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The Province of Diffusion of Innovations: Usable Social Theory for Information Systems Research

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ABSTRACT

Since the dawn of computerization the adoption of information technology has been an area of substantial research; but efforts to date have led to mixed outcomes. Many social theories have been used in these studies. Some include the theory of reasoned action, Ajzen & Fishbein (1975); diffusion of innovations, Rogers (1983); economics of technology, Arthur (1985), social cognitive theory, Bandura (1986) and technology acceptance model, Davis, Bagozzi & Warshaw (1989). However, investigations to date have been inconclusive about the ability of any of these theories to be conclusive about all the complexities found in the innovation decision-making process of adoption of information technology within an organization. In this study we further investigate one heretofore unapprised aspect of the theory of diffusion of innovations.

We re-present Everett M. Rogers' theoretical model and test his perceived characteristics of innovations (PCIs) along with others more recent contributions to this area at *pre-diffusion stage* to explore the theories fuller predictive ability for developing rates of acceptance of innovations. We select innovative licensing agreements developed by extreme social groups known as "Free Software or Open Source Software projects," e.g. GPL, LGPL, BSD and MIT agreements. We conduct a survey of Linux Users Groups for perceptions with the same instrument used for testing other innovations by Moore & Benbasat (1991), Agarwal & Prasad (1997) and Van Slyke, Lou & Day (2002). We include in our instrument the validated *intention to use* (ITU) measure developed by Van Slyke, Lou & Day, (2000). We conduct a pilot study. We make adjustment to the instrument for clarity and presentation. Then we conduct a final survey. This research in process study identifies our theoretical foundation and the methodology of our research for re-presenting Rogers (1983), Moore & Benbasat (1991), Agarwal & Prasad (1997) and Van Slyke, Lou & Day enhanced model at *pre-diffusion stage* of innovations.

Keywords: Diffusion of Innovations, Pre-diffusion Stage and GNU Licenses.

Theoretical Foundations

Investigations have centered on the complex issue of innovation decision-making in organizations particularly under the condition of authority where the decision to adopt is not made by end-users but by management. Moore & Benbasat (1991) augmented Rogers' (1983) five main perceived characteristics of innovations, relative advantage, compatibility, complexity, trialability and visibility with the inclusion of three additional PCIs that take into account more complex aspects of innovation decision making in organizations. They determined that *voluntariness; image and result demonstration* should be added to Rogers' five main characteristics and developed the test instrument used again in our study to measure their characteristics of innovations as well. *Voluntariness* was also re-evaluated and found to be essential by Agarwal & Prasad (1997). All these characteristics were tested again and found support when correlated to *intention to use* (ITU) by Van Slyke, Lou & Day (2000). This enhanced list is the theoretical foundation for this study and reminiscent of the beginning of a new framework for studying innovation in organizations as called for by Gallivan (2001).

OBJECTIVE OF THE STUDY

The primary objective of this study is to investigate the consistency of the PCIs at *pre-diffusion stage* of innovations. We emphasize the pre-diffusion stage of adoption of information technology innovations. Prior studies of PCIs were conducted

after innovations had been adopted. Rogers (1995) indicated that he does not believe the studies performed to date by themselves are complete for testing the applicability of his theory. Rogers recommended further studies during *pre-diffusion* stage to complete the testing of his theory. This research follows that recommendation. Therefore, the focus of this research is on the perceived characteristics of innovations that relate to the adoption of an information technology innovation *before* it enters into its diffusion stage, i.e. when an innovation is in *pre-diffusion* or early stages of diffusion.

ORIGINS OF ENHANCED CHARACTERISTICS OF INNOVATIONS

Rogers (1995) defines Diffusion of Innovations as the process by which an innovation is communicated through certain channels over time among the members of a social system. He also describes six main phases in the innovation-development process. They are needs/problems awareness, basic and applied research, development, commercialization, diffusion and adoption and consequences. *Pre-diffusion* is described as those stages before full commercialization of an innovation. Diffusion is described as those stages after full commercialization. Rogers also describes five main characteristics of innovations that individuals perceive in the decision-making process to adopt an information technology innovation. Moore & Benbasat (1991) reviewed these characteristics and found that three additional characteristics needed clarification for complex organizational settings, i.e. *voluntariness, image and results demonstration*. Van Slyke, Lou & Day (2002) used these enhanced characteristics and included their measure of *intention to use*. These particular constructs are described in the following section. They are the beginnings of our research.

ENHANCED CHARACTERISTICS OF INNOVATIONS (ECI)

Rogers (1995) describes five main characteristics involved in the adoption of innovations as follows: an innovation's

1. Relative advantage: the degree to which it is perceived to be better than what it supersedes.
2. Compatibility: consistency with existing values, past experiences and needs.
3. Complexity: difficulty of understanding and use referred to in the literature as ease of use.
4. Trialability: the degree to which it can be experimented with on a limited basis
5. Visibility: the degree to which an innovation is actually visible.

Moore & Benbasat (1991) found three additional characteristics in their studies:

1. Voluntariness: the degree to which use of an innovation is entirely voluntarily.
2. Image: the degree to which it is important to be seen using.
3. Result Demonstration: the ability to know the actual results of using.

Van Slyke, Lou & Day (2002) did not include Image in their study and measured the following:

1. Intention to Use: the degree to which an innovation it is more or less likely to be used.

The perceived characteristics of innovations defined by Rogers (1983) as succinct and general perceptions of innovations have raised questions about their validity for studying acceptance in *all* situations. It has been debated that these attributes may not be the ones of particular interest in all cases (Moore & Benbasat, 1991). A review of the recent studies shows a disposition toward other attributes being used in studies on adoption of information technology innovations, not just those identified by Rogers (Agarwal & Prasad, 2000, Gallivan (2001) & Van Slyke,

Lou & Day, 2002). The question that has persisted is "How can five generalized, albeit succinct, perceived characteristics of innovations be applied universally? Rogers (1995) emphasizes that, for most respondents, perceived characteristics of information technology innovations could still be described by his five elements. In his opinion, there is little, if any need to have them redefined (Rogers). Our study re-addresses that question with the inclusion of a group of ECIs as determined by the studies of Moore & Benbasat (1991), Agarwal & Prasad (2000), Gallivan (2001) & Van Slyke, Lou & Day (2002).

SOCIAL SYSTEM & NECESSARY COMMUNICATION CHANNELS

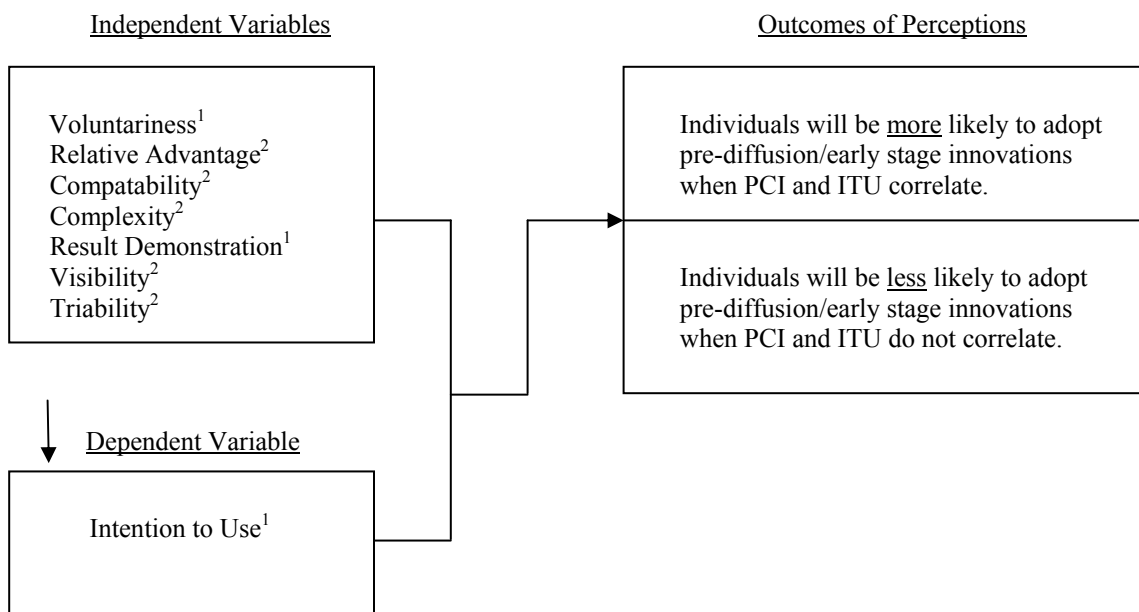
Rogers (1995) indicates that in order for diffusion to take place social systems must have communications channels. A communication channel is a means by which messages get from one individual to another. The nature of the information-exchange relationship between a pair of individuals determine the conditions under which a source will or will not transmit

the innovation to the receiver and the effect of the transfer (Rogers, 1995). Mass media channels are all those means of transmitting messages that involve a mass media such as radio, television, newspapers, magazines, trade journals, etc. that enables a source of one to reach an audience of many. Interpersonal channels involve a face-to-face exchange between two or more individuals. A social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, and organizations and/or sub systems. Each unit in a social system can be distinguished from other units (Rogers). This element is essential to our theoretical structural model.

THEORETICAL STRUCTURAL MODEL

The following intellection defines the theoretical structural model of this study. Rogers (1983), Moore & Benbasat (1991), Agarwal & Prasad (1997), Gallivan (2001) & Van Slyke, Lou & Day (2002) perceived characteristics of innovations tested on innovative license agreements for social perceptions by members of worldwide Linux User Groups are related to an individual's intention to use that innovation in their organizations. Figure 1. depicts the theoretical structural model used.

Figure 1. Predictive Diffusion of Innovation Model



¹ Defined by Moore & Benbasat (1991), Agarwal & Prasad (1997), Gallivan (2001) & Van Slyke, Lou & Day (2002)

² Defined by Rogers (1983)

These explanations define the variables within the theoretical structural model.

1. Voluntariness: the degree to which use of the innovation is perceived as being voluntary, or of free will.
2. Relative Advantage: the degree to which an innovation is perceived as being better than its precursor.
3. Compatibility: the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters.
4. Complexity: the degree to which an innovation is perceived as being easy to use.
5. Result Demonstrability: the degree to which an innovation is perceived as providing tangible evidence of its benefits.
6. Visibility: the degree to which an innovation is actually available for viewing.
7. Trialability: the degree to which an innovation may be experimented with before adoption.
8. Intention to use: the degree to which an individual indicates their likelihood of adopting an innovation.

We will measure the relationship between our enhanced list of perceived characteristics of innovations and the dependent variable *intention to use* at pre-diffusion stage. Data to be collected includes responses indicating preferences for channels of communications and social group structures encountered. Some testable hypotheses developed from the theoretical structural model and operationalizations of the constructs of interest are:

- H1a: In pre-diffusion or early stages of diffusion enhanced characteristics of information technology innovations are correlated to an individual's intention to use that technology.
- H1o: In pre-diffusion or early stages of diffusion enhanced characteristics of information technology innovations there is no correlation to an individual's intention to use that technology.
- H2a: In pre-diffusion or early stages of diffusion enhanced characteristics of information technology innovations are correlated to normal diffusion stage enhanced characteristics of information technology.
- H2o: In pre-diffusion or early stages of diffusion enhanced characteristics of information technology innovations there is not correlation to normal diffusion stage enhanced characteristics of information technology.

The empirical studies on adoption of innovations by Rogers (1983, 1995), Moore & Benbasat (1991), Agarwal & Prasad (1997, 2000), Gallivan (2001) & Van Slyke, Lou & Day (2002) are the basis for the derivation of the hypothesis of this study. Our hypothesis for this study is significant because the testing is changed to *before* rather than after an innovation has been adopted as recommended by Rogers, (1995).

METHODOLOGY

This research relies on established survey methods. The measurements used in this survey were developed by Moore & Benbasat (1991) and include the additional PCIs as identified by them, i.e. *voluntariness, image and result demonstrability*. Agarwal & Prasad (1997) also identified *voluntariness* as pertinent. The dependent variable *intention to use* was established by Van Slyke, Lou & Day (2002) when they tested a fully diffused innovation using the Moore & Benbasat (1991) instrument. For the purposes of this study only references to the current innovation in question were modified from the Van Slyke, Lou & Day (2002) instrument. The structural model for our research has been purposely maintained with those previously used (Moore & Benbasat, 1991, Agarwal & Prasad, 1997, Gallivan, 2001 & Van Slyke Lou & Day, 2002). All the methods for our study are similar to those used by previous investigators. Only the stage of diffusion for the innovation is reappraised in this study.

SURVEY FORMAT

The target audience for the innovation of this study is Free Software or Open Source Software users. The instrument was placed on a Web site where respondents can also record their responses. The instrument was designed to provide clarity of content and to avoid any ambiguity or misunderstanding of the questions. A consent form and demographic questions were suffixed to the questionnaire that ask the subjects about their gender, age, experience, and position within the organization. Social questions about how, when, where and why and with whom the innovation was encountered were also included. We selected to survey available members of the Linux User Groups in the Australia, Canada, India, Ireland, United Kingdom, United States & Russia via e-mail with return authorization codes. These individuals represent a broad range of industry and labor. Survey research was chosen as a technique because of the ability to be able to draw inferences about the population of Free Software or Open Source Software users within organizations from a sample. An additional survey is contemplated after the data analysis has been completed to balance this survey with qualitative interviews as suggested by pilot study.

DATA ANALYSIS

Regression analysis will be used to test the relationship between perceived innovation characteristics and intention to use. Hypothesis testing will include but not be limited to t-tests, analysis of variance (ANOVA), etc. A number of assumptions concerning the error term (ϵ) underlie the statistical tests used in regression analysis (Babbie, 1998). Examining other assumptions such as: independent error terms, normality, expected value of error equal to zero, constant variance, multicollinearity and for outliers will also be performed. We anticipate presenting some results in August.

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