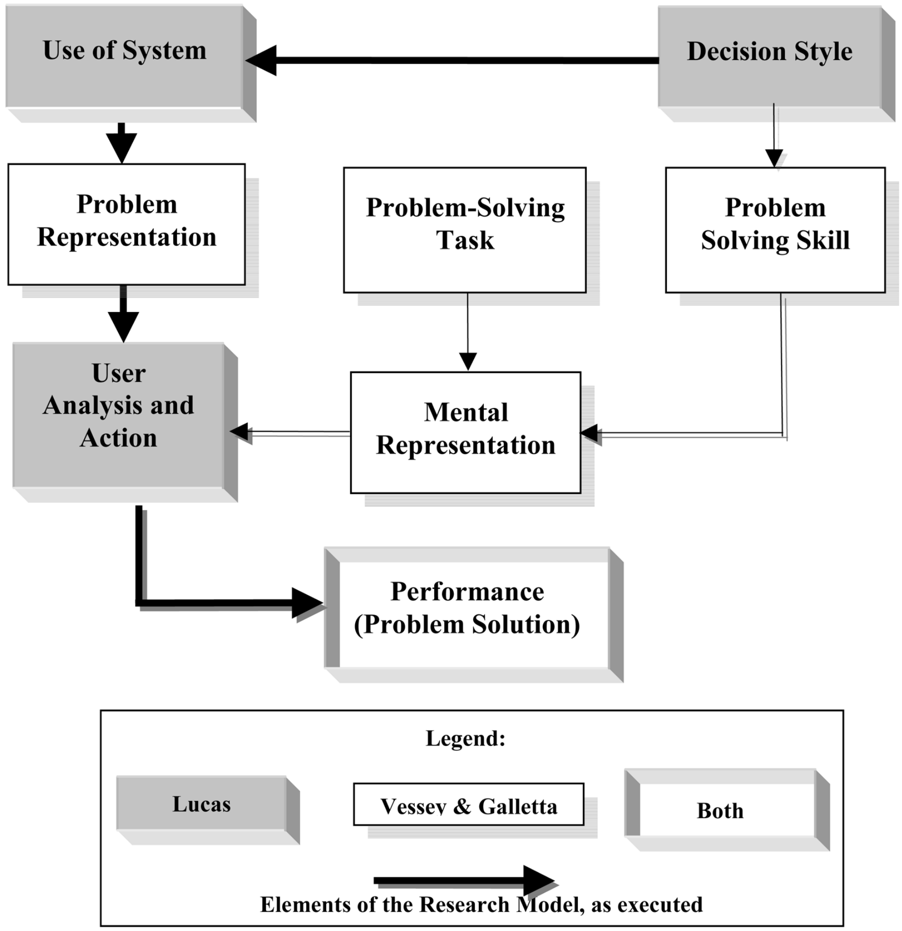
Early work developing a framework for the study of information systems is still relevant today. In Mason and Mitroff's (1973) groundbreaking "Program for Research," the psychological type of the decision maker was treated as a vital component of consideration when designing a management information system. Sprague (1980) held a similar view and stated that with respect to the design of a decision support system, it is very important that the DSS "provide the decision maker with a set of capabilities to apply in a sequence and form that fits his/her cognitive style" (p. 13).

Lucas (1973) presented a descriptive model of information systems that specifically addresses behavioral issues inherent in the design and operation of those systems. Because information systems exist within the context of an organization and the success of a system is dependent on solving organizational behavior problems in systems design, implementation, and operation, behavioral issues must be considered. This framework suggests several variables that interact to impact an individual's overall performance with the system. One of the primary relationships is with respect to the influence that decision style has on the use of the system, and subsequently, the impact that decision style has on the user's analysis and action. Lucas stated that a user's decision style is an important factor contributing to the use of a system and that "some individuals are not oriented toward using certain types of information. These decision makers have a different method of identifying and solving problems which will be reflected in their use of a system" (Lucas, 1973, p. 33). Performance can be measured on an organizational basis or on an individual basis and can take a variety of forms. Lucas's (1973) framework is particularly relevant for this research. The model's performance variable relates to the project manager's performance in the use of the project management tool.

Performance is expected to be influenced by several variables, decision style being the primary item of examination for this particular study. In addition, Shenhar and Laufer (1995) stated that "correctly identifying the project at its onset and adapting a fit management style and managerial tools may help project managers achieve better results and increase the effectiveness of their development efforts" (p. 11). Davis et al. (1987) stated that "effective managerial decisions require information support that considers both the design of information and the decision-making style of a particular manager" and that "certainly, the best support for a production manager with a particular decision-making style is one that accommodates that style" (p. 48). Additionally, Moussavi et al. (1995) examined the relationship between the usefulness of a decision tool or technique and a manager's cognitive style of decision making, and concluded that decision style does, in fact, impact how well or even *if* a particular decision tool is used.

While the Lucas model presents our research domain at a macro-level, the cognitive fit model of Vessey and Galletta (1991) can be employed to further decompose the problem-solving space to a micro-level. With respect to the interplay between the Lucas model and the Vessey-Galletta model, a project manager's decision style can be viewed as the conduit through which problem-solving skills are developed and executed. The user analysis and action component of the Lucas model provides the vehicle through which the ultimate problem representation aspect of the Vessey-Galletta model can be achieved. Finally, the problem-solving task component of the Vessey-Galletta model is clearly identified in this study as a series of project management decisions.

In the Vessey-Galletta model, these components provide the moderating characteristics of a user's



Sources: Lucas, H.C. (1973). "A Descriptive Model of Information Systems in the Context of the Organization," *Data Base*, Vol. 5, No. 2, pp. 22-39, and Vessey, I. and Galletta, D. (1991). "Cognitive Fit: An Empirical Study of Information Acquisition," *Information Systems Research*, Vol. 2, No. 1, p. 67.

Figure 1. "A Descriptive Model of Problem Solving in an Information Systems Domain" (Subset)

mental representation of a problem that ultimately yields a problem solution (or in terms of the Lucas model, performance). According to Vessey and Galletta, this model represents the essence of cognitive fit—the appropriate matching of problem representation and problem-solving skills that produce a more complete mental representation of a problem solving task leading to enhanced problem solutions. In addition, their work has made significant advances with respect to a more realistic comprehension of the problem-solving space. By integrating the Lucas model into our research framework, we suggest the possibility of antecedents to several of the constructs within the Vessey-Galletta model. The resulting conceptual model, combining Lucas and Vessey-Galletta, is shown in Figure 1.

Specific to this study, and therefore the resulting research model, consists primarily of the relationship between decision style and performance, acknowledging the intermediate influence of the use of the system, the problem representation, and the user analysis and action. This is indicated by the bold lines on Figure 1. Therefore, the following hypothesis was tested: Project managers who prefer a more structured style of decision making will achieve higher performance levels when using a computerized project management tool than project managers who prefer a less structured style of decision making.

The Methodology

The research question for this study was whether the style of decision making of project managers influenced how well they used a computerized project management tool. A total of 52 project managers from eight large organizations located throughout Kansas, Missouri, and Oklahoma participated in the study. The participants were self-selected volunteers who were made aware of the study through one primary contact at each of the eight organizations. The authors explained that criteria for participating in the study included having working knowledge of *Microsoft Project*.

The organizations represented the following industries: systems consulting, manufacturing, retail, government, healthcare, energy, and transportation. The administration of the study took place at the participants' workplaces over their lunch hour, and the authors provided lunch for the participants following the completion of the exercise. The participants reported an average of 5.7 years of project management experience (range 1 to 20 years) and an average of 10.0 years of experience in the field of information systems (range 0 to 30 years). The two individuals who indicated they had no experience in information systems had 2 and 9 years of project management experience, respectively, and perhaps were considering their work experience to be more associated with the industry their company was in, e.g., healthcare or retail. They did have the requisite knowledge—project management and *Microsoft Project*—to participate in this study.

The project managers reported that in the previous three years, they had worked on a larger number of projects of a smaller duration—six months or less, averaging 23.5 projects in this category, than projects lasting more than six months (6.4 projects). However, the project managers reported that they spent relatively more *time* working on those projects with a duration of more than six months. Twenty-four of the participants reported having received formal training on the use of *Microsoft Project*, averaging 12.25 hours. On average, the participants used *Microsoft Project* 3.75 hours per week, and had used the tool for an average of 17.2 months. The participants were asked to complete Rowe's Decision Style Inventory (DSI), followed by a survey of demographic information, and were then asked to complete a series of four separate tasks from one case scenario. The DSI consists of twenty "sentence beginnings," each of which requires an individual to rank four possible "sentence endings" ranging from most preferred to least preferred. For example:

My prime objective is to:

- have a position with status
- be the best in my field
- achieve recognition for my work
- feel secure in my job (Rowe & Mason, 1987).

As with any cognitive style instrument, the validity of the instrument itself must be considered. The DSI has undergone extensive validity tests: split-half reliability testing; test-retest reliability; item analysis of the instrument; correlation with other test instruments such as the Myers-Briggs Type Indicator, the Wilkins Embedded Figures Test, the Kolb Learning Style Inventory, and the Hermann Brain Dominance Instrument. Additionally, face validity was assessed based on over 1,000 personal interviews and observations in longitudinal studies that yielded over 90 percent subject agreement with the findings (Rowe & Mason, 1987). The conclusion is that the DSI is a valid instrument for measuring decision style.

The DSI is designed to identify four specific decision styles, as explained in the literature review section. These styles identify the propensity towards a directive, analytical, conceptual, or behavioral approach to decision making. The DSI is also designed to measure the *relative* propensity of an individual toward each of these styles. For each style, the propensity is found to be very dominant, dominant, backup, or least. A very dominant score indicates that an individual would use this style almost exclusively in most situations, a dominant score indicates a style that is used frequently, a backup style is one that could be used when the occasion demanded, and a style that is least preferred is seldom used. Consistent with prior research (Shackleton et al., 1990), if the participants were identified as possessing two dominant styles, they were classified using their most dominant style as measured by the difference between their dominant score and the normative mean. Using this technique, ten participants were identified as preferring a directive decision style, sixteen an analytical style, ten a conceptual style, and sixteen a behavioral style.

The hands-on aspect of the study consisted of a single case scenario of a project developed by Wysocki et al. (1995). The scenario consisted of four individual steps that the participants had to complete using *Microsoft Project*. The participants used personal computers available at their workplace, generally in a training room equipped with similar configurations. The configurations (processor speed, operating system) were relatively homogeneous among the organizations. The first step was to create an initial project plan on *Microsoft Project*, based on information provided in the case scenario. Measures for this step included how much time (in seconds) was needed by each participant to complete the plan and the accuracy or completeness of the plan as determined by the number of correct/incorrect items on the project plan. These items could be tasks, durations, dependencies, or resources. Accuracy was assessed by comparing the participants' solutions to the solution provided by the authors of the case study. The second step was to examine the same project, further into the development, and answer six

Pearson Correlation Significance N	Time Required to Complete Project Plan (in seconds)	Completeness of Initial Project Plan (# missed)	Variances in Project Plan (# correct)	Scope Change in Project Plan (# correct)	Change of End Date in Project Plan (# correct)
Time Required to Complete Project Plan (in seconds)		*.477 **** *.000* *52*	*-.150* *.152* *49*	*-.284 ** *.026* *47*	*-.066* *.337* *43*
Completeness of Initial Project Plan (# missed)			*-.098* *.251* *49*	*-.274 ** *.031* *47*	*.184* *.119* *.43*
Variances in Project Plan (# correct)				*.422 *** *.002* *46*	*.250 ** *.053* *.43*
Scope Change in Project Plan (# correct)					*.052* *.370* *43*
Change of End Date in Project Plan (# correct)					

***p<.001; **p<.01; *p<.10

Table 2. Correlation Among Results

yes/no questions regarding variances that had occurred from the baseline plan, using a prepared data file in *Microsoft Project*. The third step required the participants to examine the same project, still further into the development, and determine what effect adding an additional report (a change of scope) had on the project, again by answering five yes/no questions and a prepared data file in *Project*. The fourth step required the participants to examine the project, again further into the development effort, and answer four yes/no questions regarding the effect that moving the project deadline up seven days (a change of end date) had on the entire project, once again using a prepared data file in *Project*. Performance on steps two, three, and four were evaluated by determining the correct number of responses to the yes/no questions. Examples of the yes/no questions included "Has the project end date slipped?", "Has there been an increase in the total number of person days for this activity?", and "Has an over-scheduling problem developed?"

The authors of the case scenario provided the correct answers to the yes/no questions, and the participants' responses were evaluated accordingly.

Examination of the results of the study was made using ANOVA, comparing dominant or very dominant decision styles with performance on each step.

The Results

We began the analysis with an examination of correlations among the dependent variables, as shown in Table 2.

"Time required to complete the project plan" and "Number of items missed on the project plan" were significantly and positively correlated – the more time spent using the tool (which will subsequently be shown to be characteristic of the less structured decision makers), the more mistakes were made. Both of these results from step 1 were negatively correlated, in several instances significantly, with the results from steps 2, 3, and 4, with only one exception. This was expected, as the measures for step 1 were assessed as *incorrect* items, whereas the measures for steps 2, 3, and 4 were assessed as *correct* items. The one exception was between the number incorrect on the initial project plan and the number correct on the change of end date (step 4).

A MANOVA was then performed examining the five dependent variables and decision style as the factor. Decision Style was shown to be significantly related to the time required to complete the initial project plan (F=6.417, p=.001), but not the other dependent variables. However, this indicates that the data were worthy of further analysis.

Table 3 presents the detailed analysis of these results, comparing the means by decision style for each performance measure, as well as the results of the ANOVA analyses.

Performance Measure	Means standard deviation n					F test p value eta2† (Comparing directive, analytical, conceptual, and behavioral decision styles)	F test p value eta2 (Comparing directive + analytical versus conceptual + behavioral)
	Directive	Analytical	Conceptual	Behavioral	Total		
Time Required to Complete Project Plan (mm:ss)	13:19.10 5:28.26 10	13:32.31 5:57.46 16	16:03.30 4:28.77 10	22:48.44 6:47.74 16	16:49.92 7:04.21 52	8.351*** p=.000 η^2 =.343	15.170*** p=.000 η^2 =.233
Completeness of Initial Project Plan (# missed)	1.30 1.83 10	.94 .1.06 16	2.50 3.21 10	3.94 5.50 16	2.23 3.64 52	2.235* p=.096 η^2 =.123	5.712* p=.021 η^2 =.103
Variances in a Project Plan (# correct of 6)	3.50 .97 10	3.08 .1.32 13	2.60 1.26 10	2.81 1.28 16	2.98 1.23 49	1.037 p=.385 η^2 =.065	2.318 p=.135 η^2 =.047
Scope Change in a Project Plan (# correct of 5)	3.50 1.08 10	3.69 .95 13	3.22 1.92 9	3.13 1.19 15	3.38 1.26 47	.518 p=.672 η^2 =.035	1.458 p=.234 η^2 =.031
Change of End Date in a Project Plan (# correct of 4)	2.60 .97 10	2.83 1.03 12	2.28 .76 7	3.00 .78 14	2.74 .90 43	1.111 p=.356 η^2 =.079	.015 p=.902 η^2 =.000

***p<.001; **p<.01; *p<.10 †eta^2 >.14 = large, eta^2 >.06 = medium, eta^2 >.01 = small

Table 3. Analysis of Results

The first measure of performance was with respect to the time required to complete an initial project plan, in seconds, and this measure was examined in relationship to the participants' decision styles. As indicated in Table 3, the participants possessing a dominant directive style completed the initial project plan the fastest, followed by the analytical, conceptual, and behavioral styles. ANOVA indicated a significant difference (F = 8.351, p = .000) among the decision styles, and thus the null hypothesis is rejected as is pertains to this performance measure. Additionally, an η^2 of .343 indicated that a large portion of the variance is explained by an individual's decision style. Subsequent Tukey-B and Duncan Multiple Range tests indicated, however, that the significance lay only between the behavioral styles and the other three styles at the .05 level of significance. (The Duncan Multiple Range Test examines differences in the means between individual groups once a significant difference among all groups is identified using ANOVA, similar to the Tukey test. The Duncan test is considered less conservative and more powerful than the Tukey test.)

The second measure of performance addressed the accuracy or completeness of this initial project plan, in terms of the number of items incorrect or missing on the plan. As indicated in Table 3, a definite pattern emerged once again, in that the participants with either a dominant directive or analytical decision style clearly achieved a higher level than participants possessing either a dominant conceptual or behavioral decision style. ANOVA was used to test the null hypothesis predicting no difference between the groups with respect to the accuracy and completeness of the initial project plan. An F value of 2.235 (p = .096) indicated that this relationship is significant at a .10 level of significance, and thus the null hypothesis is also rejected as it pertains to this performance measure. An η^2 of .123 indicated that a moderate to large portion of the variance is due to the effect of an individual's decision style. A subsequent Duncan Multiple Range Test revealed that at a .10 level of significance, there are two groups of participants, one comprising the directive and analytical styles, and the other comprising the conceptual and behavioral styles.

The third measure of performance was addressed by examining the responses to a series of yes/no questions regarding variances that had occurred in the project plan, further into the project. This measure was assessed in terms of the number of correct responses to six yes/no questions. As Table 3 indicates, once again, a pattern appears wherein participants possessing either a dominant directive or analytical decision style scored better than participants possessing either a dominant conceptual or behavioral decision style. ANOVA was again used to test the significance of this pattern. An F value of 1.037 (p = .385) indicated that this relationship is not significant, however, and thus the null hypothesis failed to be rejected as it relates to the relationship between the correctness of responses to questions concerning variances and the decision style of the project managers.

The fourth measure of performance addressed the accuracy of responses to questions regarding a change of scope in the project plan. This measure was assessed in terms of the number of correct responses to five yes/no questions. Again, as indicated in Table 3, a pattern appears showing that project managers possessing either a dominant directive or analytical decision style scored better than project managers possessing either a dominant conceptual or behavioral decision style. ANOVA was used to test the null hypothesis as it pertains to the relationship between the correctness of responses to questions concerning a change in scope, and the decision style of the participants. An F value of .518 (p = .672) indicated that this relationship is not significant, however, and thus this null hypothesis failed to be rejected in this regard.

The final measure of performance examined the accuracy of responses to questions regarding the effect that a change of end date has on a project plan, again when relying upon a computerized project management tool for aiding in the decisions. This measure was assessed by examining the responses to four yes/no questions concerning this issue.

Referring to Table 3, it is interesting to note that for this task, the overall pattern seen previously did not hold. Participants possessing either a dominant directive or analytical decision style still achieved a better score than participants possessing a dominant conceptual decision style, but participants possessing a behavioral decision style achieved the best score of all participants. Once again, ANOVA was used to test the null hypothesis as it pertained to the relationship between the correctness of responses to questions concerning a change of end date and the participant's decision style. An F value of 1.111 (p = .356) indicated that this relationship was not significant, and thus the null hypothesis also failed to be rejected as it pertains to this performance measure.

Because of the recurring pattern in all but the final performance measure, and due to the similar nature of certain aspects of directive and analytical styles as opposed to conceptual and behavioral styles, a subsequent post-hoc analysis was performed analyzing the result of combining the participants into these two groups. Directive and analytical decision styles both prefer a structured, analytical approach to decision making, whereas conceptual and behavioral decision styles prefer a much less structured approach. By examining a combined, 2-style dichotomy, it was postulated that the results might be stronger than by examining each group compared to the other three. An initial MANOVA was performed using this new grouping as the factor. Significance was seen with respect to two dependent variables – time required to complete the initial plan (F=12.593, p = .001) and correctness of the initial plan (F=3.389, p=.073), and ANOVA was performed to examine these relationships more closely. Table 3 also provides the results of ANOVAs run for each of the performance measures described above. As indicated in the table, this new grouping did generate strong, more significant results for the first four measures. On the second task – an examination of the variance in a project plan, when two outliers were removed (identified via a Boxplot analysis), one a perfect score and the other a score of 0 correct, additional statistical significance was seen (F=3.123, p=.084) using an alpha of .10. Thus, when considering two groups of participants based on similarities in their decision style and predicted used of a decision tool, the hypothesis is supported for three of the five measures.

For the last two hypothesis tests that failed to find significance, a power analysis was performed to determine the likelihood of a Type II error. The analysis was determined based on the combined directive/analytical versus conceptual/behavioral groupings. For the third measure – evaluation of the effect of scope changes in the project, this analysis resulted in a .69 probability that the null hypothesis was appropriately rejected. For the fourth measure – evaluation of the effect of a change in end date, the probability was only .06 – indicating strongly that rejecting the hypothesis is not the correct course of action; rather that a much larger sample size is necessary to clearly examine this measure. This quite likely is, in part, due to the atypical high performance on this measure of those project managers possessing a behavioral decision style.

For this combined grouping of decision styles, the results of η^2 indicated a lesser portion of variance attributed to decision style, yet the results were still

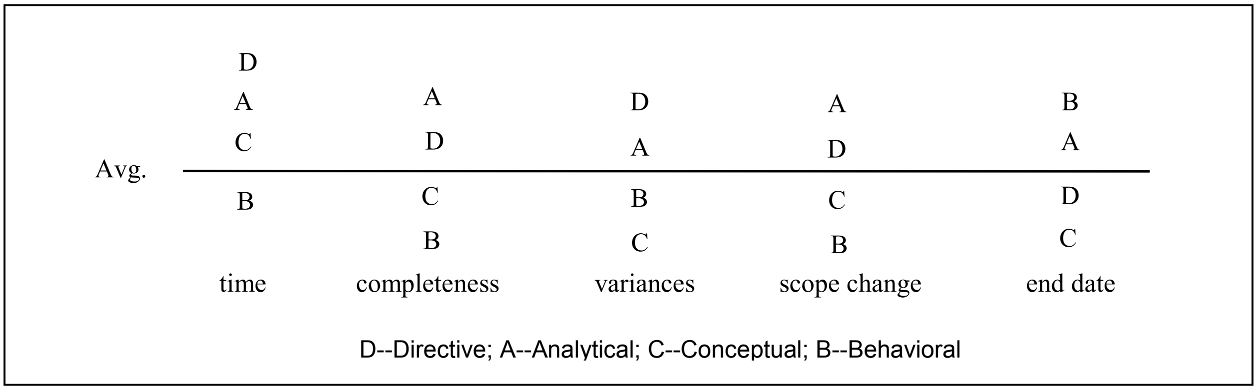


Figure 2. Task Score Comparison by Decision Style

large for time required (η^2 =.233) and completeness of the project plan (η^2 =.103), but were small for the interpretation of the effect of variance (η^2 =.047) and scope changes (η^2 =.031).

In summary, although a recurring pattern (with the exception of the final task) indicated differences between decision styles, particularly with respect to the directive and analytical decision styles versus the conceptual and behavioral decision styles, these relationships were not all significant. Significance was found only with respect to the time required to complete the initial project plan using *Microsoft Project*, the completeness or accuracy of this plan, and, when considering the two combined groups, an examination of the variances in the plan.

Discussion, Limitations, and Recommendations

Discussion

Figuratively speaking, *right*-handed decision makers are often presented with a situation where they are forced to use a pair of *left*-handed scissors. They can complete the task, but with considerably more effort than would be required if they were using a tool better suited to the way they prefer to work. The purpose of this study was to discover if a project manager's decision style impacts the use made of a computerized project management tool. The results indicated that decision style does, in fact, significantly influence both the time required to complete an initial project plan as well as the accuracy or completeness of that plan, and subsequently examining the effect of variances in the plan using *Microsoft Project*. The results also indicated an interesting pattern among decision styles across all tasks performed: first creating the initial project plan, and next responding to questions concerning variances that had occurred in the project, a scope change in the project, and a change of end date in the project. Figure 2 presents a depiction of this pattern, comparing relative scores with the average score.

For each measure, the relative position of each decision style indicates how that style performed in relation to the other styles, but does not reflect an absolute number. With regard to the measure of time, higher positions reflect faster performance. With regard to completeness, higher positions reflect fewer errors made while completing an initial project plan. With respect to variances, scope change, and end date, higher rankings indicate a larger number of correct responses to questions regarding these issues. It is clear that, based on mean performance scores, the directive (D) and analytical (A) styles consistently scored better than both the mean score and the conceptual (C) and behavioral (B) styles in all but the final task. The conceptual style did attain a score above the mean once with regard to the time required to complete the initial project plan, but again remained below both the analytical and directive styles. A t-test revealed that the conceptual style for this step was not significantly different from the mean (t = .-.549, p = .597).

Limitations

There are a number of limitations of this research which need to be considered when examining the results. One limitation concerns the selection of only one computerized project management tool used in the study—*Microsoft Project*. However, as mentioned earlier, this tool is by far the most popular on the market today, and thus, the concern for the generalizability of the results regarding this limitation is minimal.

A second possible limitation was in the choice of performing an empirical laboratory study to collect the data. Empirical laboratory studies provide a good opportunity to control extraneous variables and allow the closer examination of the variables of interest.

However, this element of control also reduces the generalizability of the results due to the creation of a less than realistic environment. In this study, however, care was taken to create a situation as similar as possible to what the participants would encounter in a normal working environment:

- only the most popular project management tool was used,
- the participants were actual project managers from industry who possessed a working knowledge of the project management tool,
- the study was conducted on-site at the project manager's place of employment, and
- the case scenario involved common situations frequently encountered by project managers.

Thus, the concerns associated with this limitation should also be greatly reduced.

Lastly, a limitation is seen with respect to the number of individuals who participated in the study. A larger group of participants could generate more significant results with respect to differences in decision style as it relates to the use of a project management tool, assuming that the overall pattern seen in the results of the study holds.

Recommendations for Further Research

The particular focus of this research can and should be extended in a number of ways, both within the realm of project management and beyond to encompass more general types of decision-aiding tools.

First, this same research context should be extended to a larger group of project managers for the purpose of determining if the pattern that became evident through this study is, indeed, statistically significant. Significant results within this framework should encourage designers of project management tools to begin examining the needs of individuals possessing decision styles not necessarily congruent to the structured, task-oriented approaches offered by today's tools. Individuals possessing dominant behavioral and conceptual decision styles could, quite possibly, be better supported with tools offering a less structured, more intuitive approach. For example, because individuals possessing a dominant behavioral decision style prefer oral communication to written communication, an interface combining audio input and output and other audio prompts and indicators, as well as touch screen capabilities, could perhaps better support their approach to decision making. Similarly, individuals with dominant conceptual decision styles could perhaps respond more appropriately to interfaces that offer multiple, graphical methods of input using touch screens, such as the ability to create Gantt charts directly using slider bars rather than requiring structured textual input which is then used to display the resulting chart. The potential for interface designs which support multiple cognitive styles is broad and fascinating. The recognition of the need for multiple interface approaches is the first step. Further research should attempt to explore alternative interface designs, in proposed conjunction with an individual's cognitive style, and evaluate performance when style is truly matched with an appropriate interface.

The framework for this research assumed, but did not test, that using an appropriate project management tool would enhance the overall effectiveness of a project manager. Further research is needed to verify this relationship. Considering the current context, one approach would be to survey project managers possessing only dominant directive or analytical decision styles (as these are the only styles presumably supported by current project management tools) and ask them to report on the success or failure of various projects they had managed where a project management tool was used significantly. Certainly, additional variables would need to be examined and controlled for, but this would help extend the framework presented in this study.

Beyond the realm of project management lies a concern that more general decision-aiding tools are not designed to support the individual styles of managers and their approach to problem solving and decision making. Spreadsheets, for example, are quite structured in their nature and use. It is entirely possible that these generalized, structured tools are not providing the appropriate fit between style and task that Rowe and Mason (1987) described. Research into this area can help identify if new decision-aiding tools are needed that more appropriately support an individual's style of decision making, and if so, to explore desirable formats for these new tools.

It is evident from this research that differences in decision style influence the use made of a decision-aiding tool, in this particular case a project management tool. Further research in this area will aid in shifting the focus away from developing software tools for a general population and towards an approach where decision-aiding tools are actually developed to support the individual making the decision.

Conclusion

This study has helped to identify that there is a statistically significant difference among decision styles with regard to both the time required to complete a project plan and the accuracy and completeness of this plan when using the project management tool, *Microsoft Project*. When combining the four decision styles into two, similar groups – directive and analytical versus conceptual and behavioral, further statistical significance is identified with respect to additional use made of the tool. The study indicated that there may be a more widespread pattern of differences among decision styles with respect to further use made of a project management tool. Additional research using larger groups of participants is needed to determine if these patterns are statistically significant.

Although not a panacea in and of themselves, project management tools are a necessary and vital component contributing to successful project management. Because successful software development projects depend on effective project management, and project managers depend on an appropriate set of tools that support their work, we must determine just what is an "appropriate" set of tools. Unless decision makers are provided with tools that support their preferred style of decision making, they will continue to struggle needlessly to reach their fullest performance and personal satisfaction potential.

References

Benbasat, I. and Taylor, R.N. (1978). "The Impact of Cognitive Styles on Information System Design," *MIS Quarterly*, Vol. 2, No. 2, pp. 43-54.

Bicknell, D. (1995). "The Politics of Failure," *Computer Weekly*, July 6, pp. 28-29.

Bowman, S.Y. (1992). "Decision-Making Styles of a Medical Center's Management Group: A Case Study," *Hospital Topics*, Vol. 70, No. 3, pp. 25-29.

Bozman, J.S. (1994). "DMV Disaster," *Computerworld*, Vol. 28, No. 19, p.16.

Brown, K.A. and Hyer, N.L. (2002). "Whole-Brain Thinking for Project Management," *Business Horizons*, Vol. 45, No. 3, pp. 47-57.

Brown, S.L., and Eisenhardt, K.M. (1995). "Product Development: Past Research, Present Findings, and Future Directions," *Academy of Management Review*, Vol. 20, No. 2, pp. 343-378.

Davis, D.L., Davis, R.D. and Shrode, W.S. (1987). "Decision Support Systems (DSS) Design for Operations Managers: An Empirical Study of the Impact of Report Design and Decision Style on Effective Choice," *Journal of Operations Management*, Vol. 7, No. 1, pp. 47-62.

Fox, P. (2002). "Tapping the Right Tools," *Computerworld*, Vol. 36, No. 17, p. 43.

Fox, T.L. (2000). "Do the Features Support the Functions?" *PM Network*, Vol. 14, No. 3, pp. 69-73.

Fox, T.L. and Spence, J.W. (1999). "An Examination of the Decision Styles of Project Managers: Evidence of Significant Diversity," *Information and Management*, Vol.36, No. 6, pp. 313-320.

Fox, T.L. and Spence, J.W. (1998). "Tools of the Trade: A Survey of Project Management Tools," *Project Management Journal*, Vol. 29, No. 3, pp. 20-27.

Gelbard, R., Pliskin, N., and Spiegler, I. (2002). "Integrating System Analysis and Project Management Tools," *International Journal of Project Management*, Vol. 20, No. 6, pp. 461-468.

Gibbons, P. (1997). "Knowing when to Abandon the Ship," *PC Week*, Vol. 14, No. 10, pp. 15-16.

Globerson, S. and Zwikael, O. (2002). "The Impact of the Project Manager on the Project Management Process," *Project Management Journal*, Vol. 33, No. 3, pp. 58-64.

Hauschildt, J., Keim, G. and Medcof, J.W. (2000). "Realistic Criteria for Project Manager Selection and Development," *Project Management Journal*, Vol. 31, No. 3, pp. 23-32.

Huber, G.P. (1983). "Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing?," *Management Science*, Vol. 29, No. 5, pp. 567-579.

King, J. (1997). "Project Management Ills Cost Businesses Plenty: Poor Planning Kills Projects, Pushes Costs Up," *Computerworld*, Vol. 31, No. 38, p. 6.

Kirsch, L.J. (1997). "Portfolios of Control Modes and IS Project Management," *Information Systems Research*, Vol. 8, No. 3, pp. 215-239.

Leonard, N.H., Scholl, R.W. and Kowalski, K.B. (1999). "Information Processing Style and Decision Making," *Journal of Organizational Behavior*, Vol. 20, No. 3, pp. 407-420.

Levine, H.A. (1995). "Innovators? Or Tripping Over Their Egos? Winners and Losers in the PM Software Industry," *PM Network*, Vol. 9, No. 7, pp. 22-25.

Lucas, H.C. (1973). "A Descriptive Model of Information Systems in the Context of the Organization," Proceeding of the Wharton Conference on Research on Computers in Organizations, in *Data Base*, Vol. 5, No. 2, pp. 27-39.

Mantel, S.J., Jr., Meredith, J.R., Shafer, S.M. and Sutton, M.M. (2001). *Project Management in Practice*, New York: Wiley.

Mason, R.O. and Mitroff, I.I. (1973). "A Program for Research on Management Information Systems," *Management Science*, Vol. 19, No. 5, pp. 475-487.

Mintzberg, H. (1976). "Planning on the Left Side and Managing on the Right," *Harvard Business Review*, Vol. 54, No. 4, pp. 49-58.

Moussavi, F., Evans, D.A. and Shia, S. (1995). "Explaining Strategic Managers' Choice of Decision Tools: Cognitive Style-Representation Method Compatibility," *International Journal of Management*, Vol.12, No. 3, pp.305-314.

Nidumolu, S. (1995). "The Effect of Coordination and Uncertainty on Software Project Performance: Residual Performance Risk as an Intervening Variable," *Information Systems Research*, Vol. 6, No. 3, pp.191-219.

Parker, R. (2002). "Poor IT Purchase Planning 'Wastes $500bn Worldwide'," *Supply Management*, Vol. 7, No. 8, p. 11.

Purvis, R.L. and McCray, G.E. (1999). "Project Assessment: A Tool for Improving Project Management," *Information Systems Management*, Vol. 16, No.1, pp. 55-60.

Rao, H., Jacob, V., Lin, F., Robey, D., and Huber, G. (1992). "Hemispheric Specialization, Cognitive Differences and Their Implications for the Design of Decision Support Systems: Responses," *MIS Quarterly*, Vol. 16, No. 2, pp. 145-154.

Robey, D. (1983). "Cognitive Style and DSS Design: A Comment on Huber's Paper," *Management Science*, Vol. 29, No. 5, pp.580-582.

Rook, P. (1986). "Controlling Software Projects," *Software Engineering Journal*, Vol.1, No.1, pp. 7-16.

Rowe, A.J. and Mason, R.O. (1987). *Managing with Style,* San Francisco: Jossey-Bass.

Rowe, A.J. and Mason, R.O. (1988). "What's Your Decision Style?," *Working Woman*, Vol. 13, No. 12, pp. 28-35.

Shackleton, D., Pitt, L. and Marks, A.S. (1990). "Managerial Decision Style and Machiavellianism: A Comparative Study," *Journal of Managerial Psychology*, Vol. 5, No. 1, pp. 9-16.

Shenhar, A.J. and Laufer, A. (1995). "Integrating Product and Project Management - A New Synergistic Approach," *Engineering Management Journal*, Vol. 7, No. 3, pp. 11-15.

Shiflett, S.C. (1989). "Validity Evidence for the Myers-Briggs Type Indicator as a Measure of Hemisphere Dominance," *Educational and Scientific Measurement*. Vol. 49, No. 3, pp. 741-745.

Smith, J. (2002). "Is Project Management Software Right for You?," *Plant Engineering*, Vol. 56, No. 6, pp. 36-38.

Sodan, A.C. (1998). "Yin and Yang in Computer Science," *Communications of the ACM*, Vol. 41, No. 4, pp. 103-112.

Sprague, R.H., Jr. (1980). "A Framework for the Development of Decision Support Systems," *MIS Quarterly*, Vol. 4, No. 4, pp. 1-26.

Springer, S.P. and Deutsch, G. (1997). *Left brain, right brain: Perspectives from cognitive neuroscience,* 5th Edition, New York: W.H. Freeman.

Swink, M. (2002). "Product Development—Faster, On-Time," *Research Technology Management*, Vol. 45, No. 4, pp. 50-58.

Vessey, I. and Galletta, D. (1991). "Cognitive Fit: An Empirical Study of Information Acquisition," *Information Systems Research*, Vol. 2, No. 1, pp. 63-84.

Vessey, I. and Glass, R. (1994). "Application-based Methodologies," *Information Systems Management*, Vol. 11, No. 4, pp. 53-57.

Vernon, P. (1984). "Intelligence, Cognitive Styles, and Brain Lateralization" *International Journal of Psychology,* Vol. 19, pp. 435-455.

Ware, R. (1991). "Project Management Software: Project Panacea?," *Journal of Information Systems Management*, Vol. 8, No. 1, pp.79-83.

Webster, G. (1994). "Whole-Brain Project Management for All," *Industrial and Commercial Training*, Vol. 26, No. 11, pp. 22-31.

Wilder, C. and Davis, B. (1998). "False Starts, Strong Finishes," *InformationWeek*, No. 711, pp. 41-53.

Wingrove, A. (1986). "The Problems of Managing Software Projects," *Software Engineering Journal*, Vol.1, No. 1, pp. 3-6.

Wysocki, R.K., Beck, R. Jr., and Crane, D.B. (1995). *Effective Project Management: How to Plan, Manage and Deliver Projects on Time and Within Budget,* New York: John Wiley and Sons.

Zmud, R.W. (1980). "Management of Large Software Development Efforts," *MIS Quarterly*, Vol. 4, No. 2, pp. 45-55.

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