Variation in Individuals' Post-Adoption Behaviors: Use of Information Systems

Completed Research Paper

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Abstract

Information Systems (IS) offers many advantages to organizations, however, research suggests that most users underutilize IS in organizations. To further leverage an IS, it requires users to vary, over time, how an IS is incorporated into their work practices. Using the Generalized Darwinism framework and drawing insights from a case study and survey findings, this paper introduces and conceptualizes the notion of 'Variation' (i.e. changes) in IS use, and investigates factors that facilitate variations. Intrinsic motivation, domain-related knowledge and feedback quality were shown to play a role in supporting and predicting the extent of variations, for both the case study and survey findings. Perceived resources, while playing a role in the case study was not significant in the survey findings. This study responds to calls for greater attention to changes in IS use and provides insights for practitioners on ways to encourage change in individuals' use of IS.

Keywords

Post-Adoption, Use, Information Systems, evolution, Generalized Darwinism

Introduction

As organisations continue to invest heavily in Information Systems (IS) to support business processes, underutilization remains a key concern that challenges efforts to exploit its benefits. Evidence suggests that most users underutilize the 'functional potential' of IS in organizations, employing narrow feature breadths, operating at low levels of feature use and rarely extending their use of the available features (Jasperson, Carter, & Zmud, 2005). A resonating question is thus 'how can organizations leverage IS use among employees to actualize the benefits of IS?' Utilization is not a simple 'yes' or 'no', as while users may not have the opportunity to choose the system they use (Lamb & Kling, 2003), there is some choice in the extent of use (Marler, Fisher, & Ke, 2009).

Given the significance of IS and its underutilization, coupled with the assumption that users are not 'passive takers' of technology, but active agents who shape their use of an IS (Sun & Zhang, 2006), it is important to understand the intricacies of post-adoption use. One approach is to examine how use of IS changes over time. To achieve greater utilization of an IS requires some degree of change on the users' part as they modify how the IS is incorporated into their work practices (Orlikowski, 2000; Sun, 2012). A change focus is valuable as the features used by individuals change over time, and it is the particular features in use at any point in time that determine various post-adoptive behaviours (i.e.

use types) and work outcomes (Jasperson et al., 2005). Thus understanding how individuals modify their use of the IS is paramount in post-adoption IS research (Sun, 2012).

This research draws on evolutionary change, that is, Generalized Darwinism to understand change in IS use. Generalized Darwinism is a meta-theoretical framework for describing and understanding change by applying a generalization of the basic Darwinian concepts of variation, selection and retention to non-biological domains.

This paper focuses on the element of '*variation*', as a first step in understanding the evolutionary process in IS post-adoption use. In biology, variation represents a modification in structure, form or function in an organism, deviating from other organisms of the same species or group. It is considered the 'raw material' for evolution, for without variations, there would be no alternatives to select from (Mayr, 1991).

The notion of 'variation' is equally important in post-adoption use, as for the benefits of the IS to be greater, individuals need to experiment or try out different ways of using the IS to support their work. These attempts to vary one's use of an IS are key, as failure to do so can result in a state of habitual behavior where the individual engages in a recurring pattern of using a selected subset of IS features in their work (Jasperson et al, 2005).

The objectives of this research are to (i) develop a conceptual and operational definition of 'Variation' in post-adoption IS use, and to (ii) understand the factors that facilitate 'Variation'. This study will draw on insights from a series of interviews to understand the nature of variation in IS use and its facilitators, which are then explored further in a survey.

This study advances IS research by offering an alternative theoretical perspective for understanding changes in individuals' post-adoptive behavior. From a practical perspective, it offers a guide for managers and practitioners to recognize how individuals can alter their IS use, and recommends actions that they can take to help encourage or induce variations in post-adoption use.

The remainder of the paper is as follows: it will discuss the concept of variation in relation to Generalized Darwinism, followed by the research methodology used in this study. Then, using the findings from a qualitative case study coupled with the extant literature, the next section discusses the variations that occurred and hypothesizes the enablers of variations. The results of the evaluation of the conceptual model are reported, followed by a discussion of the findings and conclusion.

Generalized Darwinism- Variation

Evolutionary change entails a continuous cycle of variation, selection and retention among entities in a designated population (Van de Ven & Poole, 1995). Geoffrey Hodgson and associates proposed a meta-theoretical framework, that is, 'Generalized Darwinism', for describing and understanding change by applying a generalization of the basic Darwinian concepts of variation, selection and retention to non-biological domains (Aldrich, 1999; Hodgson & Knudsen, 2006). Generalist Darwinists argue that under some minimal conditions, ongoing change in systems is inevitably Darwinian, as it must involve Darwinian principles of variation, selection, retention (Hodgson & Knudsen, 2006).

The term 'variation' stems from the Latin word *variationem (nom. variatio)*, which means "a difference, variation, change," which comes from 'variatus', past participle of 'variare' "to change". In biology, variation in the characteristics of organisms is exhibited in differences among individuals within a population and among populations and species (Buss, 1987). In a general sense, applied to non-biological domains, variation can be defined as any departure from a routine or tradition (Aldrich, 1999), or where individuals or groups generate a set of ideas on how to approach old problems in novel ways or to tackle relatively new challenges (Zollo & Winter, 2002) or generate new ways of doing things (Furneaux, Tywoniak, & Gudmundsson, 2010). Generalized Darwinism therefore does not seek to mimic or provide an analogy of how variation occurs in biology, in the evolution of non-biological domains (Hodgson & Knudsen, 2006). Instead, Generalized Darwinism argues that the existence and replenishment of variety is also a vital issue in non-biological contexts (Aldrich et al, 2008).

Variation is the first and rather essential component of the change process, and is often dubbed the 'raw material' for evolution, since if there are no variations, then there are no alternatives to select from and possibly retain (Mayr, 1991). Selection refers to forces that differentially select or selectively eliminate certain types of variations, while in retention, selected variations are then preserved, duplicated, or otherwise reproduced (Aldrich, 1999). This paper focuses on 'variation'.

A variation mechanism increases variety in the characteristics of the entities of the set; if replenishment of variety is absent, then evolution will desist. Thus it is important to understand the source of variation so as to understand where the variety comes from. Equally important are the processes that lead to the introduction of variations (Ford, 1996).

Drawing on Generalized Darwinism as a framework of evolutionary change, this research examines variation in how an IS is used to support one's work routines as well as the factors that trigger and/or enable such variations. The outcomes will include factors that influence change and provide suggestions for encouraging users through variations, to leverage more fully the potentials of the IS to support their work.

Methodology

Using a multi-method research design, this study includes an exploratory phase (qualitative) followed by a confirmatory phase (quantitative). For both phases, data was collected from university faculty members who use Learning Management Systems (LMS) to support their work. LMS have many features including file upload and download, discussion forums, assignment submission, online news and announcements, quizzes, and reporting facilities for monitoring and managing resource use and student interaction. It can be used as an informational site or as a complete online learning environment. It is a system that is somewhat malleable as faculty can often choose the extent to which they use the system (and various features) to support their work. The LMS as a study context also provided access to a range of user types and usage levels, making it a useful setting to initiate this study of change in use over time.

For the qualitative phase, a single case study was used to explore change in IS use. Users of an IS often include basic, intermediate and advanced users, with these categories of users tending to differ in the way they use the features of an IS (Munro, et al., 1997). For example, advanced users tend to have more than an encyclopedic grasp of the features and capabilities of the IS, and are more likely to find new or unusual and especially effective ways of using the IS, while basic users tend to use a narrow set of IS features in performing work tasks (Munro et al, 1997). For this study, a cross-section of 10 LMS users (i.e. basic, intermediate and advanced) in a large university was interviewed. Definitions for each user category were adapted from Munro et al. (1997) and provided to organizational contacts to help identify suitable participants.

The findings from the qualitative phase were analysed using Generalized Darwinism principles of variation and the collective results used to develop a conceptual model for further analysis. Miles, Huberman and Saldana (2013) was used to guide the analysis of the interview data. The analysis process consisted of three (3) concurrent flows of activities: data condensation/reduction, data display and data conclusion-drawing/verifying. The process was applied to each interview as it came in, that is, each interview was coded and added to what was already collected. Where necessary re-coding of already-collected data was undertaken to ensure consistency of the data analysis across the interviews and that insights gained were reflected in the earlier analyses.

Furthermore, guidelines set out by Yin (2009) coupled with those recommended by Dubé and Paré (2003) were used to evaluate the quality of the qualitative research, and assure the rigor and validity of the case study work. Thus checks were also conducted to ensure that criteria for construct validity, internal validity, external validity and reliability were met.

For the quantitative phase, both online and paper-based versions of the survey were administered. Of the 250 surveys distributed, 86 responses were received, all of which were usable, yielding a response rate of 34%.

Of the 86 respondents, 67% were male and 33% were female. Respondents were asked to rate their level of expertise on a seven-point scale ranging from -3 (basic level) to +3 (advanced level). This research grouped users that responded -3 to -1 as basic, 0 to +1 as intermediate and +2 to +3 as advanced. Of the 86 respondents, 14 (16%) were classified as basic users, 40 (47%) as intermediate users, and 32 (37%) as advanced users. In terms of length of use, 10(12%) of the users have been using the LMS for less than a year, 43 (51%) have been using the LMS for 1- 4 years, while 24 (28%) have been using it for 5- 10 years. The remaining 8 (9%) have been using the LMS for more than 10 years.

Findings from Case Study and Hypotheses Development

Variation

Variation is an essential part of the change process, and in the context of this research, it introduces variety into ones' use of an IS to accomplish work tasks.

As users described their changes in use over time (in the interviews) and provided specific examples of change, these were coded to reflect the different forms of variations that emerged. The findings showed that actions situated within variations included: *trying new features, modifying use of currently-used features, substituting some features for other features,* and *finding new or innovative ways of using various features. Trying new features* has a feature exploration focus and involves the use of features that have not been used before (Ke, Tan, Sia, & Wei, 2013; Sun, 2012). *Modifying the use of currently used features* involved changes in the way in which features were used which included 'fine-tuning' and revising the current use of features to improve efficiency and outcomes. The latter are similar to concepts of refinement (Levinthal & March, 1981) and exploitation (March, 1991). *Substituting features* refers to replacing currently-used feature(s) with other features with similar functions (Sun, 2012). *Innovating with the* IS relates to finding new uses or especially innovative ways of using IS features (Ahuja & Thatcher, 2005). As users engaged in variations, they inherently re-conceptualize their work processes to accommodate the IS. This included the creation and modification of work processes (Orlikowski, 2000) to improve the fit with the system.

This study collectively identifies these activities as '*Variations'* in how an IS is used. Thus variations are defined in this study as '*experiments with* (i) *different ways to do one's work to accommodate the System and/or* (ii) *different ways of using the System to support one's work'.*

Enablers and/or Triggers of Variations

Based on the findings, four (4) key enablers were identified: *intrinsic motivation, domain-related knowledge, perceived resources* and *feedback quality* (See Figure 1).

Intrinsic Motivation

Intrinsic motivation can be defined as the doing of an activity for inherent satisfaction rather than for some separable consequence (Ryan & Deci, 2000). The case study revealed that intrinsic motivation was a key factor that helps determine change and depth of IS use, particularly when extending one's use of the IS is voluntary. Advanced users, in particular, were more self-driven in their learning, seeking out new and different ways to use the system in their work and to overcome obstacles to use, which are characteristic of persons who are intrinsically motivated. Similarly, prior research also suggests that intrinsically motivated individuals are more likely to partake in the proactive exploration of system features (Li, Hsieh, & Rai, 2013), resulting in subsequent adaptation to the system, by altering their work processes and feature use, and selectively appropriating features (Ke et al., 2013). Hence, it is suggested that:

H1: Intrinsic Motivation is positively associated with Variations

Domain-Related Knowledge

Domain-related knowledge in this study includes knowledge of the features of the IS and of work processes; the case findings revealed such knowledge facilitated variations. The findings are consistent with prior research, which suggests that both types of knowledge are key in changing behavior (Deng, Doll, & Cao, 2008; Jones, Zmud, & Clark Jr, 2008). In order to effectively utilize the IS, it is necessary for users to understand the capabilities of the system, as well as how it may be best used within the organizational environment and work processes (Nambisan, Agarwal, & Tanniru, 1999). Likewise, it is important for users to have sufficient business and contextual knowledge in order to make effective use of the IS (Kang & Santhanam, 2003). At the same time, insufficient knowledge of the IS features available, that can possibly be used support one's work task coupled with a lack of understanding of the work processes was found to be an inhibitor to change in the case study. Consequently, it is posited that:

H2: Domain-related Knowledge is positively associated with Variations

Perceived resources

Perceived resources is the extent to which a user believes that he or she has the personal and organizational resources needed to use an IS (Mathieson, Peacock, & Chin, 2001). The case study found that peer learning and IS support were key resources that triggered and enabled variations.

The findings suggested that peer learning can improve individuals' use of an IS and enrich ones' skills and ability to further leverage the features of the IS. In particular, for task-specific uses and improvements, peers were one of the key sources of ideas and encouragers of variations. This is supported by prior research that suggests support from organizational peers is important in facilitating use (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Sykes, Venkatesh, & Gosain, 2009).

In addition, IS support was important in guiding individuals' use, whether by way of formal training or by handling general queries on the IS. Especially for Complex Information Systems, which are characteristically difficult to understand and use, the existence of different types of IS support is pivotal (Venkatesh & Bala, 2008).

The availability of organizational resources can therefore help users to use new features, and to modify or enhance their use of IS applications or related work processes (Jasperson et al., 2005); hence, it is posited that:

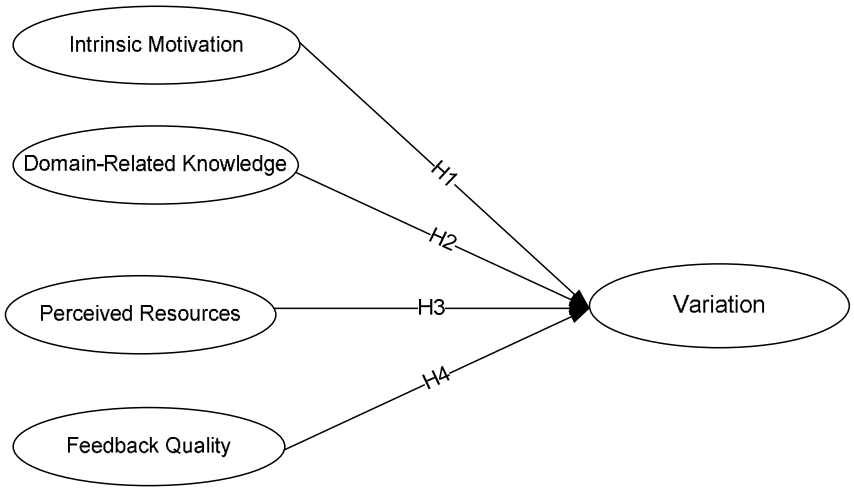
H3: Perceived Resources are positively associated with Variations

Feedback Quality

Although not directly mentioned in the case study interviews, feedback is an essential component of Generalized Darwinism as feedback can be used to promote some behaviors and suppress others (Murmann, Aldrich, Levinthal & Winter, 2003). This hypothesis looks at feedback quality in particular, which can be defined as the consistency and usefulness of feedback, and the informational value of the feedback message (Steelman, Levy, & Snell, 2004). Higher quality feedback environments are advantageous as they provide employees with greater access to information regarding desired behaviors, which can further aid in understanding actions (Peng & Chiu, 2010). This research therefore posits that:

H4: Feedback Quality is positively associated with Variations

Figure 1. Research Model



Data Analysis

PLS-Graph Version 3.00 was used to assess the measurement and the structural model. Bootstrapping using 1000 samples was used to evaluate the strength of the structural paths.

Measures for variation (3 items), intrinsic motivation (2 items), domain-related knowledge (2 items), and feedback quality (5 items) were self-developed (Tennant, 2014). Measures for perceived resources were adapted from Mathieson et al (2001).

In this study, overall measures were used to assess each construct. For example, with regards to variation, an overall measure of variation was used to evaluate the extent to which users *experimented (in general) with different ways to do their work to accommodate the System and/or different ways of using the System to support their work*. As such, a sample item was: "Overall, thinking back to when I first started, I have tried out many different ways to use or accommodate the LMS in in my job" (7-point Likert scale - Strongly Disagree to Strongly Agree).

Measurement Model

The tests for the measurement model focused on determining convergent and discriminant validity. For convergent validity, factor loadings, composite reliabilities and average variance extracted (AVE) were examined. An examination of the factor loadings showed that factor loadings ranged from 0.765 to 0.998, exceeding the recommended thresholds of 0.70 (Chin, 2010).

Composite reliabilities (CR) ranged from 0.918 to 0.998 (Table 1) and so were well above the recommended cut-off of 0.70 indicating internal consistency and that all constructs are within accepted limits and reliable (Chin, 2010). Convergent validity is considered satisfactory when the AVE for the construct is 0.50 or more. The AVE ranged from 0.690 to 0.996 (Table 1), which suggests that each construct explained more than half of the variance of its indicators (Chin, 2010).

Discriminant validity was also evaluated to assess the extent to which each construct is distinct from other constructs by empirical standards (Chin, 2010). The results showed each construct's AVE was greater than its squared correlation with the remaining constructs, which indicate that the constructs exhibit discriminant validity (Fornell & Larcker, 1981) (See Table 1).

Table 1. Discriminant Validity (Squared Correlations, Composite Reliability and AVE)

	CR	AVE	Var	IntMv	KNW	RS	FBQL
Var	0.972	0.921	1.000				
IntMv	0.998	0.996	0.125	1.000			
KNW	0.976	0.954	0.208	0.134	1.000		
RS	0.918	0.690	0.031	0.005	0.151	1.000	
FBQL	0.972	0.874	0.242	0.102	0.177	0.099	1.000

Key: Var=Variation; IntMv=Intrinsic Motivation; KNW=Domain-related Knowledge; RS=Perceived Resources; FBQL= Feedback Quality

This research also applied the Harman's one-factor test (Podsakoff et al., 2003) to detect and control for common method bias. The test was performed on the 17 items used to assess the research model. The results showed that no single factor accounted for more than 0. 414 of the variance, suggesting that common method bias was unlikely to be a significant concern for this study.

Structural Model

The findings revealed that the model accounted for 0.337 of the variance explained for variations. Both intrinsic motivation (0.143, $p \leq 0.10$) and domain-related knowledge (0.272, $p \leq 0.10$) were shown to be positively related to variations; Hypotheses H1 and H2 were supported.

Feedback quality (0.340, $p \leq 0.001$) was found to be positively related to variations, supporting H4. Contrary to expectations, the results did not provide support for the links between variations and perceived resources (-0.026); Hypotheses H3 were not supported. See Table 2.

Table 2. Structural Model Results

Hypotheses	Path Coefficient	Significance Level
Intrinsic Motivation → Variation (H1)	0.143	p≤0.10
Domain-Related Knowledge → Variation (H2)	0.272	p≤0.10
Perceived Resources → Variation (H3)	-0.026	Not Significant
Feedback Quality → Variation (H4)	0.340	p≤0.001

Discussion and Conclusion

There is a short supply of research on post-adoption IS use, particularly on how individuals choose to or are influenced to extend their use of an IS (Jasperson et al., 2005). Furthermore, there are limited empirical studies on change in IS use over time (Al-Natour & Benbasat, 2009; Sun, 2012). This research therefore seeks to bridge a gap in the literature by responding to calls for greater attention to changes in IS use (Jasperson et al, 2005; Sun, 2012).

This research therefore makes several contributions. First, it seeks to enrich our understanding of post-adoption use through a change lens - Generalized Darwinism. Although this paper did not focus on the tripartite lens of variation, selection and retention, the study serves as an initial step towards understanding how change unfolds through an evolutionary lens, by way of variation. It examined variations in both use of the IS features and of work processes. For the IS to be assimilated, users should over time, appropriate it to their own ends by absorbing it into their everyday work practices and adapting features and work processes as may be needed (Swanson, 2002). Thus, if there are many possible variants in IS use and there are many selectively superior variants, then there is a higher chance of change, improvement and possible retention as evident by continued use of the variation (Farrell & Shalizi, 2012).

Second, this research examined triggers and/or enablers that facilitate individuals varying their use of Systems over time. Drawing insights from both the case findings and the survey results, individual factors of intrinsic motivation and domain-related knowledge were shown to play a role in predicting the extent of variations.

The case study found that compared with basic users, more advanced users tended to be more intrinsically motivated to use the LMS in new and different ways, and engaged in deeper uses of the IS. This is consistent with prior research which suggests intrinsically motivated individuals are more likely to expend energy exploring the IS (Cooper & Jayatilaka, 2006). This further suggests that whether the overall setting is one that mandates IS use (or not), since performing variations is most often a voluntary behavior, intrinsic motivation may be key to encouraging persons to use their initiative to engage in actions geared at creating variations. The creativity literature also suggests that the work environment can exert a powerful impact on changes in behavior by influencing motivation (Amabile et al, 1996). For example, intrinsic motivation can arise if individuals have feelings of competency and self-determination or autonomy in their actions (Ryan & Deci, 2000), which can in turn be influenced by management.

Domain-related knowledge of IS features and work processes also enabled variations. Users' understanding of the business context in which the IS is deployed can serve as a reference framework from which to view the changes imposed (or implied) by an IS and also facilitate innovation of new work processes (Kang & Santhanam, 2003). Furthermore, prior research has shown that as users' software understanding increases, the assimilation of its features increases (Jones et al., 2008). Indeed, the case study also found that lack of knowledge as an inhibitor had a lesser impact on constraining use for advanced users than for basic users. This is likely because such persons were more persistent and more confident in their ability to overcome barriers to use (Ryan & Deci, 2000).

Furthermore, the survey findings revealed that feedback quality played a role in enabling variations. An advantageous feedback environment is characterized among other elements by a wealth of information that is high in quality, and is likely to provide employees with important information (Sparr & Sonnentag, 2008). Managers, for example, can create environments in which individuals can receive useful feedback from peers, co-workers and supervisors when they perform variations thus encouraging experimentation and changes in use.

The case study revealed that perceived resources, particularly in the form of peer learning and IS support, was important for performing variations. However, they were not found to be significant predictors of variations in the survey context. One possible explanation for the non-significant relationship between perceived resources and variations in the survey context, is that the mere existence of supporting resources (such as IS support and peer learning) though important for use (Mathieson et al., 2001) may not be enough to enable variations. At the same time, the case findings suggested that for some individuals supporting resources were important; thus their potential contribution should not be overlooked for ensuring an environment that enables variations.

Although the factors examined in this study are not exhaustive, the findings provide useful insights that further our understanding of post-adoption IS use and the mechanisms by which IS use can be changed over time. Future research can investigate further other factors that may facilitate variations such as cognitive style and a supporting environment (Amabile & Mueller, 2008).

Finally, and notwithstanding the insights gained, there are some limitations that should be noted. First, it would have been ideal to examine changes in post-adoptive use in a longitudinal study; however time, resource and access constraints did not permit this. To mitigate this limitation, for both the interviews and the survey, individuals were asked to 'think back' on how their use had changed over time, to help capture change and its 'long-term' effects, retrospectively. Also, by capturing data from different user types (i.e. from basic to advanced users), this allowed us to examine change from varying perspectives at different levels of use. Another limitation is that this study only looked at one system context - Learning Management System, which may have unique characteristics that impacted the findings, for example, the non-significance of perceived resources. Thus, it is suggested that the research model and change in use be investigated also in other contexts.

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