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Examining the Impact of Cognitive Complexity on Project Integration Performance of Project Leaders

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Introduction

Literature Review

The importance of project leadership to software project success has been well documented in MIS literature (Nidumolu, 1995; Phan et al., 1995; Frame, 1995). In a field survey of information systems professionals, Phan et al. (1995) found that project coordination and communication, and good project leaders ranked third and fourth respectively in a list of thirteen factors necessary for project success.

Lederer and Prasad (1995) examined large projects in 120 companies, where 63% overran initial cost and/or schedule estimates. For these projects, the researchers found that project management and control issues were most highly correlated with the organization's percentage of inaccurate estimates

Given then that project leadership is essential to project success, what are the key aspects of project leadership that make a project leader effective? Saarinen (1990), identified one important aspect of project management as 'internal integration', defined as "making a project team an integrated unit" (pg. 184). In looking at factors that impact project success, Saarinen found that in instances where project success was considered low, internal integration was low.

Frame (1995) examined the issue of project team efficiency, one of three factors he identifies as necessary for project success. Frame identifies a key role of project leadership, systems integration, as necessary for enhancing team efficiency

Rappaport (1995) defines systems integration as "the bringing together of the skills and tools necessary to solve a business problem". Frame (1995) emphasizes the need for a systems integrator to carefully define the 'parts' such that they will successfully integrate into a 'whole'. Thus an effective systems integrator must possess the abilities to decompose a problem into several dimensions, and subsequently integrate the dimensions for a total solution. Decomposition and integration are key aspects of the cognitive complexity theory (Schroder et al., 1967).

Cognitive complexity is a well-known theory for studying humans as information processors. This perspective states that there are differences in individuals' ability to differentiate and integrate parts of information stimuli (Schroder et al., 1967). Cognitive differentiation is the individual's ability to dissect information into smaller units.

Integration is the ability to combine smaller units of information into a whole unit. The nature and extent of integrating information is often deemed as the more important component of cognitive complexity (Stabell, 1978).

Cognitive complexity has been linked to improved performance in many contexts (Khalil and Clark, 1989; Walsh, 1995; Bartunek et al., 1983). In studying computer programmers, Khalil and Clark (1989) found that programmers with higher levels of cognitive complexity were better able to comprehend and subsequently modify computer programs. In the management literature, Miller (1993) observes that over time and with experience, most managers tend to become more narrow and 'simplistic' in their thinking. He argues for the development and encouragement of more 'complex' thinking in managers in order to ensure the very survival of organizations. Bartunek et al. (1983) also encourages 'complicated understanding' in managers, especially in complex tasks, as a way to ensure more effective managers. Effective managers were described as those with more accurate perceptions and more complete syntheses of information.

Cognitive complexity theory would appear to sufficiently describe the mental processes required for successful systems integration capabilities. Further, the impacts of cognitive complexity have been found to be greater for problem situations that are more complex (Schroder et al., 1967). Because the term systems integration has also been used in engineering and computer science disciplines to reflect the integration of hardware and system software components, we have adopted the term "project integration" for this research. Thus, the following proposition is offered:

Proposition 1: For projects that are of high complexity, as individual levels of cognitive complexity increase, performance on project integration tasks will increase

Proposition 2: For projects that are of lower complexity, there will be no significant difference in performance on project integration tasks between high and low cognitively complex individuals.

Research Method

The study will use a repeated measures experimental design to test the research proposition. The independent variables are subject's cognitive complexity (high, medium, or low), and project complexity (high or low). Because cognitive complexity is a subject variable, it is measured but not manipulated in the experiment. Cognitive complexity will be measured using two methods: Bieri's modified role construct repertory (REP) test (Bieri et al., 1966), and Schroder et al.'s paragraph completion test (PCT) (Schroder et al., 1967). The five measures of project integration performance will be scored by the researcher and an experienced industry project manager evaluating subjects' solutions to the project assignments.

Subjects for this pilot will be local industry IS professionals with and without project management experience. Each subject will receive two project scenarios, one of high complexity, and another of low complexity. For each of the projects, the subject will be asked to present a strategy (i.e. a plan or approach) for completing the project through an assigned team. The order of project presentation to the subjects will be randomly assigned. The dependent variables of interest are aspects of project integration performance including (1) problem decomposition into tasks, (2) task assignments, (3) planning, (4) managing team communication flow, (5) and quality assurance.

Table 1 summarizes the planned instrument validation process. The research hypotheses will be tested using the Multivariate Analysis of Covariance (MANCOVA) statistical technique.

Conclusion

This paper presents cognitive complexity theory as a basis for understanding project integration skills in software project leadership. For MIS practitioners, establishment of the link between cognitive complexity and project leadership performance should encourage MIS managers to actively seek ways to improve levels of cognitive complexity of their project leaders. Bartunek and Louis (1988) suggest ways to develop the capacity to think more "complexly", including training of leaders to view problems from different perspectives, to consider a variety of responses to problems, and to be cognitively flexible in the implementation of strategies. This research contributes to MIS research through a more detailed understanding of how individual differences contribute to effectiveness of project leaders. Continued research to improve the management of software development should ultimately improve the quality of MIS solutions.

Measures	**Test**	**Content Validity**	**Construct Validity**	**Reliability**
Cognitive Complexity-REP	Test-Retest Correlation with PCT		X	X
Cognitive Complexity--PCT	Interrater Agreement Correlation with REP		X	X
Project Integration Performance Variables	Interrater Agreement Literature Review IS Practitioner Review	X X		X

Table 1. Summary of Planned Measure Validations

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