

# A Generalized Darwinism Perspective on Changes in Individuals' Use of Information Systems

*Completed Research Paper*

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## Abstract

*Information Systems (IS) play a critical role in supporting business processes within organizations. There is concern however that IS underutilization by individuals is hindering efforts to exploit its benefits and infuse it into workplace practices. To extract the benefits from an IS requires users to change how they incorporate the IS in their work, progressing towards deeper use. This paper draws on evolutionary theory, that is, Generalized Darwinism and its principles of variation, selection and retention, motivational theory and findings from a case study and survey to better understand how individuals' IS use change over time. Furthermore, it discusses the impact of change on deep use, in particular, extended use. Moreover, the role of intrinsic and extrinsic motivation and feedback as triggers of change are highlighted. The findings provide useful insights that further our understanding of post-adoption IS use and the mechanisms by which IS use changes over time.*

**Keywords:** Information Systems, Post-Adoption, Change, Evolution

## **Introduction**

As organizations implement Information Systems (IS) to support business processes, the underutilization of such systems is a key concern that challenges efforts to exploit their benefits (Jasperson, Carter & Zmud, 2005). An IS can be used to varying degrees by individuals, so even in settings where use is mandatory, it is often optional how individuals use, adopt, extend, expand and in essence, leverage the IS features (Marler, Fisher, & Ke, 2009). What is most desirable is for users to proactively revise their use of the IS by applying best-suited features. But, too often users engage in surface-level use, minimizing their interactions with the IS. Yet for many users how they use an IS will change over time to become progressively deeper as the IS is embedded more in the performance of various tasks.

The ability to manage how people use information systems is critical for organizations to avoid the problem of IS underutilisation and to extract the most benefit from their investments. To achieve this requires some degree of change on the users' part as they modify how the Information Systems (IS) is incorporated into their work practices (Fadel, 2012; Orlikowski, 2000; Sun, 2012). This study assumes that IS 'use' as a behavior can change, and the aim of this research is to provide a comprehensive yet parsimonious explanation of how post-adoption IS use changes over time.

This paper draws on theories of evolutionary change, in particular, Generalized Darwinism to understand change in IS use. Using Generalized Darwinism as an overarching theory, the concept of variation, selection and retention are applied to the domain of post-adoption use, at the individual level. The evolutionary framework for describing change however fails to account for the processes that lead to the introduction of variations (Ford, 1996). To bridge this gap, the case findings as well as motivational theory and prior research are used to help frame the triggers and how these relate to evolutionary change.

The results of this study are expected to contribute both to theory and to practice. From a theoretical perspective, there is a short supply of research on post-adoption IS use, particularly on how individuals choose to or are influenced to learn about, selectively adopt and apply, and then extend IS use (Jasperson et al, 2005). While prior models such as Technology Acceptance Model and Task Technology Fit provide insights on the use of an IS, they do not explain how and why users revise their use of an IS as they enact work tasks (Beaudry and Pinsonneault, 2005). This research therefore seeks to bridge a gap in the literature (Fadel, 2012; Sun, 2012) by investigating further the process of change providing insights on how and why individuals revise their use of an IS. Another theoretical and empirical contribution of this research is that it puts forward and assesses a new lens, that is, Generalized Darwinism, for examining change in IS use over time. From a practical perspective, the findings are instrumental as they will shed light on opportunities for organizations to actively foster appropriate changes in IS use through improved understanding of the rationale behind users' actions and by implementing strategies that will facilitate changes and consequently, improved IS use.

## **Literature Review**

Change is a part of life; it is "a phenomenon of time. It is the way people talk about the event in which something appears to become, or turn into, something else, where the 'something else' is seen as a result or outcome" (Ford & Ford, 1994, p. 759). Over time, it is likely that individual use of an IS will change such that how an IS is used today may not be the same as how it was used in the past or may be used in the future. This literature review will examine post-adoption use focusing on change in use, followed by an introduction of the evolutionary framework, Generalized Darwinism that underpins this research.

### ***Change in Post-Adoption Use of IS***

Use of Information Systems is 'critically important', and is arguably the "most crucial variable in the repertoire of empirical and behavioral studies pinpointed at the intersection of computing and human beings" (Straub & del Guidice, 2012, p. ii). However, the 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 et al., 2005). A resonating question is thus 'How can organizations leverage IS use among employees to actualize the benefits of IS?' Post-adoption utilization of an IS 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, i.e. how they interact with it (Marler, et al., 2009).

Post-adoption use can be defined as a 'myriad of feature adoption decisions, feature use behaviours, and feature extension behaviours made by an individual user after an IT application has been installed, made accessible to the user, and applied by the user in accomplishing his/her work activities' (Jasperson, et al., 2005). Post-adoption use of IS varies from surface-level use to deeper levels of use that exhibit value-added engagement with the system (Argawal, 2000). Deeper use of an IS occurs when users make greater use of the features of an IS to support their work (Schwarz, 2003). The extant literature covers a range of post-adoption behaviors that reflect this idea of deeper use such as extended use (Saga and Zmud, 1994; Hsieh and Wang, 2007), infusion (Cooper & Zmud, 1990; Saga & Zmud, 1994), deep usage (Schwarz, 2003), deep structure usage (Burton-Jones and Straub, 2006), and innovative use (Ahuja & Thatcher, 2005). While findings on these use types are instrumental in advancing our understanding, the emphasis has been on 'what factors' are important (Shaw & Jarvenpaa, 1997) as opposed to "how" they shape outcomes (Newman & Zhao, 2008).

Prior research suggests that there are continuous adjustments and improvisations in use, as users actively select how 'technology' structures are applied (DeSanctis & Poole, 1994; Orlikowski, 1996). Insights from appropriation and adaptation literature construe selective changes in the use of IS (Barki, Titah, & Boffo, 2007), reaffirming that users are not 'passive takers' of technology, but active agents that shape their use of the IS (Sun & Zhang, 2006). Hence an infinite number and variety of use-oriented behaviors are likely as users selectively apply certain features, and make modifications to how and for what purpose they use a system.

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 influence and determine work outcomes (Jasperson et al., 2005). Yet few studies have empirically examined change in use, even though research has found that feature selection varies over time (Al-Natour & Benbasat, 2009). Understanding change in use, that is, how individuals revise their use of the IS features, is paramount in advancing the post-adoption agenda (Sun, 2012), and ensuring progression towards deeper engagement with, and use of IS.

### ***Evolutionary Change: Generalized Darwinism***

Evolutionary change entails a continuous cycle of variation, selection and retention among entities in a designated population (Van de Ven & Poole, 1995). Scholars have recognized the value of using evolutionary theory to guide their work to non-biological disciplines (Goetz & Shackelford, 2006), with the theory being used to describe more than 95% of organizational changes (Burke, 2010). Principles of Darwinism have therefore been used to study change in various domains at the micro- and macro-levels (Aldrich, 1999; Breslin, 2011).

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 (or replication/inheritance) to the socio-economic domain (Aldrich Howard & Ruef, 2006; Hodgson & Knudsen, 2006). Generalized Darwinism argues that Darwin's theory of evolution can be applied to all evolutionary processes, that is, the "broad class of systems and populations of entities, including all feasible manifestations of development and change" (Hodgson & Knudsen, 2006). With this in mind, Generalist Darwinists further argue that 'under some minimal conditions' ongoing change in systems is inevitably Darwinian, as it must involve Darwinian principles (i.e. variation, selection, retention).

*Variation* is an essential part of the process, and is often dubbed the 'raw material' for evolution, for if there is no variation, then there are no alternatives to select from (Mayr, 1991). In a general sense, applied to non-biological domains, variation can be defined as any departure from routine or tradition (Aldrich, 1999, p. 22), or where individuals 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, 2012). *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).

Generalist Darwinists argue that the Darwinian framework has a high degree of generality, which provides a meta-theoretical structure of over-arching principles that can be used to frame and explain change (Hodgson & Knudsen, 2006). For although the abstract principles (i.e. variation, selection and retention) do not themselves provide full or complete answers regarding change, nevertheless they must be honored, for the explanation of evolution to be adequate (Aldrich et al., 2008).

Drawing on Generalized Darwinism as an overarching framework of evolutionary change, this research examines change in how an IS is used to support one's work. The factors that facilitate such change are also examined. The case findings as well as motivational theory and other prior research are used to better understand the nature of these triggers and how they relate to evolutionary change. The outcomes identify key factors that influence change and provide suggestions for encouraging users through change, to leverage more fully, the potentials of the IS to support their work.

## **Methodology**

The purpose of this study is to investigate change in individuals' use of an IS within organizational contexts. This paper reports on a multi-phase study to examine change in use. Phase 1 is exploratory in nature and applies a qualitative mode of enquiry (i.e. case studies), while Phase 2 is confirmatory and uses a quantitative mode of enquiry (based on survey data). The purpose of this mixed-method approach research design was developmental (Ventakesh, Brown and Bala, 2013), that is, the qualitative study in Phase I was used to identify and develop constructs and hypotheses within the Generalized Darwinism framework, while the quantitative study in Phase II was used to investigate the hypotheses.

This study focused on complex IS. In Phase 1, data was collected from users of a *Customer Relationship Management System (CRM)* while a *Learning Management System (LMS)* was the target system in Phase 2. Although different IS were used for the study phases, both were Complex Information Systems (Hong, Chan, Thong, Chasalow and Dhillon, 2014; Wang and Hsieh, 2006), with CRM managing functional areas such as sales, marketing, and customer support, while LMS are enterprise level systems that manage, support and deliver learning resources for varying number of courses. Both systems therefore have a wide range of features, and are somewhat malleable as while use was mandatory for most in both contexts, users could often choose the extent to which they used the system (and various features) to support their work. Both the CRM and LMS were therefore appropriate for studying post-adoption use (Schwarz, 2003). Further, given the range of features following initial use of the IS, users were able to extend their use by looking for and over time applying new system features to support their work tasks (Hsieh and Wang, 2007).

Both systems were suitable for this study. At the same time differences between the systems and contexts which may yield situational factors that impact the findings are acknowledged, with Phase 1 was conducted in a business setting, while Phase 2 was conducted in a university setting. For example, while use of the CRM was mandated, there was more flexibility in the extent of use of the LMS, though all users had used some aspects of it in their work. Also while impact on performance reviews were a key driver of use of the CRM, use of the LMS had less impact for University faculty. Nonetheless, the system characteristics as complex IS and usage context make both appropriate for studying change in use.

### **Phase 1**

Phase 1 used case studies to explore how individuals' use of IS changes over time within a 'real life' context (Yin, 2002). Case studies in IS research is a viable strategy as it allows researchers to study IS in a natural setting and is suited for research on the on-going use of IS (Oates, 2005).

Purposeful sampling (Miles & Huberman, 1994) was used to select the participating organization, the focal system and subsequently the users who were interviewed. This paper reports the findings from 19 users of a *Customer Relationship Management System (CRM)* in a large firm in New Zealand. The firm is a large supplier of fertilizer products, and uses a CRM to manage its customer base and help improve the quality of service provided to clients.

Interviews were the primary data collection technique used for the case studies. Since users differ in the way they apply an IS in their work (Munro et al., 1997), this study sought to interview a variety of users, that is, basic, intermediate and advanced users. Definitions adapted from Munro et al (1997) were used to

delineate the user types; these were given to organizational contacts to help identify suitable participants.

There were two key user groups of the CRM: Customer Service Representatives (CSR) and Account Managers. Both use the system in distinct ways to reflect their different roles and needs. The CRM is used by CSRs in the call centres to record and update customer details, record and handle customers' queries, transact sales, and general management of the client's information. On the other hand, the Account Managers are assigned several clients (of varying sizes) and ultimately manage these clients' accounts. Nineteen (19) users drawn from both groups (i.e. CSRs and Account Managers) were interviewed: 3 basic, 7 intermediate, and 9 advanced users. Interviews and other meetings were also held with the Chief Information Officer and the in-house trainer to gain an understanding of the IS, its background, how it is used in the firm, and to get a walkthrough of the IS.

For the user interviews, the Critical Incident Technique (CIT) (Flanagan, 1954) was used to guide the data collection as it facilitates the investigation of significant occurrences (e.g. events, incidents, or processes) identified by the respondent, how they are managed, and the outcomes. As respondents described their 'journey' of how their use of the IS had changed (or not) over time, they were asked to relate incidents or events that reflect the changes; probing questions were then asked to further understand the 'how' and 'why' of such changes. Interviews were audio-recorded and fully transcribed.

The findings from the qualitative phase were analysed using Generalized Darwinism principles of variation, selection and retention, and the collective results used to develop a research model for further analysis. The Miles, Huberman and Saldana (2013) framework 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. This 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 over time were reflected in the earlier analyses. Also, to assure the quality of the qualitative research, steps were taken to safeguard construct validity, internal validity and external validity, and reliability (Dubé and Paré, 2003; Yin, 2009).

## ***Phase 2***

For Phase 2, the quantitative phase, findings from the qualitative phase (involving two user groups) coupled with a review of the literature and insights from Generalized Darwinism principles of variation, selection and retention were used to develop a conceptual model to frame changes in post-adoption use for further analysis.

Data for the field study was collected by surveying 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, instant messaging, online news and announcements, calendaring, quizzes, wikis 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. In some cases, IT support are able to develop and deploy user-defined features, allowing users through IT to 'create' new features or adjust existing system features for use in 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.

An invitation to participate in the study was sent via e-mail to approximately 200 academics in New Zealand; they had the option to complete the online survey or the paper-based version of the survey. Altogether 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 or its predecessors 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 Development of Hypotheses

Although, it is typical for hypotheses to be discussed earlier in a paper (e.g. in the literature review), these are discussed here to mirror the process that underpinned this research. Using the Generalized Darwinism framework, findings from the case studies, motivational theory and a review of the literature, this section discusses key aspects of variation, selection and retention in regards to IS use, and the outcome of change (by way of retention through continued use of selected features). Triggers of variations and retention are also discussed. These factors and their relationships are then used to frame a conceptual model of change in IS use (See Figure 1) for testing in Phase 2; for completeness, the associated hypotheses are also introduced in this section.

### **Variation**

Variation is defined as change from current routines (Aldrich, 1999). 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. Variation, in this context introduces alternatives in how the IS can be used to accomplish work routines.

Findings from the interviews 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. For example, a user on describing how their use has changed, commented, "*I'm starting to use more and more of the other pages.*" Similar concepts in the extant literature include trying new features and feature exploration (Ke et al., 2012; Sun, 2012). Users also described how they modified their currently used features by way of changing the way in which features were used, which included 'fine-tuning' and revising the current use of features to improve efficiency and outcomes. For example, a user in discussed how their use of a search feature varied over time stated, "*you change where you're looking [the criteria] and then you can cut down the search.*" Modifying use of currently-used features is similar to concepts of refinement (Levinthal & March, 1981) and exploitation (March, 1991). Substituting features refers to replacing currently used features with other features with similar functions (Sun, 2012). For instance, a user described how they had replaced a previously used feature to perform a task with another because "*it's easier to look up for a specific order.*" Innovating with the IS relates to finding new uses or innovative (i.e. very unusual) ways of using IS features (Ahuja & Thatcher, 2005). For example, a user shared how they started to use 'segments' for an atypical but useful purpose, that is, to verify whether CSRs are using the correct naming convention for special mixes. As users engaged in variations, they inherently re-conceptualized their work processes to accommodate the IS. This included the creation and modification of work processes (Orlikowski, 2000).

Collectively, considering these varieties of use, this study defines variations in how an IS is used, 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'.

### **Selection and Retention**

Variations provide the raw materials for selective systems to operate on. Selection emphasizes the "differential elimination of certain types of variations" in which some variants are chosen and others are rejected, while retention represents the case where "selected variants are preserved, duplicated or otherwise reproduced" (Aldrich, 1999). Some scholars have used the term 'variation' and 'selective retention' to collectively represent the processes that underlie evolution (Campbell, 1965; Feldman and Pentland, 2003). Feldman and Pentland (2003) posit that through the selection of variation, aspects of the routine is created, maintained and modified, referring to this as '*selective retention*'. Likewise, this paper will also examine the process of selection and retention together (rather than as distinct elements) to understand change in individuals' use of an IS, on the premise that change occurs when variations in how an IS is used are *selectively retained* over time. Also, as users recounted their stories of how their use changed over time, the mechanisms by which they selected and then chose to retain variation were not necessarily distinct activities or easily separable. Since, the overall aim is to provide insights into how individuals *selectively retain* a variation, that is how they 'turn a variation into part of their story' about

how they perform their work routines (i.e. retention) (Feldman & Pentland 2003), it is useful to examine selection and retention together.

Based on the evolutionary process, it is evident that unless selected, the variant cannot be retained. Retention permits selected variants to persist and thus contribute to the variation upon which future selections act (Donahoe, 2012). While noting that members of an organization may or may not choose to incorporate variations into their routine (Feldman & Pentland, 2003), variations nevertheless increase variety in the entities of a set, some of which may then be retained (Stoelhorst, 2008). For instance, a user in describing how they had incorporated particular features into their routine shared “*if you do see a feature or function and see what it does...from that you can determine whether it is of any help to you or not.*” Selection and by extension retention, requires variety, for if variety is absent, then evolution will desist (Aldrich et al, 2008). Thus, an increase in variations will increase the likelihood for change through selection and retention. This research therefore posits that:

H1: Variations is positively associated with retention

Retention occurs when an individual turns a variation into part of the story about how they accomplish a work task (or process) (Feldman & Pentland, 2003), which generates change. As changes occur over time, it is expected that ultimately such changes in a rational context would be aimed at developing more deeply ingrained use behaviors. As users recounted their stories, they shared about how they now used more of the IS features to support their work (evidenced by retaining use of particular features). As one user shared “*I use far more features of the CRM now*”. Thus, by way of retention, users started to use more features of the IS to support a more comprehensive set of work tasks. Use of this nature is referred to as ‘extended use’ and represents a type of deep use (Saga and Zmud, 1994; Hsieh and Wang, 2007). Accordingly, the study focused on *extended use* as it was the type of post-adoption deep use most often referred to by users. Extended use can include features and tasks that are within the scope of those initially conceived by designers and implementers, but which go beyond that required by management (Hsieh & Robert, 2006). Thus, as changes in post-adoptive behavior occur, users may come to apply previously unused features and features to perform work tasks (Jasperson et al, 2005). Hence, it is suggested that:

H2: Retention is positively associated with extended use

### ***Triggers to Change***

Despite the usefulness of an evolutionary framework for describing change, it fails to account for the processes that lead to the introduction of variations (Ford, 1996). This section will discuss key themes that emerged from the case study and literature review, which were identified as antecedents (i.e. triggers) of variation and retention and the resulting hypotheses (See Figure 1). Motivational theory is also used to provide a theoretical framework for understanding the triggers and how these relate to outcomes, that is, variation, retention and consequently change in use.

### ***Antecedents to Variations***

As noted earlier, Phase 1 of the study was exploratory in nature. The interview findings suggested that motivation (intrinsic and extrinsic) and knowledge are key to facilitating variations. These findings are supported by the literature so are discussed alongside this literature, in the development of the research model and accompanying hypotheses.

### ***Intrinsic Motivation***

Compared to extrinsic motivation, researchers have paid significantly less attention to the role of intrinsic motivation in understanding IS use (Li et al., 2013). One possible reason for this is the often oversimplified conceptualization of intrinsic motivation towards IS use (Li et al., 2013). Most measures of intrinsic motivation focus on the pleasant experiences of use (Gerow, Ayyagari, Thatcher, & Roth, 2013; Wu & Lu, 2013), with a hedonic emphasis (Li et al., 2013). However a hedonic emphasis is limited as, it does not capture the ‘richness’ of innate rewarding aspects (Li et al., 2013) and thus neglects other aspects of intrinsic motivation such as the cognitive and affective elements (Amabile et al., 1994). Furthermore,

intrinsic motivation at work may differ from that in leisure activities and the hedonic context (Thomas & Velthouse, 1990). Vallerand and colleagues proposed a tripartite taxonomy of intrinsic motivation: (i) *intrinsic motivation to know*, (ii) *intrinsic motivation towards accomplishment*, and (iii) *intrinsic motivation to experience stimulation* (Vallerand, et al, 1992; Vallerand, 1997). This taxonomy has been successfully used to explain motivation in different domains including academic motivation (Guay, Vallerand, & Blanchard, 2000; Vallerand et al., 1992), sports motivation (Pelletier et al., 1995; Vallerand, 2004), exercise motivation (Li, 1999), and more recently, IS use (Li et al., 2013).

*Intrinsic motivation to know* (IM-to-know) refers to engagement in an activity to experience pleasure and satisfaction from learning, exploring or trying to understand something new (Vallerand, 1997). This type of intrinsic motivation relates to constructs such as exploration, intrinsic intellectuality, intrinsic curiosity and intrinsic motivation to learn (Vallerand et al., 1992). Intrinsic motivation was evidenced in the case findings as users proactively engaged with the IS because of the pleasure and satisfaction they experience when learning, exploring, or trying to understand something new in the IS. For example, one participant shared, “*I just like to know what it [the System] can do...*” Prior research suggests that IM-to-know plays a critical role in post-adoption use, and can serve as an enabler of pro-active use behaviors (Li et al., 2013). Consequently, it is posited that:

H3a: Intrinsic Motivation to Know (IM-to-know) is positively associated with Variations

*Intrinsic motivation toward accomplishment* (IM-to-accomplish) refers to engagement in an activity for the pleasure and satisfaction experienced when attempting task mastery, surpassing oneself, or in trying to accomplish or create something (Pelletier et al., 1995; Vallerand, 1997). This was evident in the case findings, as participants shared how they gained satisfaction from trying to solve work problems and accomplish tasks when using the CRM, as a user shared “*I just fiddled with it [the CRM] until I got it to what I want it to do*”. Intrinsically motivated individuals tended to seek out complex and difficult tasks (Amabile et al., 1994), and when they find optimal challenges, they work to conquer them in a persistent way (Deci & Ryan, 1985). Consequently, it is posited that:

H3b: Intrinsic Motivation toward Accomplishment is positively associated with Variations

*Intrinsic motivation to experience stimulation* refers to engagement in an activity for feelings of sensory pleasure, fun, excitement or aesthetic enjoyment associated with it (Vallerand, 1997). Research on feelings of fun and excitement in intrinsic motivation has shown positive effects on post-adoption use behaviors such as exploratory usage (Ke et al., 2013) and innovative use (Li et al., 2013). Intrinsic motivation of this nature is most often used in IS research (Gerrow et al, 2012). Some participants shared that they engaged in variation because of the fun and excitement of engaging with the CRM, as one user shared, “*it’s quite fun to do... just to see what things you can do [in the System]*.” Prior research has shown that this positive affect influences creativity (Amabile, Barsade, Mueller, & Staw, 2005) and by extension individuals’ creative performance, thus increasing personal initiative and pro-active behavior (Rank & Frese, 2008). Hence, it is expected that:

H3c: Intrinsic Motivation to Experience Stimulation is positively associated with Variations

## **Extrinsic Motivation**

Extrinsic motivation pertains to a wide array of behaviors where the goals of the action extend beyond those inherent in the activity itself (Guay et al., 2000). Deci and Ryan (1985) proposed a continuum of behavioral regulation that ranges from non- self-determined regulation (external regulation) to completely self-determined regulation (integrated regulation). Four types of extrinsic motivation have been described by Deci and Ryan (1985), namely *external regulation*, *introjected regulation*, *identified regulation*, and *integrated regulation*. These forms of extrinsic motivation vary by the degree to which individuals internalize and integrate the regulations (Ryan & Deci, 2000). Internalization is the process of taking in a regulation or value, and integration is the process by which an individual more fully transforms a regulation into their own, so it originates from their sense of self (Ryan & Deci, 2000). Based on the case findings, this study further examined three (3) of the types of extrinsic motivation put forward by Deci and Ryan (1985): *external regulation*, *introjected regulation*, and *identified regulation*. The fourth type, *integrated regulation*, which is the closest form of extrinsic motivation to intrinsic motivation, was not examined in this study. Integrated regulation occurs when identified regulations have



been fully assimilated to the self, and through self-examination the individual brings the new regulations into congruence with their other values and needs (Ryan & Deci, 2000). Integrated forms of motivation being both autonomous and unconflicted therefore share several qualities with intrinsic motivation (Ryan & Deci, 2000), so overlap to some extent with intrinsic motivation.

*External regulation* is the least autonomous form of extrinsic motivation, and the behavior is performed to satisfy an external demand or to obtain an externally imposed reward contingency (Ryan & Deci, 2000). External regulation suggests that the individual perceives the origin of one's behavior in external influences or pressures (Malhotra, Galletta, & Kirsch, 2008). The findings from the case showed that extrinsic motivation was largely evident in the form of mandated use or directives from management (e.g. to use specific features of the IS), that is, external regulations. For example, users noted that when they were told that use of certain features was part of their performance review, they started to use those features. With external regulation, behavior is regulated by rewards or to avoid negative consequences, thus regardless of whether the goal of the behavior is to obtain rewards or to avoid sanctions, the individual experiences an obligation to behave in a specific way (Guay et al., 2000). Consequently, it is suggested that:

H4a: External Regulation is positively associated with Variations

Another form of extrinsic motivation is *introjected regulation*. Introjection suggests a formerly external regulation has been 'taken in' and is now enforced through internal pressures such as guilt, anxiety, or related self-esteem dynamics (Ryan & Connell, 1989). Through introjection, reliance on environmental regulation is minimized and replaced by new and quite different affective determinants and qualities (Ryan & Connell, 1989). Nevertheless, introjected regulation still retains a quality of pressure and conflict, or a lack of complete integration with the self and has an external perceived locus of causality (Ryan & Deci, 2000). For example a user shared that although they were "*more of a diary, a paper person*", they had to use the CRM to perform certain tasks as management now uses the system to generate various performance reports (including those used for employee reviews). Introjected regulation is thus more of a controlling than an autonomous type of motivation, and although individuals do not accept the action as their own (Ryan and Deci, 2000), introjected regulation can trigger change in behaviors. Consequently, it is suggested that:

H4b: Introjected Regulation is positively associated with Variations

A more autonomous or self-determined form of extrinsic motivation is *identification regulation*. It reflects a conscious valuing of a behavioral goal or regulation (Ryan & Deci, 2000). With identified regulation, self-determined behaviors occur when individuals place value on and judge an activity as important to the self (Ryan & Deci, 2000). Thus, the action is undertaken because of its value, importance or usefulness (Deci & Ryan, 1985). For example, an interviewee recounted how he/she realized the value of using the CRM's calendar after being told that they were no longer allowed to use written diaries. The interviewee shared "*It's the most convenient calendar to use because you were able to sync it through the CRM calendar into our phones and PDA's. So you have that calendar there with you.*" Unlike external regulation, identified regulation occurs when a behavior becomes valued and perceived as being chosen by oneself (Guay et al., 2000); this may occur over time as a once mandated behavior becomes internalized, and accepted as though it was chosen by oneself. Nonetheless, the motivation is still considered extrinsic because the activity is not performed for itself but as a means to an end. Hence, it is suggested that:

H4c: Identified Regulation is positively associated with Variations

## Domain-relevant knowledge

Domain-related knowledge which includes knowledge of the *features of the IS* and of *work processes* was also instrumental in facilitating changes in post-adoption use (Deng & Chi, 2012), with prior research showing that domain-related knowledge is key in changing behavior (Jones et al., 2008). Some participants shared that as they gained greater knowledge of the IS, in terms of the features available and how they can be used in their work tasks, this allowed them to engage with the CRM further. At the same time, insufficient knowledge of the IS features available and applicability in supporting ones' work and of an understanding of one's work processes was shown to be an inhibitor to change. Furthermore, some users recounted how greater understanding of work processes in regards to their job role also triggered

changes in use. Prior research also suggests that as users gain a better understanding of their work processes in the IS context, it is likely that they will uncover new system features to better support these processes (Jones et al., 2008). Consequently, it is posited that:

H5: Domain-related Knowledge is positively associated with Variations

## Feedback

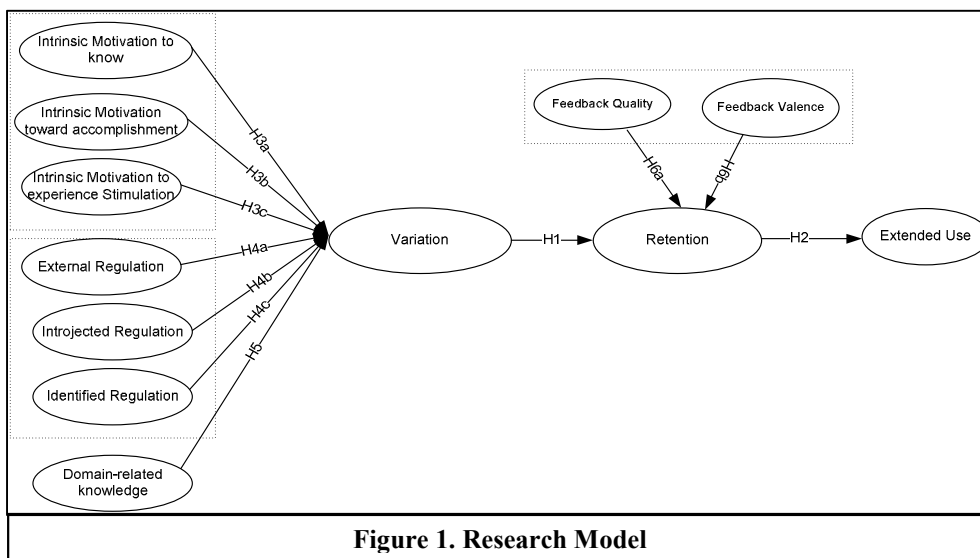
Feedback is essential in the dynamics of the evolutionary process and can impact systems that are evolving under Darwinian principles (Robertson, 1991). At the micro-level, individuals make choices throughout the evolutionary process (variation, selection and retention) with feedback playing a key role in the decision making process (Breslin, 2011). Feedback can promote certain behaviours and suppress others (Murmman, Aldrich, Levinthal & Winter, 2003). Findings from the case study also showed that feedback played a key role in retention decisions. As users interact with an IS, they consider and process surrounding informational cues (by way of feedback), which can direct future behaviors (Jasperson et al, 2005). These included feedback from managers and peers commending or correcting persons in how they used a particular feature. In this paper, both feedback quality and valence are examined.

Feedback Quality refers to *the consistency and usefulness of feedback, and the informational value of the feedback message* (Steelman et al., 2004). High-quality feedback is generally perceived as more useful than low-quality feedback (Steelman et al., 2004), and is therefore likely to provide an individual with information that aids in understanding an action or behavior (Peng & Chiu, 2010) and its outcome. Consequently this research posits that:

H6a: Feedback Quality is positively associated with retention

The literature argues that there are fundamentally two (2) types of feedback: positive and negative (Robertson, 1991; Smith, 1986). Both types have radically different effects, as negative feedback tends to produce stability and resistance to change, while positive feedback produces instability (Robertson, 1991). Negative feedback can be considered deviation-counteracting as it enables processes that maintain equilibrium situations, whereas positive feedback is deviation-amplifying (Smith, 1986). Positive feedback indicates the appraisal of satisfactory behavior, while negative feedback indicates undesirable behavior and can lead to stasis (Van den Bossche, Segers & Jansen, 2010; Seaborg, 1999). Thus, this study posits that positive feedback may lead to reinforcement and continuation of an initial action (i.e. variation), resulting in retention, while negative feedback may cause a user to abandon a variation they have experimented with. Hence it is posited that:

H6b. Feedback valence is positively associated with retention



## Data Analysis

There were several considerations in determining the approach used to assess the relationships in the model (Hair, Ringle and Sarstedt, 2011). Key considerations pertained to the goals of the study, properties of the data and model. For example, PLS-PM is recommended when the goal of the study is that of prediction (or identifying key 'driver' constructs), which is more suited to covariance-based SEM. Also in relation to the sample size (which was small at 86 observations), the research model was relatively complex (with many constructs and indicators); here PLS-PM is able to provide reliable analysis with small sample sizes. PLS-Graph Version 3.00 was used to assess the measurement and the structural model, and bootstrapping (with 1000 samples) used to evaluate the strength of the structural paths.

Measures for all constructs were developed using insights gained from the literature and the interviews: variation (3 items), retention (4 items), intrinsic motivation to know (2 items), intrinsic motivation toward accomplishment (2 items), intrinsic motivation to experience stimulation (3 items), external regulation (3 items), introjected regulation (2 items), identified regulation (3 items), domain-related knowledge (2 items), feedback quality (5 items), feedback valence (3 items) and extended use (4 items). In the case of variation, retention, and domain-related knowledge, overall measures were used to assess the constructs. For example, with regards to variation, 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). Appendix A shows the measures used in this study

### 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 0.728 to 0.996, exceeding the recommended thresholds of 0.70 (Chin, 2010).

Composite reliabilities (CR) ranged from 0.884 to 0.996 (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 0.657 to 0.992 (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)**

	Mean	SD	CR	AVE	Var	RTN	IMKn	IMAc	IMSt	ExtReg	IJReg	IdReg	KNv	FBQL	FVL	ExUse
Var	2.840	1.596	0.972	0.921	1.000											
RTN	2.906	1.376	0.948	0.820	0.487	1.000										
IMKn	1.367	1.326	0.920	0.852	0.141	0.116	1.000									
IMAc	0.842	1.462	0.985	0.971	0.043	0.016	0.385	1.000								
IMSt	0.646	1.552	0.978	0.937	0.049	0.053	0.505	0.515	1.000							
ExtReg	-0.027	1.345	0.948	0.860	0.033	0.041	0.071	0.108	0.101	1.000						
IJReg	-0.278	1.563	0.996	0.992	0.045	0.050	0.164	0.284	0.241	0.302	1.000					
IdReg	0.700	1.328	0.929	0.813	0.217	0.144	0.296	0.281	0.191	0.321	0.275	1.000				
KNW	0.193	1.700	0.976	0.954	0.209	0.036	0.130	0.094	0.095	0.009	0.022	0.122	1.000			
FBQL	0.579	1.060	0.972	0.874	0.242	0.154	0.127	0.041	0.107	0.026	0.124	0.088	0.175	1.000		
FB VL	0.496	1.038	0.966	0.905	0.219	0.131	0.114	0.057	0.134	0.012	0.058	0.080	0.171	0.636	1.000	
ExUse	1.531	1.272	0.884	0.657	0.343	0.236	0.103	0.124	0.098	0.054	0.130	0.246	0.268	0.163	0.239	1.000

Key: Var=Variation; RT= Retention; IMKn= Intrinsic Motivation to Know; IMAc= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; ExtReg= External Regulation; IJReg=Introjected Regulation; IDReg= Identification Regulation; Knw=Domain-related Knowledge; FBQL=Feedback Quality; FBVL= Feedback Valence; ExtUse=Extended Use

This research also applied the Harman’s one-factor test (Podsakoff et al., 2003) to detect common method bias. The test was performed on the 36 items used to assess the research model. The results showed that no single factor accounted for more than 0.377 of the variance suggesting common method bias was unlikely to be a significant concern for this study.

**Structural Model**

Table 2 shows the results for the structural model. The results show that the relationship between variation and retention was strongly supported (0.666,  $p \leq 0.001$ ), suggesting that greater variety in one’s use will have a positive effect on retention. H1 was therefore supported. The model also showed that retention had a strong and positive impact on extended use (0.485,  $p \leq 0.001$ ), accounting for variance explained of 0.236. Hypothesis 2 was supported.

Turning to variations, the results showed that the model accounted for 0.347 of the variance explained for variations. Intrinsic motivation to know (0.211,  $p \leq 0.10$ ), identified regulation (0.373,  $p \leq 0.05$ ) and domain-related knowledge (0.324,  $p \leq 0.05$ ) were positively related to variations; Hypotheses H3a, H4c and H5 were therefore supported. However contrary to expectations the results did not provide support for the links between variations and, intrinsic motivation toward accomplishment (-0.171), intrinsic motivation to experience stimulation (-0.070), external regulation (-0.062) and introjected regulation (0.042); Hypotheses H3b H3c, H4a, and H4b were therefore not supported.

For retention the results show that variations, feedback quality and feedback valence accounted for 0.490 of the variance explained for retention. As noted earlier, the relationship between variation and retention was significant, however neither feedback quality (0.069) nor feedback valence (-0.005) were significant with respect to variations. Thus H6a and H6b were not were supported.

<b>Table 2. Structural Model Results</b>		
Hypotheses	Path Coefficient	Significance Level
Variation → Retention (H1)	0.666	$p \leq 0.001$
Retention → Extended Use (H2)	0.485	$p \leq 0.001$
Intrinsic Motivation to Know → Variation (H3a)	0.211	$p \leq 0.10$
Intrinsic Motivation to Accomplish → Variation (H3b)	-0.171	Not Significant
Intrinsic Motivation to experience Stimulation → Variation (H3c)	0.070	Not Significant
External Regulation → Variation (H4a)	-0.062	Not Significant
Introjected Regulation → Variation (H4b)	0.042	Not Significant
Identified Regulation → Variation (H4c)	0.373	$p \leq 0.05$
Domain-Related Knowledge → Variation (H5)	0.324	$p \leq 0.05$
Feedback Quality → Retention (H6a)	0.069	Not Significant
Feedback Valence → Retention (H6b)	-0.005	Not Significant

**Discussion and Conclusion**

The aim of this study is to deepen our understanding of individuals’ change in IS use. The study applies a Generalized Darwinism framework using the tripartite lens of variation, selection and retention to examine changes in use. The case findings, motivational theory and other prior research were used to identify and frame how triggers related to evolutionary change, and survey data used to assess the resulting model.

Variation is often dubbed the 'raw material' for evolution and is instrumental in the evolution process, as without a rich variation, selection processes have no material to work on (Mayr, 1991). Both the qualitative and quantitative findings revealed that variations occurred as individuals experimented with different ways to do their work to accommodate the System or different ways of using the System to support their work. This resulted in a range of post-adoptive behaviors such as 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. Furthermore, users created and modified their work processes to accommodate the IS. The findings revealed that in performing variations over time, users were able to improve their use of the IS and enhance their work routines. These findings corroborate prior research which suggests that to achieve success in IS use, it is pivotal that users alter their work processes and selectively appropriate IS features (Ke et al, 2013).

Consistent with Generalized Darwinism, the survey findings showed that the link between variation and retention was strongly supported suggesting that greater variety in one's use will have a positive effect on retention and thus change in one's use of an IS over time. 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).

On examining the impact of retention on extended use, the results showed that retention had a positive and significant effect. This suggests that as IS use changed over time, by way of retention, it resulted in greater use of the system features to support one's work (Schwarz, 2003), that is extended use. As such, by way of extended use, individuals learn and apply more of the available IS features, thus making deeper use of the IS to support their work (Hsieh & Wang 2007; Saga & Zmud, 1994).

Using the case study findings and motivational theory, the study also examined the roles of intrinsic and extrinsic motivation in variations. Intrinsic motivation was also particularly salient in the case studies and in the survey findings. The case findings revealed that variation was triggered by various forms of intrinsic motivation, namely, intrinsic motivation to know, intrinsic motivation toward accomplishment and intrinsic motivation to experience stimulation (Vallerand, 1997). Traditionally, the IS literature focuses on fun and excitement as a measure of intrinsic motivation (Li et al, 2013). However the findings of this study suggest other elements of intrinsic motivation are important and should be explored as they may be instrumental in promoting post-adoption use of an IS. The survey findings only showed support for the relationship between intrinsic motivation to know, and variation. The difference in context for the case study (Customer Relationship Management System) and the survey (Learning Management System) may have played a role in the difference between the findings. For example, a possible explanation for the insignificant relationship between intrinsic motivation to accomplish and variation for the survey context may lie with the fact that use of the CRM impacted the performance reviews, motivating user to 'push the boundaries' while use of the LMS did not figure strongly in performance appraisals for faculty.

Nevertheless, both qualitative and quantitative findings provide insights into specific aspects of intrinsic motivation (IM) that managers can focus on. For example, managers can nurture users' intrinsic motivation by taking actions to encourage IM to know, IM towards accomplishment and IM to experience stimulation. For example, to encourage IM to know, managers could take steps to foster a learning environment in which users are able to learn as they share knowledge with each other and satisfy their curiosity (Li et al., 2013). In the case of IM toward accomplishment, managers can provide the necessary resources, for example through IS or peer support to assist users when they face difficulties in using IS (Li et al., 2013). Finally, to foster IM to experience stimulation, managers can offer IS that have hedonic characteristics which may help to improve employee moods, increase user satisfaction, and encourage involvement through experimentation (Gerow et al., 2013).

The role of extrinsic motivation in variations was also examined. There were differences in findings between the case study and survey. The findings from the case studies revealed that external regulation, introjected regulation and identified regulation played a role in triggering variation. In the case organization, managers often mandated the use of particular features; individuals' performance was also tied to use of the CRM. There was also evidence where users identified with the value of using particular features, and thus internalized the benefits. On the other hand, the survey findings revealed a significant relationship only between identified regulation and variation, which may have been due to the study context. For example, external regulation may not have been a significant predictor of variations, as faculty were generally not mandated to use the LMS for their work. At the same time, research has shown

that all three forms of extrinsic motivation can play a role in changing behaviors, although this may differ across contexts. Studies have shown however that more autonomous forms of extrinsic motivation (such as identified regulation) are positively related to expending effort to engage in certain behaviors, and associated with greater engagement, higher learning and among other outcomes (Ryan and Deci, 2000).

In considering the findings from both the case and the survey, various forms of extrinsic motivation can impact change in use; however these can have an even greater impact on change when management communicates the benefits and instrumental value of using various aspects of the IS to users. This in turn can help individuals to better identify with the importance of the behavior (identified regulation), hence making it a more autonomous or self-determined form of extrinsic motivation (Ryan & Deci, 2000). Especially in voluntary settings, identified regulation is more likely to lead to change.

Another factor that may play a role in changing behavior is knowledge (Amabile and Mueller, 2008) Domain-related knowledge of IS features and work processes also enabled variations in both the case and survey findings. 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). Previous research has also shown that as users' software understanding increases, the assimilation of its features increases (Jones et al., 2008). To further develop users' knowledge, managers can implement strategies to bridge the gap between what users know and what they need to know, to help enable a better user experience (Ceaparu, Lazar, Bessiere, Robinson, & Shneiderman, 2004), which may in turn cause change (Jones et al., 2008).

The case study findings showed that feedback played a key role in retention decisions. Two aspects of feedback were therefore evaluated in the survey - feedback valence and feedback quality. However the survey showed that neither forms of feedback were significant predictors of the level of retention that was observed. One possible explanation for the disparate findings may again lie with the study context. The case organization seemingly had a richer feedback environment with greater opportunity to receive feedback from peers and managers as individuals interacted and experimented with the IS. For example, persons were encouraged by their managers to use the system as much as possible, and find ways of using the system to support their work; significant new uses of the IS were recognized and persons encouraged to share their 'discoveries' with others in team meetings and other forums. This however was not the case in the survey context. Nonetheless, feedback is considered critical for change to occur (Breslin, 2011). Studies show that once a variation is selected and the new action is enacted, individuals then interpret the feedback and decide whether to retain or discard the selected variation. If the feedback is perceived as favorable, then retention may occur (Breslin, 2011). As individuals used an IS, managers, for example, can create environments where individuals receive useful feedback from peers and supervisors when they perform variations. Also, the system itself can be a good source of feedback; if users can access to a 'test' version of the IS, they can freely experiment without affecting the main system to see how well their experiments work. While feedback has generated interest in other domains (such as management), there is a paucity of research in relation to IS use. Although the relationship between retention and feedback was not significant, future investigation of the role of feedback in enabling change may be of value.

In summary, this study responds to calls for research examining changes within and across individual's post-adoption behavior (Jasperson et al, 2005). It seeks to understand changes in use using Generalized Darwinism as a meta-theory supported by motivational theory, and on IS use. Although the factors examined are not exhaustive, the findings provide useful insights that further our understanding of post-adoption IS use and the mechanisms by which IS use changes (and can be changed) over time.

### **Limitations and Future Work**

Finally, while acknowledging the insights gained, there are some limitations to note. For example, it would have been ideal to examine changes in post-adoptive use in a longitudinal study, but this was not feasible for this research. However, it should be noted that in the case interviews and the survey, individuals were asked to 'think back' on how their use has changed over time in an attempt to capture change retrospectively. Also, by capturing data from different user types (i.e. from basic to advanced users), this also allowed us to capture varying perspectives on different stages of the journey. Collectively these enabled reflection on key aspects of change over time even if these were not captured directly through longitudinal study. Second, in the survey, users were asked to self-rate their level of expertise,

extent of variations and retention etc.; with this there is a possibility of response bias including under- of over-reporting. Another limitation is that the case study and survey were focused on one system context only – Customer Relationships Management and a Learning Management System respectively. The findings showed that each had some unique characteristics which impacted the findings. While on the one hand this ensured richer insights, it is evident that the nature of the research model and change in use may change depending on context. Hence there is opportunity to investigate the model further in other contexts, to uncover elements that are broadly applicable across contexts as well as those which may be particular to certain contexts.

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## Appendix A: Measurement Scales

Construct	Measures (Items)
Variation (Overall)	<p>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 (<i>Strongly Disagree to Strongly Agree</i>)</p> <p>Overall, thinking back to when you first started, how much have you experimented with different ways of using or accommodating the LMS in your job?</p> <ul style="list-style-type: none"> <li>o None at all to A Great Amount</li> <li>o Not at all to A Very Great Extent</li> </ul> <p>(<i>Self-developed items, 7-point Likert scale</i>)</p>
Retention (Overall)	<p>Overall, thinking back to when I first started, most of the Variations I have experimented with (<i>in using or accommodating the LMS in my job</i>) have been INCLUDED in my work routine (<i>7-point Likert scale: 'Strongly Disagree to Strongly Agree</i>)</p> <p>Overall, thinking back to when you first started, of the Variations you have experimented with (<i>in using or accommodating the LMS in your job</i>) how much have you INCLUDED in your work routine?</p> <ul style="list-style-type: none"> <li>o None at all to A Great Amount</li> <li>o Not at all to A Very Great Extent (<i>7-point Likert scale</i>)</li> </ul> <p>Overall, thinking back to when you first started, of the Variations you have tried out (<i>in using or accommodating the LMS in your job</i>) approximately what % have you ADOPTED into your work routine?</p> <p>(<i>Self-developed items</i>)</p>
Extended Use	<ol style="list-style-type: none"> <li>1. Of the <b>relevant</b> features of the LMS for supporting your work, about what % are you using? (<i>Percentage</i>)</li> <li>2. Of <b>all the features</b> that the LMS offers, about what % are you using to support your work? (<i>Percentage</i>)</li> <li>3. I am using a large percentage (%) of the <b>relevant</b> features of the LMS to support my work. (<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</li> <li>4. I am using a large percentage (%) of <b>all the features</b> that the LMS offers to support my work (<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</li> </ol> <p>(<i>Self-developed items</i>)</p>
Intrinsic Motivation to know	<p>When experimenting with Variations:</p> <ul style="list-style-type: none"> <li>o I get enjoyment from learning new things (Guay et al., 2003)</li> <li>o I receive satisfaction from acquiring new knowledge (Guay et al., 2003)</li> </ul> <p>(<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Intrinsic Motivation toward Accomplishment	<p>When experimenting with Variations:</p> <ul style="list-style-type: none"> <li>o I experience satisfaction from outdoing myself (Guay et al., 2003)</li> <li>o I experience satisfaction from surpassing myself (Guay et al., 2003)</li> </ul> <p>(<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Intrinsic Motivation to experience Stimulation	<p>When experimenting with Variations:</p> <ul style="list-style-type: none"> <li>o I get enjoyment from fulfilling my intrinsic need for fun</li> <li>o I get pleasure from advancing my need for fun</li> <li>o I receive satisfaction from supporting my internal need for enjoyment</li> </ul> <p>(<i>Self-developed items, 7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
External Regulation	<ul style="list-style-type: none"> <li>o I am supposed to experiment with Variations (Ryan and Connell, 1989)</li> <li>o Experimenting with Variations is something that I have to do (Guay et al., 2000)</li> <li>o I feel that I have to experiment with Variations adapted (Guay et al., 2000)</li> </ul> <p>(<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Introjected Regulation	<ul style="list-style-type: none"> <li>o People who are important to me think that I should experiment with Variations</li> <li>o People whose opinions matter to me think that I should experiment with Variations</li> </ul> <p>(<i>Adapted from Ajzen &amp; Fishbein, , 7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Identified Regulation	<ul style="list-style-type: none"> <li>o Experimenting with Variations is important for me (Guay et al., 2000)</li> <li>o I believe that experimenting with Variations is good for me (Guay et al., 2000)</li> <li>o Experimenting with Variations is of value to me (Self developed)</li> </ul> <p>(<i>7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Domain-related knowledge (overall)	<ul style="list-style-type: none"> <li>o I have a lot of background knowledge when it comes to my experimenting with Variations</li> <li>o I have the know-how for experimenting with Variations</li> </ul> <p>(<i>Self-developed items, 7-point Likert scale, Strongly Disagree to Strongly Agree</i>)</p>
Feedback Quality	<p>On the whole, the feedback you receive when you experiment with a Variation is:</p> <ul style="list-style-type: none"> <li>o Useless...Useful</li> <li>o Worthless...Valuable</li> <li>o Meaningless...Meaningful</li> <li>o Insignificant...Significant</li> <li>o Unimportant...Important</li> </ul> <p>(<i>Self Developed, 7-point scale, semantic differential</i>)</p>
Feedback Valence	<p>On the whole, the feedback you receive when you experiment with a Variation is:</p> <ul style="list-style-type: none"> <li>o Bad to Good</li> <li>o Negative to Positive</li> <li>o Favourable to Unfavourable</li> </ul> <p>(<i>Self-developed items, 7-point scale, semantic differential</i>)</p>