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December 2007

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ACCOMMODATING DIFFERENCES IN THE *UNIFORMITY* AND *STABILITY* OF INFORMATION SYSTEMS ARTIFACTS

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ABSTRACT

A considerable body of prior literature has examined the adoption and use of a wide variety of information systems artifacts by individuals in organizations. Studies have used both cross-sectional and longitudinal research designs to gather data regarding adoption and use from individuals, either from one organization or pooled from multiple organizations. Two common assumptions are prevalent in this research on adoption and use. Information systems artifacts are generally assumed to be uniform *across individuals and organizations as well as* stable *over time. Despite the insights gained from this literature, these assumptions may not be descriptive of real-world organizational settings due to three factors:* **innovation extensibility**, **individual behaviors**, *and* **organization routines**. *Moreover, the lack of attention to the differences in uniformity and stability may limit our understanding of information systems adoption and use. Future studies should explicitly consider the differences in the uniformity and stability of the artifacts in theorizing information systems adoption and use.*

Keywords: information systems, artifacts, uniformity, stability, feature-centric

Introduction

The adoption and use of information systems (IS) by individuals in organizational settings continue to be central to IS research and practice. Prior literature has examined a wide variety of IS artifacts such as decision support systems, executive information systems, group support systems, electronic communication systems, expert systems, operating systems, enterprise resource planning systems, etc. Studies have typically employed cross-sectional or longitudinal designs or both involving individuals from one or several organizations to understand adoption and use of IS artifacts. Despite such differences in research designs and participants, studies have generally assumed the IS artifacts to be *uniform* across organizations or individuals within organizations and *stable* over time. In real-world settings, however, there are likely to be differences in uniformity and stability of the IS artifacts. The uniformity and stability assumptions of the IS artifacts have the potential to actually limit our understanding of IS adoption and use. Such limitations may be overcome by employing a feature-centric view of IS artifacts and explicitly theorizing the differences in uniformity and stability of the IS artifacts used by organizations and individuals.

Uniformity and Stability of IS Artifacts

Research on IS adoption and use exhibits two common assumptions regarding the IS artifacts: a) the *uniformity* of the IS artifacts and b) the *stability* of the IS artifacts.

- **Uniformity** refers to the similarity of the IS artifacts across different units of analysis, specifically, organizations or individuals within organizations.

- **Stability** refers to the endurance of an IS artifact in its original form over time for a given unit of analysis, specifically, an organization or an individual within an organization.

These two assumptions can be illustrated using examples from extant research. For instance, Thompson, Higgins and Howell (1994) examined 219 users in 8 organizations regarding the use of personal computers. Lee, Kim and Lee (1995) obtained

236 responses from individuals in 11 organizations on the use of computer-based information systems. Igbaria, Guimaraes and Davis (1995) examined the use of personal computing by 358 individuals in 203 organizations. These are examples of research that assumed uniformity of IS artifacts across different organizations, i.e. all organizations would have had similar implementations of IS artifacts.

Similarly, Venkatesh et al. (2003) conducted a longitudinal analysis of individuals' intention to use various IS artifacts. Data were gathered at three points in time from 119 individuals of voluntary-use technologies and 96 individuals of mandatory-use technologies[1]. Compeau, Higgins and Huff (1999) obtained data on computer use from 394 users at two points in time separated by one year. Szajna (1996) tracked the use of an electronic mail system by 61 individuals over a 15-week period. These are examples of research that assumed stability of IS artifacts over time, i.e. all IS artifacts endured over time in their original forms.

However, the IS artifacts are not always uniform across organizations/individuals or stable over time[2]. Several possible reasons may be offered in support of differences in uniformity and stability of the IS artifacts. Figure 1 depicts three factors – innovation extensibility, individual behaviors, and organization routines – that have the potential to be *negatively* related to uniformity and stability of the IS artifacts.
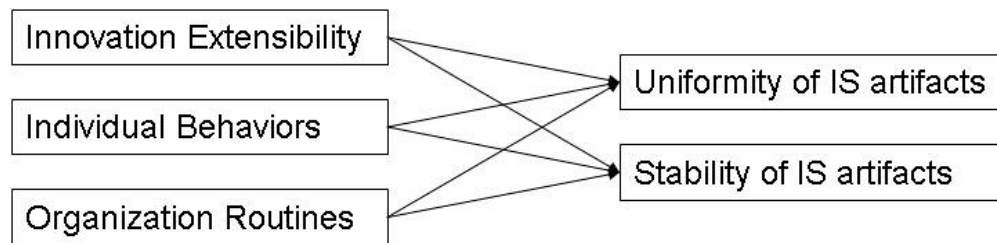

Figure 1. Model of Impacts on Uniformity and Stability

- **Innovation extensibility**. The capabilities and functionalities of the IS artifacts may be extensible as and when needed by the individuals using the IS artifacts. Extensibility is possible through various mechanisms such as add-ons, plug-ins, extensions, patches, custom installations, utility (or on-demand) computing, version upgrades, editions, configurations, etc. over and above the basic functionality of the original IS artifact (e.g. Birsan 2005; Chang et al. 2004). For instance, prior research showed multiple ways of altering the basic functionality of the IS artifact such as high integration and expansion (Lassila and Brancheau 1999).

- **Individual behaviors**. Individuals may behave in unique ways with regard to and their interactions with the IS artifacts. Such behaviors include their roles as pilot users or testers of the IS artifacts, roles as champions or change agents for specific IS artifacts, roles as higher-level managers or lower-level employees, requests for bug fixes and/or additional functionalities for the IS artifacts, access (e.g. restricted or unrestricted) to different components of the IS artifacts, use of external or supporting solutions for missing functionalities, etc. (e.g. Howell and Higgins 1990; McGill, Hobbs and Klobas 2003; Pan, Zhang and Yang 2006; Rogers 1995).

- **Organization routines**. Organizations may have instituted routines regarding the distribution, management and use of IS artifacts by affiliated individuals. These may include such activities as mandatory periodic updates of the IS artifacts, upgrades to the previous versions of the IS artifacts, training programs that introduce specific ways of working with IS artifacts, technical help desks or hotlines that provide assistance on the use of IS artifacts, organizational policies that govern the continuous design, development, and deployment of IS artifacts, etc. (e.g. Mukherji, Rajagopalan and Tanniru 2006; Igbaria et al. 1995; Thompson, Higgins and Howell 1991).

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[1] The research also included a cross-validation study in which 80 individuals reported on voluntary-use technologies and 53 individuals reported on mandatory-use technologies over three points in time.

[2] Uniformity and stability are not inconceivable in restricted settings such as lab experiments in which the same IS artifact is given to all participants for the duration of the experiment.

Implications of Uniformity and Stability

The uniformity and stability assumptions of the IS artifacts have profound implications for research on information systems adoption and use. Any one or a combination of the three factors – innovation extensibility, individual behaviors, and organization routines – can have an impact on the uniformity and stability of IS artifacts.

Figure 2 provides one illustration of the many possibilities that may be prevalent in real-world contexts in which research on information systems are conducted. Specifically, Figure 2 depicts two hypothetical organizations (A and B) that have made the decision to adopt the same IS artifact: however, they differ in the extent of their implementation. Suppose that Organization A made the decision to adopt seven modules of the system whereas Organization B decided to adopt only two of the modules. The individuals affiliated with the two organizations exhibit a wide range of behaviors in dealing with the system. The following points may be noted about uniformity and stability of the IS artifacts in the two organizations.

- Due to variations in the organizational decisions on the extent of implementation, the systems available to the individuals across the two organizations are not uniform. Whereas individuals in Organization A have access to functionalities in seven modules, individuals in Organization B have access to functionalities from only two modules.

- Even within the same organization, in which the system has the potential to be uniform across individuals, there can be differences between the systems used by individuals. For instance, one of the individuals in Organization A has access to only one module of the system even when seven modules have been implemented by the organization.

- Finally, the systems used by individuals are not stable over time. One of the individuals in Organization B, for instance, was a pilot user of the system and identified bugs that needed to be fixed. One of the individuals in Organization A received updates of the system that also included new functionalities.
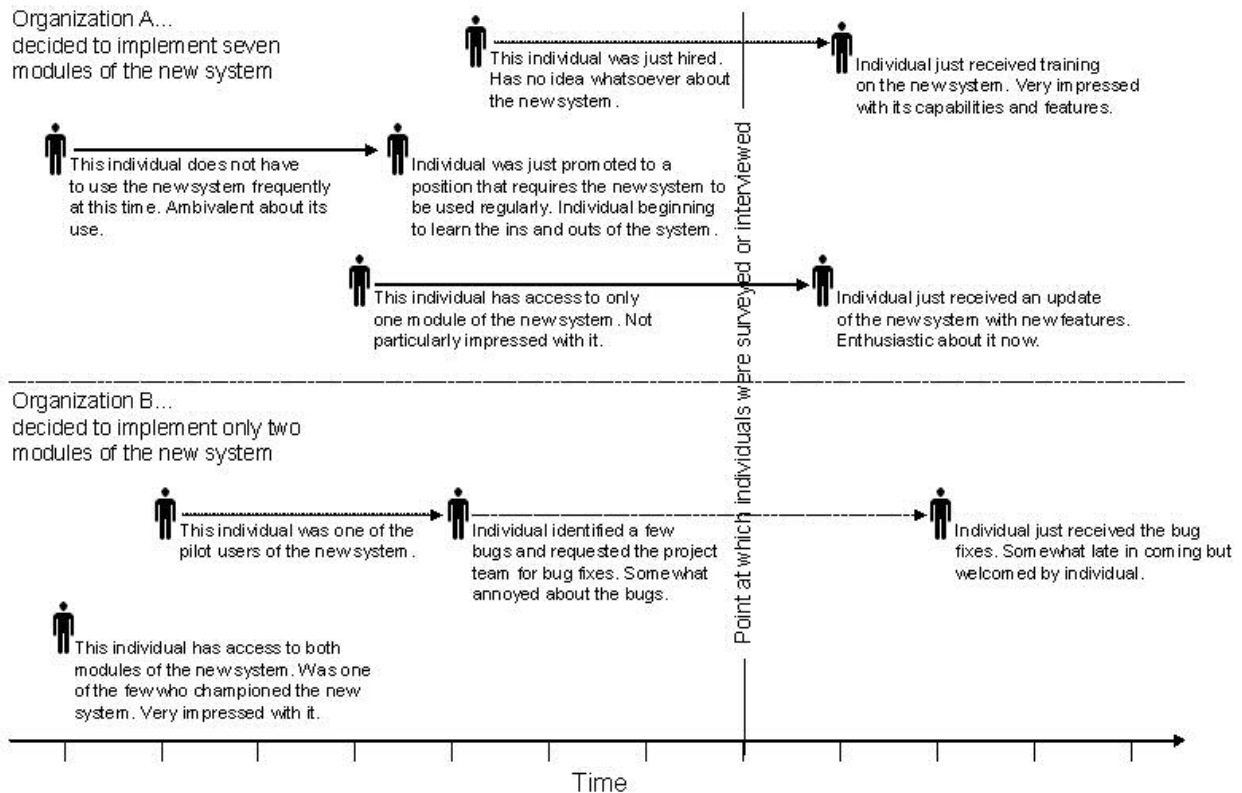

Figure 2. Differences in Uniformity and Stability Illustrated

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These illustrations are only some of the possible scenarios involving innovation extensibility, individual behaviors, and organization routines that demonstrate the differences in IS artifacts – specifically, that uniformity and stability are not always the norm in real-world settings.

Further, consider a research project that examines the adoption and use of IS artifacts by individuals in these two organizations. Figure 2 depicts the time at which the organizations and its individuals are included in the research effort. Figure 2 also illustrates how five individuals in the two organizations deal with non-uniform and non-stable IS artifacts either side of the time at which the research is conducted. In such a situation, the lack of uniformity and stability of the IS artifact is lost if the research does not explicitly focus on the IS artifact and its differences or at least on the factors that lead to the non-uniformity and non-stability of IS artifacts.

Prior research has examined a variety of characteristics leading to IS adoption and use. These include innovation attributes such as perceived usefulness, perceived ease of use, relative advantage, complexity, compatibility, trialability, observability, system quality, and costs (Davis, 1989; DeLone and McLean, 1992; Rogers, 1995); task characteristics such as importance, newness, difficulty, variety, routineness, and autonomy (Igbaria, 1990; Guimaraes et al., 1992; Raymond and Bergeron, 1992; Sanders and Courtney, 1985); individual characteristics such as playfulness, innovativeness, self-efficacy, computer experience, and attitudes (Agarwal and Prasad, 1997; Compeau and Higgins, 1995; Igbaria et al., 1995; Taylor and Todd, 1995; Webster and Martocchio, 1992); and contextual factors such as top management support, facilitating conditions, social norms, task-fit, and voluntariness (Agarwal and Prasad, 1997; Igbaria et al., 1995; Karahanna et al., 1999; Goodhue and Thompson, 1995; Venkatesh et al., 2003). None of these different classes of variables directly deal with the differences in the uniformity or stability of IS artifacts being examined.

Finally, the lack of attention to the differences in uniformity and stability of IS artifacts may result in distorted views of adoption and use obtained from individuals. Consider Figure 2 with reference to the different states or mindsets of the individuals when the research instrument is administered. Of the five individuals depicted, one individual does not know anything about the system yet, another individual is just beginning to learn the ins and outs of the system, two individuals are either not impressed or somewhat annoyed about the system, and the remaining individual has championed the system. Assuming that these individuals participate in the research[3], their responses to, say, usefulness, is likely to be ambivalent or negative in a majority of the cases. The obvious, but quite likely erroneous, conclusion of the research would be that the system is not useful to the individuals.

However, as shown in Figure 2, if only the research had been administered at a later point in time, probably four of the five individuals (excepting the second one from the top, who may still be learning the system) would have been positive, or at least not negative, about the system. At such a time, the individuals would have responded more positively to questions regarding usefulness, and the research would have happily concluded that the system was quite useful to the individuals[4]. But it may not be possible to find the right time to administer the instrument since such perfect information is typically not available. An alternative arrangement is needed to counter this situation. One such alternative is to explicitly consider the differences in the uniformity and stability of the IS artifacts used by individuals.

Feature-Centric View of Uniformity and Stability

Considerations regarding the uniformity and stability of the IS artifacts may be explicitly incorporated in theorizing adoption and use by employing a feature-centric view of the IS artifact (Jasperson et al., 2005). The feature-centric view argues that the system can be decomposed and understood in terms of its features or capabilities or functionalities.

To benefit from the feature-centric view of IS artifacts, differences in uniformity and stability should be expressed in terms of features. This is relatively straightforward for both cases: the difference between two IS artifacts at any point in time OR the difference in an IS artifact at two points in time may be attributed to the change in the features of the IS artifacts. That is, non-uniformity of IS artifacts arises because the features available on one artifact are different from features available on

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[3] It is possible to argue that not all of these individuals may participate in the research; however, if these individuals are even representative of similar others in the organizations, then a distorted view of adoption and use is even more likely.

[4] It can be argued that the individuals may continue to exhibit negativity toward the system over time. In such a case, at least there would be a more definitive basis for conclusions regarding usefulness.

the other artifact. Similarly, non-stability of IS artifacts arises because the features of the IS artifact at one point in time are different from the features of the IS artifact at another point in time.

Furthermore, the various mechanisms leading to non-uniformity and non-stability of the IS artifacts are consistent with the feature-centric view of IS artifacts. For instance, updates, upgrades, add-ons, updates, plug-ins, and extensions are all different mechanisms by which the IS artifacts become different in terms of uniformity and stability across individuals or organizations and over time. This is because the upgrades, extensions, etc. end up altering the set of features available on the IS artifacts.

Modeling Differences in Uniformity and Stability

To overcome the limitations of the assumptions of uniformity and stability of the IS artifacts, studies should explicitly incorporate some indicators of uniformity and stability. Such indicators can then be modeled as antecedents of IS adoption and use, or at the very least, as controls in models of IS adoption and use. Research participants may be invited to provide data on these indicators such that differences in uniformity across individuals or organizations and stability over time can be modeled.

The indicators may be based on the three factors – innovation extensibility, individual behaviors, and organization routines – introduced earlier. The following is a partial set of questions that may be given to research participants as they recount their experiences regarding the adoption and use of IS artifacts.

> Has your system been upgraded since it was first made available to you?
> How many times has your system been upgraded since you began using it first?
> How significant were the upgrades in terms of changed functionality or capability of the system?
> Were you a beta tester of the system at this organization prior to its full implementation?
> Were you a champion of the system to others in your group, unit, or organization?
> Have you ever found any bugs or errors on the system?
> Have you ever requested for bug fixes or additional functionalities for the system?
> Have you ever used external solutions to supplement the functionalities of the system?

This is a research-in-progress work. Currently, the development of appropriate instruments, depending on the research designs employed, to capture the differences in uniformity and stability of IS artifacts is in progress. More detailed description and additional information on the instruments will be presented at the conference.

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