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# Understanding the Effects of a Paradigm Shift: The Case of Object-Oriented Technology

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## ABSTRACT

Object-oriented technology has been around for over thirty years and offers some significant improvements over structured techniques and procedural languages. It has seen very slow growth in business applications, but is expected to grow at such a rate as to nearly replace those systems now being used at some point in the near future. It represents a paradigm shift that is difficult to master for both novice and experienced IS personnel. Radical changes, such as OO, force changes in the thought and work processes of workers and generally wreaks havoc in the workplace. Using the organizational psychology theory of Person-Environment fit, this study proposes a model to explain the behavioral performance and the amount of stress felt by a person in their workplace when undergoing a paradigm shift. The shift to OO is used as the test case for the model.

## INTRODUCTION

As the demand for larger and more complex computer systems grows, IS professionals have recognized that the need exists for better tools and techniques to shorten development time and improve software quality (Weinberg, Guimaraes and Heath, 1990). Although many of the traditional structured techniques have helped to improve the ability of developers to meet demand, there is still a major shortfall of output which some have called the software crisis (Pressman, 1997). It is believed that object-oriented (OO) technology can provide solutions to these problems (Smith and McKeen, 1996). Specifically, OO technology can allow for greater flexibility and ease of modification, support increasingly complex systems, provide a user-friendly interface, and improve productivity. Yet with all these advantages, OO technology has been slow to be fully accepted in the business environment. The reasons for this slow acceptance are problematic and the subject of this research. The purpose here is to investigate the relationships of workers and their environment in the midst of radical changes (paradigm shift) in order to build a general model of performance. The study uses the transition to OO technology as the application to build this model because it represents a paradigm shift within the information technology discipline and because it has been slow to be accepted.

## THE RESEARCH

Object-oriented technology represents a paradigm shift—a major departure in systems development and implementation from the way things were done previously (Fayad, et al., 1996). One way to speed the transition to this new technology is to identify those individuals who can more easily adjust to that shift. The characteristics of people who might do this are related both to their own cognitive and personal traits and to their perceptions of the environment in which they work. Once a firm has made the decision to make this transition, the identification of such people would provide a valuable tool in the transition. It would enhance their management of the transition by providing some direction as to how to go about it. That is—identify the right person or team to lead you through the transition and succeed, or conversely, fail to find those who can make this paradigm shift and lead others to understand it, and the company risks failure.

The purpose of this research is to build a theoretical model that explains the performance of individuals who must make a radical transition (i.e., paradigm shift) in the execution of tasks associated with their jobs. The model includes elements of individual traits and environmental characteristics. The research question posed by this study is: how can we identify the right people to make the most successful transition when a paradigm shift is required? The model is based on theories found in social and organizational psychology.

To help build this model, this study uses the specific area of object-oriented programming. This area is considered representative and a good test bed for this model for the following reasons:

- 1) Most systems today are written in procedural languages. Fully 80% of business systems in use today are written in COBOL (Doke and Hardgrave, 1998). Because of this, most business system programmers learn procedural techniques first and must transition to OO at a later time.
- 2) The transition to OO is a difficult one that requires a paradigm shift (Van der Salm, 1998).
- 3) Domain knowledge during the transition does not help until the technical knowledge is mastered and may better be provided by domain experts who have little technical knowledge (Fayad et al, 1996, van

der Salm, 1998). Domain knowledge refers to what is known about a specific business situation. Although studies have linked domain knowledge to certain behaviors that enhance a designer's ability to form adequate abstract mental models and therefore improve system design (Adelson and Soloway, 1988), much of this is based on previous experience with both the domain and the development methodologies (Vessey and Conger, 1995). When unfamiliar with the ways in which to apply a methodology, Vessey and Conger (1995) found that novice systems analysts have difficulty in forming a mental model of the system. It seems logical to extend this finding to programmers and to say that forming a mental model, especially one based on past experience, is crucial in successful system development, regardless of the phase within the life cycle (i.e., analysis, design or implementation).

- 4) Those who attempt the transition first become novices themselves and may take an extended period of time to complete the transition, and worse, about 25% of those who attempt the transition will not succeed (Jones, 1995).

This study requires a paradigm shift in the workplace. Once this change has taken place, the model then measures certain characteristics of the individual and the components of this required change so as to accurately gauge the degree of success expected as a person attempts to make this transition.

The model is based on theories that seem to converge in certain areas. The theory of work adjustment (Dawis and Lofquist, 1984), social cognitive theory (Bandura, 1982), the cost/benefit paradigm (Beach and Mitchell, 1978), the theory of reasoned action (Ajzen and Fishbein, 1980), adaption-innovation theory (Kirton, 1976) and job characteristics theory (Kulik, et al., 1982) all tend to overlap. Some have been used as the basis for person-environment fit models (cf. Puccio, et al., 1993)

Person-environment fit takes into account both individual traits and characteristics of the environment that directly affect the person involved in a changing paradigm. This research uses person-environment fit and extends it by investigating certain relationships not previously thought of to be significant. It also investigates the relationship of stress to performance as a mediating variable. Most person-environment fit models

address only the stress that results from a poor fit between person and environment. Those that have included performance as an outcome variable have not investigated the mediating relationship between fit, stress and performance (cf. Livingstone, et al., 1997). This model then builds on previous models by investigating these relationships and by applying the model to the specific area of people and organizations attempting to deal with radical change.

Person-environment fit models can be measured along two dimensions (Edwards and Harrison, 1993). The first dimension addresses the needs of the individual and the commensurate supplies available for him in the work environment. In this case, the person is the consumer and the environment is the supplier. This provides the first measure of fit. The second dimension reverses these roles by looking at the demands placed on the individual by the work environment and the commensurate abilities that a person has to meet those demands. This then provides the second measure of fit.

Adaption-innovation theory (Kirton, 1976) has been applied as the basis for models of person-environment fit (cf. Puccio, et al., 1994). This theory posits that people can be found on a bipolar continuum ranging from purely adaptive to purely innovative or somewhere in the middle. Each of the two personality types has certain traits that are opposite of each other. Adaptors prefer to work in structured environments, while innovators find structure to be an encumbrance to their problem solving or creative abilities (Kirton, 1994). Adaptors prefer to work within a single paradigm, while innovators prefer to work across paradigms (Kirton, 1994). These characteristics do not suggest that one group's ability in problem solving is better than another. In fact these cognitive styles are independent of cognitive capacity, success, cognitive techniques and coping behavior (Kirton, 1994). The degree of innovativeness can be used as an assessment for person-environment fit (cf. Livingstone, et al., 1997, Puccio, et al., 1993)

The ultimate use of the organizational behavior theories cited in this research is to explain, predict and sometimes alter behavior. The dependent variable in this model is performance. It is considered to be behavior reflected in individual action (Campbell, 1990). It is distinguished from effectiveness because effectiveness represents an outcome from a particular behavior, not the behavior itself. It is also distinguished from productivity as this is merely the ratio of input to output. The performance of the individual worker must also be relevant for the goals of the organization (Campbell, 1990).

Performance is a function of both individual characteristics and environmental conditions. These two sets of antecedents are found in the models of person-environment fit. This research seeks to measure the two dimensions of person-environment fit and use the goodness-of-fit indicators to explain the performance of

people involved in the transition to a new paradigm. In this case the application used to build the model is the transition to object-oriented technology. The proposed model is shown in Figure 1.

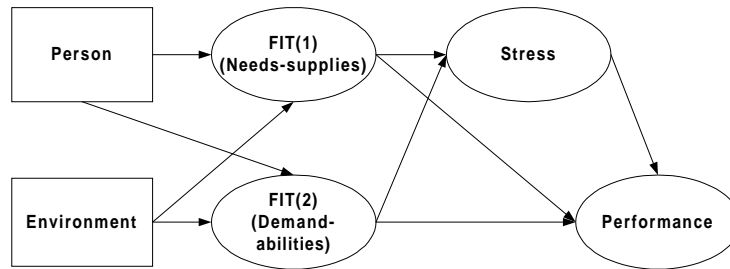
The propositions are developed from the model and describe the relationships among the variables contained within it. They are 1) the greater the goodness of fit between the needs-supplies form of person-environment fit, the less the stress and the greater the performance of the individual involved in a paradigm shift; 2) the greater the goodness of fit between the needs-supplies form of person-environment fit, the greater the performance of the individual involved in a paradigm shift; 3) the greater the goodness of fit between the demand-abilities form of person-environment fit, the less the stress and the greater the performance of the individual involved in a paradigm shift; and 4) the greater the goodness of fit between the demand-abilities form of person-environment fit, the greater the performance of the individual involved in a paradigm shift. These propositions have been stated in such a way as to reflect both the direct effects of fit on performance as well as the mediating effect of stress on performance.

## SUMMARY AND CURRENT STATUS OF THE PROJECT

The purpose of this in-progress study is to investigate the relationships of workers and their environment in the midst of radical changes (paradigm shift) in order to build a general model of performance. The study uses the transition to OO technology as the application to build this model. Person-environment fit is used as the basis for the model with extensions from other theories and prior empirical research.

The research methodology employed allows for the building and testing of theory and will be conducted in four phases: (1) build the theoretical model and associated instrument; (2) validate the instrument; and (3) test the model. Currently, phase 1 is well underway. The remaining phases should be complete before the AIS conference in August. Results can be presented at that time.

References available upon request from Michael A. Chilton



**Figure 1: A Model of Person-Environment Fit, Stress and Performance**