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RESEARCH PAPER

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Revisiting the Impact of System Use on Task Performance: An Exploitative-Explorative System Use Framework

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Abstract

How information systems impact task performance has attracted a significant amount of attention from information systems researchers and generated high interest among practitioners. A commonly accepted view is that the potential of information systems must be realized through system use. Nevertheless, existing findings regarding the impact of system use on task performance are not yet conclusive. We attributed this to the various conceptualizations of system use and the unclear mechanisms through which system use influences task performance. Thus, this research attempts to create a better understanding of how system use influences task performance. To this end, we developed an exploitative-explorative system use framework in order to reconcile the various conceptualizations of system use and to depict how both exploitative and explorative system use influences task performance through impacting task innovation, management control, and task productivity. We created an instantiation of the framework using USAGE (exploitative system use) and adaptive system use (ASU, explorative system use). We conducted two empirical studies involving two different populations and using two different technologies. The first study consisted of 212 experienced users of MS Office, whereas the second study employed 372 new users of a video-editing tool. Our findings offer insight into how exploitative system use and explorative system use independently and jointly influence task performance constructs and also have implications for research and practices.

Keywords: Adaptive System Use, Exploitative and Explorative System Use, Task Performance, Complementarity.

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1 Introduction

The impact of information systems (IS) on individual task performance has been frequently studied by IS researchers and practitioners. A commonly accepted view is that information systems impact performance through system use (Boudreau & Robey, 2005). System use at the individual level has been defined as behaviors concerned with employing system features to accomplish tasks (Barki, Titah, & Boffo, 2007, Goodhue & Thompson, 1995, Sun, 2012). For research, understanding the link between system use and task performance affords opportunities to craft prescriptions for how to better design and implement new systems. In practice, such understanding helps justify the enormous investment in IS. Therefore, the means of maximizing the benefits afforded by IS through system use remains an important, high-impact question for IS researchers and practitioners (Hsieh, Rai, & Xu, 2011).

To date, studies examining relationships between system use and task performance have yielded mixed findings. Although many empirical studies have found that system use (measured in many different ways) has a significant impact on individual users' task performance, the magnitude of the impact varies (Burton-Jones & Straub, 2006): from positive (Goodhue & Thompson, 1995; Igbaria & Tan, 1997), to insignificant (Lucas & Spitler, 1999), or even negative (e.g., Ang & Soh, 1997; Pentland, 1989; Szajna, 1993). For example, Pentland (1989) demonstrated that system use and productivity—a crucial aspect of task performance—were only weakly associated.

We believe that two factors contribute to the mixed findings regarding the impact of system use on task performance. First, the definition and measures of system use vary across studies. IS researchers have offered different empirical and theoretical conceptualizations of system use, such as continued use (Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004), deep structure use (Burton-Jones and Straub, 2006), extended use (Hsieh et al., 2011, Hsieh & Wang, 2007), system use adaptation (Barki et al., 2007, Sun, 2012), feature extension (Jasperson, Carter, & Zmud, 2005), and habitual/automatic system use (Kim, Malhotra, & Narasimhan, 2005, Limayem, Hirt, & Cheung, 2008, Polites & Karahanna, 2013). Variance across these theoretical and operational conceptualizations makes it difficult to build a cumulative understanding of system use and its implications. Second, across contexts, studies have offered different operational and theoretical conceptualizations of task performance. This may also have resulted in the mixed findings in previous studies because task performance, albeit named the same, may mean different things. Hence, it is necessary to delineate the task context factors through which system use impacts task performance.

In attempting to resolve the mixed findings on system use and task performance, this research pursues two objectives. First, we seek to reconcile the diverse system use definitions found in the literature using the exploitation-exploration framework (March, 1991). This framework assists in conceptualizing system use according to two facets: (1) exploitative system use, and (2) explorative system use. Second, we delineate how system use influences task performance. This aim is also two-faceted: On the one hand, we build a model based on the theory of complementarities (Milgrom & Roberts, 1995, Samuelson, 1974) to delineate how exploitative system use and explorative system use independently and jointly influence task performance factors, On the other hand, based on the previous work on the impact of system use on task performance (Ahearne, Hughes, & Schillewaert, 2007, Deng, Doll, & Cao, 2008, Torkzadeh & Doll, 1999, Torkzadeh, Koufteros, & Doll, 2005), we delineate the relationships among task performance factors. Specifically, we maintain that system use influences task productivity—a major task performance factor—through two task-context factors: management control and task innovation.

To realize our objectives, we constructed a model, based on the exploitation-exploration research to depict how both exploitative and explorative system uses can have direct and complementary effects on task performance factors (i.e., management control, task innovation, and task productivity). We examined the research model within two empirical studies. In Study 1, we examined two constructs, USAGE and *adaptive system use* (ASU), which represent the exploitative system use and explorative system use respectively. In Study 2, we extended Study 1 and examined the exploitative-explorative system use framework in a new population of inexperienced users and with an additional system use factor: *deep structure usage* (DSU). Together, our two empirical studies evidence the utility of the exploitative-explorative system use framework and create opportunities for future research.

This research contributes to system use research in two important ways. First, we develop the exploitative-explorative system use framework to synthesize the somewhat piecemeal body of research on system use. Second, using our exploitative-explorative system use framework, we develop a research model to investigate how system use influences task performance factors (i.e., management control, task innovation, and task productivity). Taken together, this research contributes to IS research by clarifying how system use impacts task performance.

2 Research Framework Development

2.1 The Exploitative-Explorative System Use Framework

To describe and synthesize existing studies on system use, this research draws on March's (1991) research on exploitation and exploration as well as the theory of complementarity (Milgrom & Roberts, 1995; Samuelson, 1974). Exploitation (of old certainties) refers to the routine execution of knowledge and includes such elements as "refinement, choice, production, efficiency, selection, implementation, [and] execution" (Burton-Jones & Straub, 2006, March, 1991, p. 71). However, exploration (of new possibilities) refers to the search for innovative ways of doing things and includes "search, variation, risk taking, experimentation, play, flexibility, discovery, innovation" (Burton-Jones & Straub, 2006; March, 1991, p. 71). Exploitation and exploration coexist and complement each other. According to the theory of complementarities (Milgrom & Roberts, 1995; Samuelson, 1974), complementary means that the impact of one resource is enhanced by the presence of another resource, or more explicitly, "doing more of one thing increases the returns to doing more of another" (Milgrom & Roberts, 1995, p. 181). Thus, people may employ complementary approaches when applying exploitation and exploration strategies to enhance performance (Andriopoulos & Lewis, 2009).

The theory of complementarity has been applied in IS research to study system use at both the macro- and microlevels. At the macrolevel, the concept of complementarity has been used to study the strategic behavior of organizations, particularly the IT productivity paradox (i.e., the phenomenon that investment in IT does not appear to significantly contribute to boosting productivity at the level of the whole economy or at the level of the manufacturing and service sectors) (Brynjolfsson, 1993). Brynjolfsson and Hitt (1998) argue that the benefits of IT "appear to be realized when computer investment is coupled with other complementary investments; new strategies, new business processes and new organizations all seem to be important in realizing the maximum benefit of IT" (p. 50-51). At the micro (individual) level, Titah and Barki (2009) applied the concept of complementarity to study how two individual-level concepts—attitude and subjective norms—complement each other in order to influence individual intention to use a technology. Their findings suggest that elevations of one factor can enrich the effects of another. Such research suggests that users have limited resources, such as cognitive capacity and time. These limitations drive them to invest resources in complementary system use strategies; thus, individuals are capable of generating "broader system effects" which lead to optimal outcomes (Milgrom & Roberts, 1995).

Our research framework (Figure 1) illustrates the exploitation-exploration research and the theory of complementarities. Based on the definitions of exploitation and exploration, (Burton-Jones & Straub, 2006; March, 1991), we define exploitative system use as the routine use of a system and its features, and explorative system use as a user's search for new features and/or new ways of using system features. We believe that exploitative system use and explorative system use coexist and jointly impact a person's task performance. Considering them simultaneously and studying their direct and complementary effects allow us to access a more holistic understanding of how system use influences task performance.

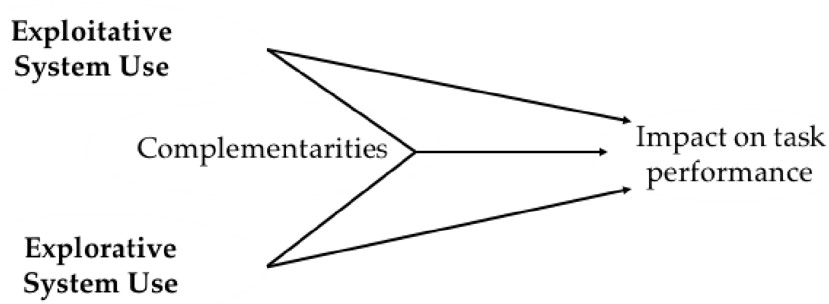

Figure 1. The Exploitative-Explorative System Use Framework

2.2 Examining Existing System Use Constructs Using the Exploitative-Explorative System Use Framework

Table 1 examines some major system use constructs that have been studied in IS research using the exploitation-exploration framework. As shown in Table 1, many studies have applied an *exploitation-only* view of systems use (e.g., how frequently a system is used or how many features of the system have been used). For example, early work on technology acceptance focused on predicting greater quantities of use (DeLone & McLean, 2003). More recent work has continued this focus on exploitation, with constructs such as *deep structure usage* (DSU)—i.e., the "extent to which the user employs the system['s]" features (Burton-Jones & Straub, 2006, p. 233)—becoming popular in the literature. Another example is routine use, defined as "employees' using IS in a routine and standardized manner to support their work" (Li, Hsieh, & Rai, 2013, p. 659). The study on exploitative system use has much utility, especially when the use context is stable, when the task is routine, and therefore when system use becomes habitual or routine (Guinea & Markus, 2009; Limayem et al., 2008; Ortiz de Guinea and Webster, 2013). In such contexts, exploitative system use can effectively indicate how much people benefit from system features: the more a system is used, the more benefits the user can reap from it.

Table 1. A Representative Sample of Explorative and Exploitative Systems Use Constructs

	Constructs and definitions
Exploitative system use: Routine use of a system and its features. Includes constructs that evaluate exploitation indicate how much people benefit from system features—the more a system is used, the more benefits the user can reap from it.	
Goodhue & Thompson, 1995	**Utilization**: The behavior of employing the technology in completing tasks (p. 218).
	Task-technology fit: The degree to which a technology assists an individual in performing his or her portfolio of tasks (p. 216).
Davis, 1989	**Intention to use:** The strength of a person's intention to use IT.
Burton-Jones & Straub 2006	**Deep structure usage:** The "extent to which the user employs the system['s]" features (p. 233).
Li et al., 2015	**Routine system use:** "employees' using IS in a routine and standardized manner to support their work" (p. 659).
Explorative system use: Searching for new ways of using system features. Includes constructs that evaluate whether users actively revise their system use in response to changes in the use context as a means to achieve a better fit between the system and the context in which they are using it.	
Nambisan et al, 1999	**Intention to explore:** A user's willingness and purpose in exploring a new technology and finding potential uses.
Ahuja & Thatcher, 2005	**Trying to innovate:** A user's goal of finding new uses for existing workplace information (p. 431).
Sun, 2013	**Adaptive system use:** How people actively revise their use of systems' features through four behaviors: trying new features, feature substituting, feature combining, and feature repurposing (p. 454).
Li et al., 2013	**Innovative system use:** "employees' discovering new ways to use IS to support their work" (p. 659).

The exploitation-only view of system use has attracted criticism from IS researchers. DeLone and McLean (2003) argue that this view of system use is "too simplistic" because "simply measuring the amount of time a system is used does not properly capture the relationship between usage and the realization of expected results" (p. 16). Lucas and Spitler (1999) call for studying the relationship between actual use and performance. In a similar vein, Benbasat and Barki (2007) suggest that IS researchers "broaden their perspective of system use from one that exclusively focuses on a narrow 'amount' view of users' direct interaction with systems to one that also includes users' adaptation, learning, and reinvention behaviors around a system" (p. 215).

Recent research has moved beyond the exploitation view to examine different forms of system use. For example, IS researchers have studied cycles of adaptation of systems (Jasperson et al., 2005; Limayem et al., 2008), during which users actively revise their system use in response to changes in the use context as a means of achieving a better fit between the system and the context in which they are using it (Ahuja & Thatcher, 2005; Barki et al., 2007, Boudreau & Robey, 2005; Jasperson et al., 2005; Leonard-Barton, 1988; Saga & Zmud, 1994; Sun, 2012). Another example is innovative use, defined as "employees' discovering new ways to use IS to support their work" (Li et al., 2013, p. 659).

It is worth noting that the exploitative-explorative system use framework is consistent with recent IS research. For example, Ortiz de Guinea and Webster (2013) distinguished two types of system use behavior: exploitative and adaptive. Exploitative means interacting with a system in a straightforward manner to accomplish a task, in comparison to adaptive behavior, which is aimed at altering an aspect of the system. In the same vein, Li et al., (2013) also distinguished routine use from innovative use and argued that these two types of system use coexist.

3 Research Model

The exploitative-explorative system use framework operates at a high level of abstraction. Therefore, to demonstrate its utility, we offer an instantiation of it, which includes one type of exploitative system use (i.e., USAGE) and one type of explorative system use (i.e., adaptive systems use, ASU), as depicted in Figure 2. The former refers to the *frequency* and *duration* of system use and reflects the degree to which features of a system are exploited (DeLone & McLean, 1992). Consistent with Sun (2012), ASU is defined as a user's modifications concerning how he or she uses system features. ASU draws on the concept of *features in use* (FIU): the features known and ready to be used by a user. ASU describes user behaviors that explore a system's potential through trying new features, substituting currently used features with new ones, combining features, and repurposing existing features (Sun, 2012). ASU is conceived by Sun (2012) as a third-order aggregate construct with two aggregate second-order dimensions: *Revising the Content of FIU* (RevContent) and *Revising the Spirit of FIU* (RevSpirit), as depicted in Figure 3. *RevContent* refers to users' revisions regarding "what" features are included in their features in use or, more explicitly, what features are used. It has two formative first-order subdimensions: *trying new features* (TR: using new features) and *feature substituting* (FS: replacing a currently used feature with a new feature). *RevSpirit* refers to users' revisions to their FIU pertaining to "how" features are used. It has two formative subdimensions: *feature combining* (FC: using two or more features together to perform a task for the first time) and *feature repurposing* (FR: using a feature in a way that is not intended by the developer). Although ASU is only one of many ways to describe how people adapt their use of IS, it is useful for our research because the higher-order conceptualization synthesizes several views of innovation, feature use, and systems exploration, and consequently provides a contemporaneous, comprehensive, and parsimonious means to describe explorative system use in the workplace.

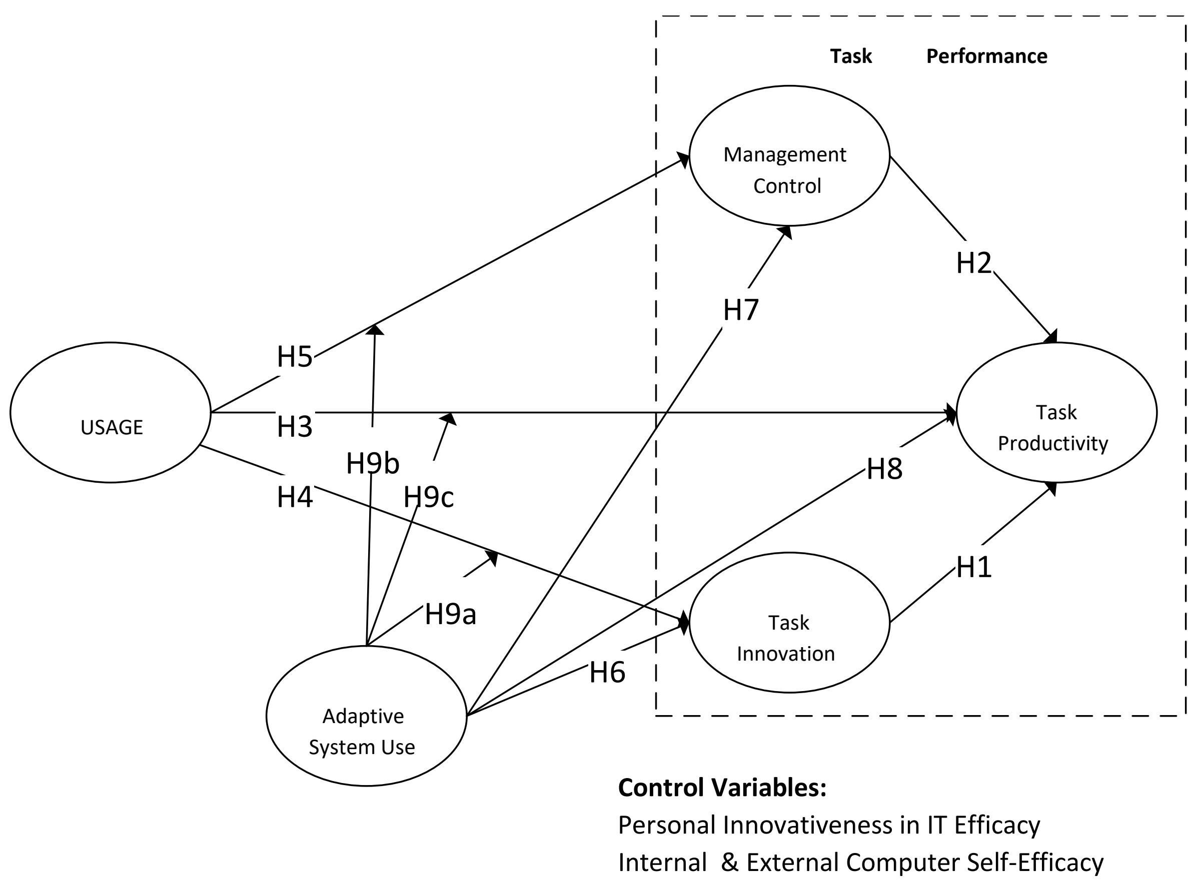

Figure 2. The Research Model

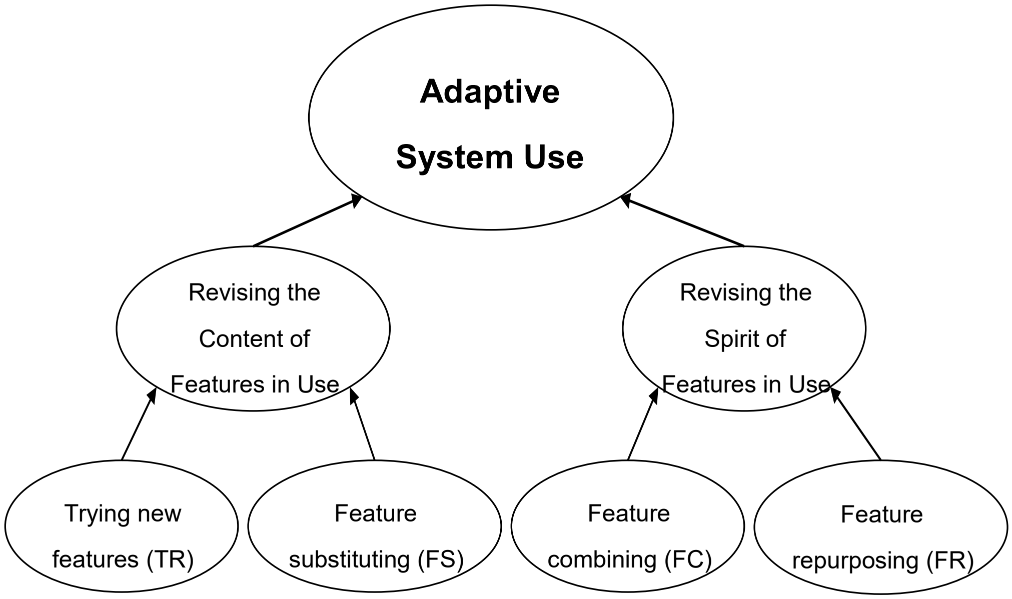

Figure 3. High-Order Nature of Adaptive System Use (Source: Sun, 2012)

Consistent with the theory of complementarity, we argue that ASU and USAGE have complementary effects on task performance. We study three task performance factors: *task productivity, management control,* and *task innovation* (Torkzadeh & Doll, 1999, Torkzadeh et al., 2005). The research model also controls for three personal factors: *personal innovativeness in IT* (PIIT), and internal and external computer self-efficacies. Next, we discuss the relationships described in the research model.

3.1 Dependent Variables: Task Performance Factors

Task performance refers to "the accomplishment of a portfolio of tasks by an individual", where higher performance means "improved efficiency, improved effectiveness, and/or higher quality" (Goodhue & Thompson, 1995, p. 218). Prior research has argued that systems influence task performance through impacting *task productivity*, *management control*, and *task innovation* (Torkzadeh & Doll, 1999). Impact on *task productivity* refers to "the extent that one application improves users output per unit of time" (Torkzadeh & Doll, 1999 p. 329). Impact on *task innovation* refers to the extent that a system helps users create and try new ideas in their work (Torkzadeh et al., 2005). Impact on *management control* refers to the extent that a system helps regulate work processes and performance (Torkzadeh & Doll, 1999).

Task innovation and *management control* have been shown to influence task productivity (Ahearne et al., 2007; Deng et al., 2008). First, when a user is innovative at work, he or she can access better (and faster) ways of doing work (i.e., task innovation) and thus the user is more likely to experience high task productivity (Deng et al., 2008). Second, better management control can reduce the time that users invest in monitoring and managing the work process, thus allowing users to focus on tasks that are more productive. For example, Ahearne et al. (2007) demonstrated that IS can help salespeople improve task productivity by reducing the time required for routine tasks (i.e., management control), thus freeing up more time for value generating tasks, such as sales calls or visits to customers. Therefore, we hypothesize:

H1: Task innovation is positively related to task productivity.

H2: Management control is positively related to task productivity.

3.2 USAGE and Task Performance

The relationships between USAGE and *task performance* have been well-established (DeLone & McLean, 1992; DeLone & McLean, 2003). More use of a system can improve the ability of a business to reap its benefits (Boudreau & Robey, 2005). Specifically, we expect that with increased use of the system, user benefits from the system will also increase due to the improvement of all three task performance factors: *task productivity*, *task innovation*, and *management control* (Torkzadeh & Doll, 1999). First, the more a system is used (USAGE), the more the *task productivity* is enhanced. Since most information systems are designed to automate tasks for enhancing productivity, when a person's use of a system increases, the design potential of enhancing task productivity is likely also further exploited. For instance, Torkzadeh et al. (2011) identified a strong relationship between task productivity and system usage of 308 end users. For this reason, we hypothesize:

H3: USAGE is positively related to task productivity.

Second, USAGE can improve *task innovation*. IS enables new work outcomes and new ways of doing work (i.e., task innovation). For example, IS can create new ways of interfacing with customers—such as online live chat (Harvey, E. Lefebvre, & L. Lefebvre, 1993). The more a person uses the system, the more he or she exploits the benefits of the system for testing and experimenting with innovative ideas, thus facilitating *task innovation*. For example, Deng et al. (2008) demonstrated that decision support system usage increased task innovativeness for 743 engineers at five different firms. We, therefore, hypothesize:

H4: USAGE is positively related to task innovation.

Third, USAGE has a positive influence on *management control*. IS empowers employees to manage job pressures by affording users greater control over the timing and content of the task (Kraemer & Danziger, 1990). Information systems employ features that empower users to better control both their own and others' work behavior. For example, in MS Word, the "Track Changes" feature potentially enables users to better track their own as well as manage their collaborators' revisions in a document. With increased use, such benefits within a system are increasingly realized and exploited to enhance *management control*. Further, management scholars have posited that *management control* is positively related to system use (e.g., Weick, 2000, Zuboff, 1988). Therefore, we hypothesize:

H5: USAGE is positively related to management control.

3.3 The Impact of ASU on Task Performance

We argue that ASU (i.e., adaptive system use) has direct effects on all three task performance factors. First, ASU can enhance *task innovation*. Information systems are often designed to represent sets of formalized best practices within work systems (Burton-Jones & Grange, 2008; Weber, 1997). Users are often involved in the development and use of information systems to make a system representative of the work domain (Burton-Jones & Grange, 2013). Consider how MS Office includes features based on developers' understanding of the needs and work styles of diverse populations of potential users for word processing (Word), creating and formatting spreadsheets (Excel), and presentation (PowerPoint), among others. In other words, MS Office can be viewed as a representation of office work, developed based on in-depth understandings of how different types of users do such work. These work methods are embedded in software applications in many ways, such as in MS Office's features for formatting a document: using a Template, using the Format Painter feature, and using the Style feature. Hence, an IS, particularly one with an extensive feature set, can be viewed as affording access to a knowledge repertoire of work methods.

ASU captures whether users take advantage of different work methods. By adaptively using system features, a user gains access to new information about other people's expertise about how to complete a task (Leonardi, 2007). In other words, through the system's design or actual use of the system itself, users communicate and share their expertise through the system (Barki et al., 2007). Thus, ASU extends users' ability to use the system to complete tasks more innovatively (Saga & Zmud, 1994). Furthermore, beyond offering access to knowledge and enabling idea generation, ASU can enrich and accelerate a user's innovation implementation. IS provides an information-rich environment that helps users try out and assess the consequences of innovative ideas. For example, a user who adopts a new template for company documents can sample this new look using the Preview function in Word. Together, we hypothesize:

H6: ASU is positively associated with task innovation.

Second, we argue that ASU has a positive effect on the user's *management control*. Users are motivated to improve *management control* to deal with time pressures imposed by the job (Ahuja & Thatcher, 2005; Amabile, 1997; Kraemer & Danziger, 1990). ASU facilitates use of a higher number of a system's features, empowering the user to actualize improved project planning, scheduling, monitoring, and control (Raymond & Bergeron, 2008). For example, a user may use MS Excel for managing their projects. He or she later substitutes certain features in MS Excel with those in MS Project—a tool better suited for professional project management. Such ASU behavior (i.e., feature substituting) broadens user options, offers potential improvements in management control over one's own work, and improves the mechanisms of tracking others' progress. In addition, ASU can potentially empower workers to learn how to use IT to stay informed, communicate with peers, and involve themselves in decision-making processes, which are essential for management control (Huber, 1990). For instance, a user may find the Track Changes feature in

MS Word to be more effective than frequent emails for communicating with others about document revisions. Substituting emails with Track Changes can facilitate more control over who makes what revisions to a document. This increases the user's ability to communicate, monitor, and influence others, and accordingly, improves control over the progress of the project (Kraemer & Danziger, 1990).

H7: ASU is positively associated with management control.

Third, ASU positively affects *task productivity*. ASU has the capacity to increase the number of features that users employ, and thus potentially improves the productivity of task completion. Under the *bounded rationality* assumption, it has been argued that adaptation behaviors facilitate the alignment of system use and specific task context, thus improving task performance (Barki et al., 2007; Boudreau & Robey, 2005; Jasperson et al., 2005). ASU requires users to make conscious decisions to explore new possibilities of finding or applying system features. Such decisions are typically made in response to changes in the environment—such as new task assignments or observing other people's use—that stimulate changes in how one interacts with the system (Jasperson et al., 2005; Sun, 2012). Therefore, ASU naturally aims at realizing a better fit between the task, the technology, and the environment, and accordingly, enhances *task productivity*.

H8: ASU is positively associated with task productivity.

3.4 Complementary Effects of ASU and USAGE on Task Performance

Beyond its direct impact on task performance, complementarity between ASU and USAGE may influence task performance. Specifically, ASU indicates how much the potential of system features are explored, whereas USAGE determines the degree to which such potential is exploited. When ASU is high, users actively revise their systems use through trying new features, substituting old features with new ones, using features in tandem to accomplish new tasks, and repurposing features. Such variations of use can lead to optimal fit between system use and task. By enriching the content of use, ASU allows users to reap increased benefits from the same amount of use (i.e., USAGE).

We posit that ASU moderates the influence of USAGE on all the three task performance constructs: *task innovation*, *management control*, and *task productivity*. For example, *trying new features* can enlarge a user's *features in use* (FIU) and thus engage new work methods, endowing the user with the ability to generate and test more innovative ideas at work with the same amount of system use. In addition, adaptation behaviors such as *trying new features* and *combining features* afford a user more ways to complete a task.

By contrast, when ASU is low, system use is lean. Users apply old features to new tasks. When new demands arise (e.g., a new task), users draw on an existing FIU set to meet the requirements, possibly leading to misalignments between system use and the task, and subsequent poor performance from the same amount of use. That is, the features being used may not be aligned correctly with the new task (e.g., using the Format Brush for formatting long Word documents). As a result, the same amount of system use may stimulate fewer innovative ideas, and the user may have less control over work progress, thus decreasing productivity. Hence,

H9: ASU moderates the relationship between USAGE and (1) task innovation, and (2) management control, and (3) task productivity such that the relationship is stronger when ASU is higher.

4 Research Method

We conducted two empirical studies. Study 1 captured general use of a popular business application—i.e., MS Office by experienced users. Study 2 was designed to extend Study 1 in several ways. First, in contrast to Study 1, which uses an application (MS Office) that is widely diffused with experienced users, Study 2 employs a less widely diffused technology (a video-editing system) and samples from less experienced users. Second, Study 2 uses a more general measure of ASU and employs a longitudinal research design. This strengthens our ability to test the causality implied in the research model. Third, Study 2 incorporates a richer measure of exploitative system use: *deep structure usage*, and objective measures of performance. In short, Study 2 complements Study 1 by affording opportunities to test the generalizability, robustness, validity, and reliability of the exploitative-explorative system use framework.

4.1 Study 1: Experienced Users of MS Office

In Study 1, we examined exploitative and explorative system use of MS Office. MS Office was used for several reasons. First, MS Office has many features that are applicable to different types of tasks. Therefore, it affords an opportunity for users to engage in ASU behaviors such as combining features and substituting features. Second, because MS Office is widely diffused in the workplace, it is unlikely that users would switch or abandon the application due to relative advantages of alternative systems or the limitations of its existing features. Rather than switching to a new system, it is more likely that MS Office users would adapt their feature use to complete a new activity. Third, MS Office enables a broad variety of work methods and tasks including: (1) problem solving, (2) decision rationalization, (3) horizontal integration, (4) vertical integration, and (5) customer service, and has significant implications for task performance (Doll & Torkazedah, 1998).

4.1.1 Measures and Procedures

Appendix A provides details on the measures. Consistent with Sun (2012), ASU was operationalized as a third-order aggregate construct comprised of two second-order constructs: *RevContent* and *RevSpirit*, which are formed by first-order factors. *RevContent* is formed by *trying new features* (TR) and *feature substituting* (FS). *RevSpirit* is formed by *feature combining* (FC) and *feature repurposing* (FR). Seventeen items were used to measure ASU: four items for TR, three for FS, four for FC, and six for FR. To focus respondents on ASU, the questionnaire asked them to describe an incident where they adapted their use of MS Office. They were instructed to write (1) a brief report of what they did using MS office, and (2) a description of the outcome of their actions. This exercise increased respondents' awareness of their ASU behaviors (Orlikowski & Yates, 2002). After completing the description, they were asked to complete the survey based on the activity described in the report.

Adapted from Kim and Malhotra (2005), USAGE was operationalized using two items that measured frequency and duration of system use. Task performance was operationalized using nine items from Torkazedah and Doll's (1999) work, which measured users' perceptions of the impact of IS on *task productivity* (three items), *management control* (three items), and *task innovation* (three items).

We also controlled for *personal innovativeness in IT* (PIIT) and *computer self-efficacy*. PIIT, defined as an individual trait reflecting one's willingness to try out any new technology, was operationalized using an existing measure (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1999). *Computer self-efficacy*, defined as "judgment of one's capability to use a computer", was operationalized as internal and external computer self-efficacy (Compeau & Higgins, 1995, p. 195; Thatcher, Zimmer, Gundlach, & McKnight, 2008), with each dimension operationalized with three items. The measures were tailored to direct a respondent's attention concerning the use of MS Office (see Appendix A).

It is worth noting that the two use variables: USAGE and ASU have different numbers of indicators. There are ongoing debates in the research method literature regarding the use of multiple items for measuring a construct, going back to Jacoby (1978), who alerted researchers to the "folly of single indicants" (Bergkvist & Rossiter, 2007; Diamantopoulos, Sarstedt, Fuchs, & Wilczynski, 2012). The number of indicators influences the construct's reliability, the predictive validity (Diamantopoulos et al., 2012), and also the level of abstraction (Wetzels, Odekerken-Schroder, & Oppen, 2009). ASU is a third-order formative construct; to operationalize ASU, we calculated the latent variables scores for the first- then second-order dimensions, and used them as indicators of the higher order construct. This means that ASU, to some degree, can be viewed as having two general indicators—i.e., its two second-order subconstructs—which contribute to maintaining a balance between the number of indicators of USAGE and ASU.

4.1.2 Subjects

In Study 1, data were collected by StudyResponse, which is a nonprofit academic survey research service hosted by Syracuse University (New York, United States). Empirical studies using data collected from StudyResponse have appeared in prestigious social science journals (e.g., Piccolo & Colquitt, 2006; Sun, 2012). An invitation email with the URL of the online questionnaire was sent to 1,500 individuals, who were randomly selected from the panel of 2,455 people registered in the "Administration" occupation category. Panel members reported responsibility for extensive administrative work, such as word processing and basic data processing using MS Excel. Five Amazon.com gift cards of 50 US dollars each were raffled off as incentives. StudyResponse administered the raffle, in accordance with its Institutional Review Board's protocols. A reminder email was sent one week later to boost the response rate. As a result, SurveyResponse's invitation elicited 274 responses. We deleted several incomplete responses, resulting in a final sample of 212 records. Table 2 reports sample demographics. To assess nonresponse bias, we conducted a wave analysis: the first and last quartiles of respondents were compared (Armstrong & Overton, 1977). The two groups were not significantly different in terms of age, gender, and education level, indicating that nonresponse bias should not be a concern for this study.

Table 2. Demographics of the Sample (Study 1)

Variables	Sample composition
Age	Mean = 37.72; std. dev = 9.80; range 22-63
Gender	Female (150) 71% Male (62) 29%
Highest educational level attained	Graduate degree 12.5% Some graduate work 4.8% University or college degree 36.5% Some university or college 37.5% Secondary school or less 8.7%

4.2 Study 2: Inexperienced Student Subjects

4.2.1 Procedure and Measures

In Study 2, a video creation task was designed that (1) introduced participants to a new technology, (2) provided participants with flexibility in how they used the technology, and (3) allowed participants to complete the assignment in many different ways. In the assignment, participants were asked to create a video using either Apple's iMovie or Microsoft's Movie Maker. The videos were required to be three minutes in length and had a variety of mandatory elements (See Appendix B).

Data were collected at two points in time. At Time 1 (T1) we collected: internal and external computer self-efficacy, PIIT, and gender. At Time 2 (T2), after the assignment was completed, we collected: USAGE, ASU, and three task performance factors. In addition, we had an objective measure of performance (i.e., performance grade for the assignment) and *deep structure usage* (DSU). The grade was calculated using a rubric (see Appendix B). Following Tinsley and Weiss (1975), two independent evaluators gave each assignment a grade from 1 to 10. All disagreements between the assigned grades were discussed using the rubric until the evaluators agreed on a final value.

It is worth noting that our measures of ASU differed across Study 1 and Study 2. Specifically, we helped situate respondents in Study 1 by having them recall a specific ASU scenario because it is hard for respondents to recall their ASU behavior in a complex work environment (Orlikowski & Yates, 2002). In Study 2, we used a more general measure of ASU. We did so because Study 2 participants were focused on a clearly defined scenario for systems use (i.e., a clearly defined assignment that occurred during a relatively short period) and it took time for them to complete the video-creating task. While the actual items differed, the instantiation of ASU was comparable across these two studies in that they both directed participants' attention to ASU behaviors, specific task(s), and a specific time frame.

4.2.2 Subjects

Study 2 was conducted at a large northeastern university in the United States. 403 participants were recruited from an introductory MIS course. We removed 18 responses from participants who had video editing experience as well 13 responses from participant who did not complete each part of the procedure—which included a pretest, assignment, and a posttest. This resulted in 372 usable responses. Table 3 reports sample demographics.

Table 3. Demographics of the Sample (Study 2)

Variables	Sample composition
Age	Mean = 20.35; std. dev = 2.08; range 18-37
Gender	Female (163) 56% Male (208) 44%

4.2.3 Statistical Power

This research obtained sufficient statistical power for both studies. The minimum sample size should be the larger of: (a) 10 times the number of items for the most complex construct, or (b) 10 times the largest number of independent variables impacting a dependent variable (Chin, 1998; Chin, 2010). ASU, the most complex construct, was measured using 17 items. In addition, the largest number of independent variables used to predict a dependent variable is six (including the interaction item and control variables). Furthermore, a power analysis was estimated using G*Power 3.1. As suggested by Ringle and colleagues (2012), we provided a post hoc analysis using linear regression models. The effect size in the calculation was small (f^2 = 0.08), the error probability was $\boldsymbol{\alpha}$ = 0.05, and the total sample sizes were 212 and 372. Both power models suggest appropriate power (1-$\boldsymbol{\beta}$; Study 1 = 0.94, Study 2 = 0.99).

5 Analysis and Results

We used SmartPLS 3.2.4 for data analysis, given the explorative nature of our study. Furthermore, PLS is a powerful tool for studies that have nonnormally distributed variables (Gefen, Rigdon, & Straub, 2011). Wetzels and colleagues (2009) demonstrated that PLS can be used to evaluate the measurement properties of high-order formative constructs such as ASU. To evaluate complementarity, we used the interaction method (S. Bharadwaj, A. Bharadwaj, & Bendoly, 2007; Zhu, 2004). The interaction method is considered a reliable method for estimating complementarities (Ping, 1998; Ping, 2004; Titah & Barki, 2009) and has been used to examine the complementarity between individual level concepts, user attitude, and subjective norms (Titah and Barki, 2009). To test USAGE and ASU's influence on task performance, we follow Venkatraman's (1989) approach, and conceptualize interaction as a fit relationship:

$$Y = \propto + \beta_(X + \beta_* Z + \beta_, X * Z + \zeta$$

$\propto$ is the intercept. ζ is the residual term. $_($ and β_* represent the coefficient of factor X and factor Z respectively. $\beta_,$ is the coefficient of the interaction and determines the relationship between X and Z. Specifically, when $\beta_,$ is positive, it means that X and Z are complements. When it is negative, X and Z are substitutes. When it equals zero, it means X and Z are independent. We expect that USAGE and ASU complement each other ($\beta_, > 0$).

5.1 Measurement Model

To assess the measurement model, we evaluated the reliability, convergent validity, and discriminant validity constructs, as well as ASU's four reflective first-order factors (see Table 4). All items loaded more strongly on their primary constructs than on other constructs (Appendix C). Each construct demonstrated acceptable reliability, with composite reliabilities greater than 0.70 for all constructs (Nunnally & Bernstein, 1994). Also, we found evidence of convergent validity, with item loadings greater than 0.707 and average variance extracted (AVE) statistics greater than 0.50 (Fornell & Larcker, 1981) (see Appendix C for items loadings and Table 4 below for AVEs).

Also, the average variance shared by each construct and its measures (measured by squared roots of AVE) is greater than the variance shared by the construct and other constructs (i.e., correlations), suggesting discriminant validity (Compeau, Higgins, & Huff, 1999) (see Table 5). Collectively, our analysis provides support for our constructs being reliable and convergent.

Further, as suggested by Henseler, Ringle, & Sarstedt (2015) we estimated the Hetrotrait-monotrait (HTMT) ratios. All constructs were below the 0.85 cutoff, except the relationship between task productivity and task innovativeness (Study 1 = 0.87). Since Study 2's HTMT estimation was considerably lower than the recommended cutoff (Study 2 = 0.58), we argue that constructs in both studies can be considered empirically discriminant. See Appendix C for the fill HTMT results.

Common method bias (CMB) is a possible concern for survey and laboratory-based research. Given that unmeasured latent marker variable approaches are problematic (Chin, Thatcher, & Wright, 2012; Richardson, Simmering, & Sturman, 2009), we followed P. Podsakoff, MacKenzie, Lee, & N. Podsakoff's (2003) advice to mitigate and assess the effect of CMB in Study 1 and Study 2. First, ex ante, to avoid CMB affecting the results, independent variables and dependent variables were measured at different points of time in Study 2. Second, ex ante, we developed instruments that mixed the ordering of the questions. Third, ex post, we developed interaction models that included moderating effects, which are less likely to be susceptible to CMB. Finally, ex post, a Harmon one-factor analysis was used to check if the variance in the constructs were attributed to CMB. Specifically, in Studies 1 and 2, a single factor accounts for less than 35% of the variance (Study 1 = 33.49%, Study 2 = 29.19%). The cutoff for the Harmon's one-factor test is 50%. Therefore, our analysis provided no evidence of common method bias affecting our results (Podsakoff et al., 2003).

Table 4. Descriptive Statistics (Study 1 and Study 2)

Construct	No. of items	Mean	Std dev.	Average variance extracted	Composite reliability
1. TR	4	5.36 | 5.85	1.53 | 1.24	0.85 | 0.83	0.96 | 0.95
2. FS	3	4.42 | 5.23	1.78 | 1.37	0.82 | 0.79	0.93 | 0.92
3. FC	4	4.44 | 5.43	1.59 | 1.38	0.73 | 0.64	0.92 | 0.88
4. FR	6	3.50 | 3.27	1.66 | 1.61	0.76 | 0.76	0.95 | 0.95
5. USAGE	2	4.74 | 2.40	1.51 | 0.79	0.72 | 0.71	0.84 | 0.83
6. TP	3	5.35 | 5.30	1.45 | 1.41	0.88 | 0.86	0.96 | 0.95
7. MC	3	5.07 | 5.24	1.52 | 1.48	0.96 | 0.81	0.99 | 0.93
8. TI	3	5.03 | 5.18	1.56 | 1.39	0.95 | 0.89	0.98 | 0.96
9. PIIT	3	4.77 | 4.64	1.53 | 1.82	0.86 | 0.84	0.95 | 0.94
10. iSE	3	5.00 | 5.62	1.25 | 2.01	0.84 | 0.85	0.94 | 0.95
11. eSE	3	5.47 | 7.92	1.31 | 1.32	0.83 | 0.80	0.93 | 0.92
12.DSU (Study 2)	5	5.34	0.97	0.70	0.92

Notes:
Study 1 | Study 2
TR: trying new features; FS: feature substituting; FC: feature combining; FR: feature repurposing; TP: task productivity; MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy; DSU: deep structure usage

5.2 The Structural Model

The weights of formative indicators are equal to the beta coefficients in a standard regression model and indicate the relative importance of formative indicators (Cenfetelli & Bassellier, 2009). The weights and significance statistics are in Table 6. To assess multicollinearity among ASU's formative factors, variance inflation factor (VIF) statistics were estimated. As can be seen in Table 6, the VIFs of all second-order and first-order factors were less than 3.3, suggesting that multicollinearity did not affect the results of our analysis (Diamantopoulos & Winklhofer, 2001). It is important to note that the weights and significances of the formative indicators of ASU may differ across the two studies. This is not surprising because of interpretational confounding, which refers to the meaning of a formative construct changing when the dependent variables are changed (Howell, Breivik, & Wilcox, 2007). We discuss the issue of interpretational confounding in more detail in Appendix D.

To test the moderating effects of USAGE on the relationships between ASU and the three task performance factors, we employed the *product of sums* approach recommended by Goodhue and colleagues (2007). Specifically, we multiplied the factor scores of USAGE and moderator (ASU) to generate the product of sums. A single-item interaction factor was then added to the model and linked to the task performance factors. Structural model results are presented in Figure 4 and Table 7.

Table 5. Square Roots of AVEs and Correlations [†] [a]

Construct	1	2	3	4	5	6	7	8	9	10	11	12
1. TR	**0.92** **0.91**											
2. FS	0.50 0.66	**0.90** **0.89**										
3. FC	0.55 0.71	0.62 0.69	**0.86** **0.80**									
4. FR	0.10 0.11	0.55 0.25	0.53 0.20	**0.87** **0.87**								
5. USAGE	0.48 0.27	0.44 0.23	0.51 0.28	0.31 0.00	**0.85** **0.84**							
6. TP	0.30 0.49	0.28 0.45	0.36 0.07	0.17 0.07	0.55 0.20	**0.94** **0.93**						
7. MC	0.26 0.52	0.35 0.51	0.40 0.57	0.25 0.10	0.49 0.22	0.79 0.72	**0.98** **0.90**					
8. TI	0.28 0.44	0.36 0.41	0.41 0.45	0.28 0.29	0.49 0.23	0.83 0.54	0.68 0.57	**0.97** **0.95**				
9. PIIT	0.43 0.08	0.38 0.17	0.36 0.22	0.26 0.20	0.46 0.06	0.43 0.14	0.40 0.11	0.45 0.11	**0.93** **0.91**			
10. iSE	0.24 0.01	0.06 0.09	0.15 0.12	-0.05 0.01	0.05 0.02	0.13 0.11	0.05 0.14	0.16 0.00	0.10 0.50	**0.92** **0.92**		
11. eSE	0.46 0.15	0.32 0.14	0.30 0.14	0.12 -0.06	0.38 -0.01	0.33 0.15	0.31 0.11	0.31 0.05	0.57 0.37	0.19 0.50	**0.91** **0.89**	
12. DSU	0.61	0.59	0.61	0.17	0.31	0.61	0.62	0.55	0.12	0.10	0.09	**0.84**

Notes:
[†] Study 1 on top; Study 2 on the bottom except for DSU.
The diagonal elements (in bold) are the square roots of the variance shared between the constructs and their measurement (AVE). Off-diagonal elements are the correlations among constructs. Diagonal elements should be larger than off-diagonal elements in order to exhibit discriminant validity.
[a] Due to the high correlations among the task performance factors (as shown in Table 5), we conducted a robustness check. Specifically, using the Study 2 dataset, we estimated a revised model with a new second-order task performance construct that has three first-order constructs with satisfactory loadings: task innovation (loading = 0.807), management control (0.904), and task productivity (0.864). The results of the structural model are consistent with the results of the original model. Therefore, we concluded that the high correlations among the task performance factors did not confound our findings in any significant way.

Table 6. Formative Nature of ASU

Second-order				First-order			
Construct	**Weight**	**t value**	**VIF**	**Construct**	**Weight**	**t valve (p level)**	**VIF**
RevContent	Study 1: 0.38* Study 2: 0.75*	1: 2.04* 2: 8.85*	1:1.89 2:1.32	TR	1: 0.40* 2: 0.65*	1: 2.65* 2: 49.23*	1:1.33 2:1.77
				FS	1: 0.73* 2: 0.45*	1: 5.84* 2: 42.82*	1: 1.33 2: 1.77
RevSpirit	1: 0.65* 2: 0.39*	1: 3.91* 2: 8.87*	1:1.89 2:1.32	FC	1: 0.92* 2: 0.45*	1: 9.37* 2: 11.49*	1:1.40 2:1.05
				FR	1: 0.12* 2: 0.80*	1: 0.80(ns) 2: 24.33*	1:1.40 2:1.05
Notes: *p < 0.05; 1: = Study 1; 2: = Study 2							

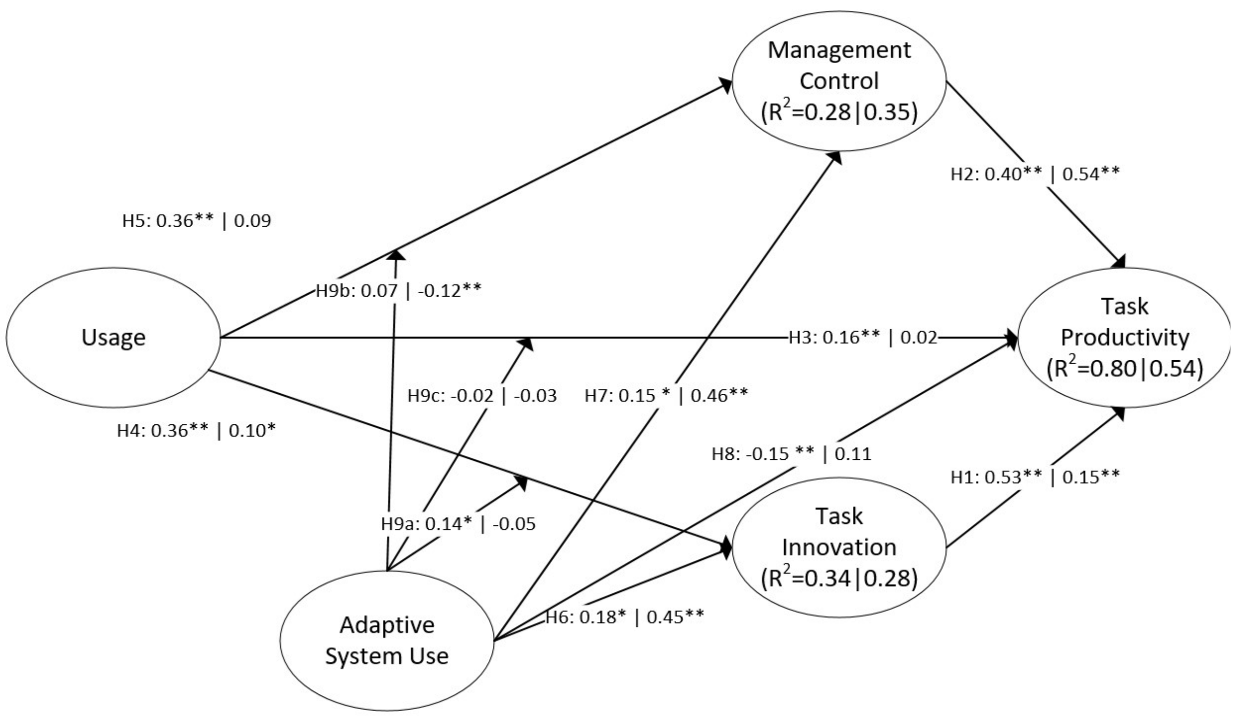

Figure 4. Results of the Structural Model

Table 7. Summary of Hypothesis Testing

Hypothesis	Path coefficient	*t* statistic	Supported?
H1: TI→→TP	0.53 | 0.15	10.29* | 2.92*	Yes
H2: MC →→TP	0.39 | 0.54	8.28* | 9.79*	Yes
H3: USAGE→→TP	0.16 | 0.02	4.51 * | 0.38(ns)	Partial
H4: USAGE→→TI	0.36 | 0.10	4.34* | 2.07*	Yes
H5: USAGE→→MC	0.36 | 0.08	4.08* | 1.89(ns)	Partial
H6: ASU→→TI	0.18 | 0.45	2.61* | 6.69*	Yes
H7: ASU→→MC	0.15 | 0.46	2.57* | 8.34*	Yes
H8: ASU→→TP	-0.15 | 0.11	3.99* | 1.94(ns)	No
H9a: ASU moderates USAGE→→TI	0.14 | -0.05	2.51* | 1.25(ns)	Partial
H9b: ASU moderates USAGE→→MC	0.07 | -0.12	1.68(ns) | 2.82*	Partial
H9c: ASU moderates USAGE→→TP	-0.02 | -0.03	0.96(ns) | 0.97(ns)	No
Control variables			
PIIT→→TP	0.03 | -0.05	0.79(ns) | 1.08(ns)	
PIIT→→MC	0.15 | 0.07	1.80(ns) | 1.25(ns)	
PIIT→→TI	0.21 |- 0.04	2.44* | 1.05(ns)	
iSE→→TP	0.01 | 0.01	0.34(ns) | 0.26(ns)	
iSE→→MC	0.05 | 0.11	0.58(ns) | 1.56(ns)	
iSE→→TI	0.01 | -0.05	0.07(ns) | 0.70(ns)	
eSE→→TP	0.03 | 0.08	0.92(ns) | 1.75(ns)	
eSE→→MC	-0.02 | -0.02	0.32(ns) | 0.43(ns)	
eSE→→TI	0.08 | 0.01	1.34(ns) | 0.11(ns)	

Notes:
Study 1 | Study 2
* $p < 0.05$; ns: nonsignificant; ASU: adaptive system use; TP: task productivity; MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy

The analysis supports many of the hypothesized relationships. *Task innovation* (H1) and *management control* (H2) have significant effects on *task productivity*. Hypotheses 3 and 5 received mixed support. USAGE has a significant effect on *task productivity* (H3) and management control (H5) in Study 1, but not in Study 2, although its effect on task innovation (H4) was confirmed in both studies. ASU significantly influences *task innovation* (H6) and *management control* (H7). Its direct effect on task productivity (H8), however, was not confirmed in either study. Indeed, Study 1 showed a significant negative effect of ASU on task productivity. Of the control variables, the only significant relationship was between PIIT and *task innovation*.

We found mixed support for complementarity between ASU and USAGE (H9), which may indicate that the relationship is contextual in nature. We found that ASU positively moderates the relationship between USAGE and *task innovation* (H9a) in Study 1, but not in Study 2. Support for ASU moderating the relationships between USAGE and *management control* (H9b) was also mixed: this moderating effect was not confirmed in Study 1; in Study 2 we found evidence of moderation, but in the opposite direction.

Our analysis clarified a substantial amount of the variance in explaining task performance factors in Study 1 and Study 2 (Figure 4). A two-step approach was employed to assess the effect size of ASU on task performance—without and with ASU respectively, using Cohen's f^2 formula

(Cohen, 1988). Table 8 summarizes the results. ASU demonstrated medium to large effects on management control and medium effects on task innovation in Study 1 and Study 2. Taken together, our analysis suggests that considering ASU contributes significant additional explanatory power to the USAGE-only model for explaining *management control* and *task innovation*, but not *task productivity*.

Table 8. Effect Sizes for ASU

Dependent variable	R-square with ASU	R-square without ASU	Change in R-square	Effect size†
Management control	0.28 | 0.35	0.28 | 0.09	0.07 | 0.25	0.10 (medium) | 0.38(large)
Task innovation	0.34 | 0.28	0.32 | 0.07	0.09 | 0.21	0.13 (medium) | 0.29(medium)
Task productivity	0.80 | 0.54	0.79 | 0.53	0.01 | 0.01	0.05 (small) | 0.02 (small)

Notes:
Study 1 | Study 2
† Effect size (f^2) is calculated by the formula $(R^2_{full} - R_{partial}^2)/(1-R^2_{full})$ (Tyre & Orlikowski, 1994).
Cohen (Mathieson, Peacock, & Chin, 2001) suggested 0.02, 0.15, and 0.35 as operational definitions of small, medium, and large effect sizes, respectively.

5.3 Post Hoc Analysis

To further verify the explorative-exploitative system use framework, we conducted a post hoc analysis of the Study 2 data, by employing a new system use construct—*deep structure use* (DSU)—and an objective measure of task performance.[1] Burton-Jones and Straub (2006) argued that there is a continuum of rich and lean measures of system usage. We posit that DSU constitutes a "very rich measure" as it includes measurement of the IS, the user, and the task. Further, we added to our analysis by using the grade from the Study 2 video assignment as an objective measure of task performance.

Table 9 summarizes our post hoc analysis. Only *task productivity* is significantly related to the grade for the project. Similar to testing the effect sizes above, we also tested the effect size of DSU with TI (f^2 = 0.13, medium size), MC (f^2 = 0.17, medium size), and TP (f^2 = 0.05, small size). This finding is similar to the effects that ASU had on the three dependent variables. Finally, as reported in Table 10, we found that ASU and DSU fully mediate the influence of USAGE on all three performance constructs (Hoyle and Kenny, 1999).

[1] We thank an anonymous reviewer for this suggestion.

Table 9. Summary of Post Hoc Model Testing

Hypothesis	Path coefficient	*t* statistic	Supported?
H1: TI→→TP	0.11	2.11*	Yes
H2: MC →→P	0.48	7.80*	Yes
H3: USAGE→→TP	-0.01	0.34(ns)	No
H4: USAGE→→TI	0.04	0.82(ns)	No
H5: USAGE→→MC	0.02	0.40(ns)	No
H6: ASU→→TI	0.28	2.73*	Yes
H7: ASU→→MC	0.24	3.32*	Yes
H8: ASU→→TP	0.04	0.57(ns)	No
H9a: ASU moderates USAGE→→TI	0.14	1.53(ns)	No
H9b: ASU moderates USAGE→→MC	0.01	0.13(ns)	No
H9c: ASU moderates USAGE→→TP	0.03	0.65(ns)	No
Post hoc: DSU→→TP	0.22	3.99*	
Post hoc: DSU→→TI	0.34	4.10*	
Post hoc: DSU→→MC	0.40	6.05*	
Post hoc: ASU moderates DSU→→TI	-0.16	2.04*	
Post hoc: ASU moderates DSU→→MC	-0.09	1.18(ns)	
Post hoc: ASU moderates DSU→→TP	-0.04	0.77(ns)	
Post hoc: TP→→Grade	0.17	2.93*	
Post hoc: TI→→Grade	0.05	1.07(ns)	
Post hoc: MC→→Grade	0.02	0.42(ns)	
Control variables			
PIIT→→TP	-0.04	0.89(ns)	
PIIT→→MC	0.08	1.63(ns)	
PIIT→→TI	0.04	0.70(ns)	
iSE→→TP	-0.01	0.12(ns)	
iSE→→MC	0.07	0.32(ns)	
iSE→→TI	-0.01	0.12(ns)	
eSE→→TP	0.09	1.90(ns)	
eSE→→MC	-0.02	0.32(ns)	
eSE→→TI	0.09	1.32(ns)	

Notes: *$p < 0.05$; ns: nonsignificant at $p > 0.05$; ASU: adaptive system use; TP: task productivity; MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy; DSU: deep structure use

Table 10. Mediation Tests

Mediation	Direct	Direct w/ med.	Sobel	Result
ASU med. USAGE → MC	0.224*	0.051 ns	0.000	Full mediation
DSU med. USAGE → MC		0.029 ns	0.000	Full mediation
ASU med. USAGE → TP	0.202*	0.043 ns	0.000	Full mediation
DSU med. USAGE → TP		0.006 ns	0.000	Full mediation
ASU med. USAGE → TI	0.234*	0.097 ns	0.000	Full mediation
DSU med. USAGE → TI		0.064 ns	0.000	Full mediation
Note: * $p < 0.05$; ns: nonsignificant at $p > 0.05$; Sobel test is p-value.				

6 Discussion

To enrich our understanding of the relationship between system use and performance, this research proposed and examined an exploitative-explorative system use framework, which depicts how exploitative system use and explorative system use jointly influence task performance. We tested an instantiation of this framework using various system use constructs, including ASU, USAGE, and DSU, in two empirical studies of 274 experienced users of MS Office and 372 new users of video-editing systems. The results, when taken together, support the utility of the exploitative-explorative system use framework: considering exploitative system use and explorative system use and their complementarities helps explain task performance in a richer way. At the same time, our findings open opportunities for future research.

Interestingly, but not surprisingly, our two empirical studies show different results for the direct influence of ASU on task productivity: in Study 1 of experienced users, this direct relationship is negative while in Study 2 of inexperienced users, it is not significant. The negative relationship between ASU and task productivity in Study 1 is very interesting. It is actually consistent with some existing arguments about the possible detrimental short-term effects of adaptive behaviors such as ASU (Sun, 2012). Specifically, in the short term, ASU may actually lead to a decrease in task productivity, distracting the user from the main task. Recall that in Study 1, we used a cross-sectional design: ASU and task performance factors were measured at the same time, which provides opportunities to observe the short-term detrimental effects of ASU. This result, together with the strong positive effects of ASU on management control and task innovation, indicates the profound influence of adaptive system use behaviors on task performance. Although ASU may decrease task productivity in the short-term, it has positive effects on task innovation and management control, which carry long-term benefits.

Ironically, given our work's motivation, we obtained mixed findings regarding the complementarities of ASU and USAGE. Specifically, ASU positively moderates the impact of USAGE on *task innovation* in Study 1, but not in Study 2. ASU has a negative moderating effect on the impact of USAGE on *management control* in Study 2. We did not confirm the moderating effects of ASU on *task productivity* in both studies. The mixed findings underscore the importance of the studies' context (e.g., the technology, the user, and the task), for understanding system use. First, the technology in Study 1 (MS Office) is a comprehensive system while the technology in Study 2 (video-editing system) is a specifically designed system with limited features. Information systems are representations of work domains (Burton-Jones and Grange, 2013). A system must be comprehensive enough to offer features relevant to a wide range of innovative work methods. This may explain why we did not find the expected positive moderation of ASU on the USAGE-task innovation relationship in Study 2.

Second, subjects in Study 1 are experienced users while those in Study 2 are inexperienced users. Experience is a necessary condition for innovation (Scott & Bruce, 1994). Experienced users are more likely to benefit in terms of *task innovation* from system use with adaptive behaviors, as shown in Study 1. For inexperienced users, explorative behavior such as ASU may actually lead to decreases in *management control*. The rationale is that when an inexperienced user is adapting with his or her system use behavior, the user must deviate from the main task and change how he or she manages the task (Boudreau & Robey, 2005; Ortiz de Guinea & Webster, 2013). This may indeed cause confusion about task management: users may be lost in the transition of different work methods, due to inexperience.

Third, in Study 1, subjects had the freedom to report any previous task. In contrast, the task in Study 2 was well-defined and had a specific end product. Therefore, there was less freedom for the subjects to innovate in Study 2. In short, the two empirical studies differ in terms of the technology, the user, and the task. As a result, the complementarities of ASU and USAGE have different influences on task performance factors in the two studies. This indeed opens opportunities for future research to refine our understanding by considering the contextual effects on the complementarities of exploitative and explorative system uses.

6.1 Limitations

This study has limitations. First, this research examines only two types of IS, two types of users, and two types of tasks. Although this design creates easy to understand contrasts, future research should examine additional contexts. For example, ASU may be constrained in highly restricted systems such as ERP systems (Silver, 1988). Second, we drew professionally or demographically homogeneous sample frames (e.g., office administrators and students). To understand the synergies between exploitation-exploration, future research should draw participants from more diverse populations. Third, we examined a narrow set of factors associated with task performance. This research does not study other important indicators of performance such as customer satisfaction. While our measures of task performance were appropriate for systems such as the MS Office suite or video editing, many contemporary technologies enable employees to interact with customers or offer self-help customer service (Hsieh et al., 2011). Future research should investigate how ASU and USAGE influence customer satisfaction using systems that have direct customer service components.

6.2 Research Implications and Future Research

This research offers several implications for IS research. First, we recognize that *task productivity* is a good proxy for objective performance: it explains the large variance in actual student grades.

Second, we observed the complementary nature of rich (e.g., ASU) and lean measures (e.g., USAGE) of system use. That said, we do not see evidence suggesting that adding another rich measure of use (e.g., DSU) would account for a substantial change in the variance explained in this model. This finding suggests that ASU alone offers a strong contribution and complements understanding when using a lean measure of use, but the model does not improve substantially when other rich measures of system use are included. Further, the post hoc analysis provides evidence that DSU and ASU are significantly related to task outcomes. This speaks to the different nature of use (e.g., exploration or exploitation) that can be captured using lean or rich measures of usage.

Also, we see that rich measures of system use (both ASU and DSU) fully mediate the relationships with USAGE and task performance variables. [2] Past research on these complementary constructs has not considered mediation relationships between USAGE and task performance. We provide evidence that ASU and DSU not only moderate the relationship between USAGE and task performance, but that they also mediate these relationships. This indicates that longer and more frequent use of the system does not necessarily lead to higher task performance. It is *how* the system is used that determines task performance. For example, longer or more frequent use of a system may be the result of inadequate feature design or improper use of the system. Together, these findings suggest that USAGE alone can predict variance in dependent variables, but that a richer study of usage adds explanatory power. Our findings imply that researchers consider both the mediating and moderating effects of complementarity in order to fully understand the implications of system use. This finding helps reconcile results reported in prior studies and echoes Benbasat and Barki's (2007) argument that broadening the view of system use may result in stronger prediction of "salient outcome variables such as individual performance" (p. 215).

This paper clarifies how explorative behaviors such as ASU influence the relationships between exploitative system use and task performance. A system often includes opportunities to use new features, the full value of which can only be enacted through adaptation behavior. If such opportunities are not exploited, the influence of the system on task performance is limited, no matter how much it is routinely used. It is interesting to note that Barki et al. (2007) treated exploitation, i.e., accomplishing tasks through system use (called "technology interaction behavior"), and exploration, i.e., learning how to use the system through communicating with other users and IS professionals (called "individual adaptation behavior"), as two separate system use related activities. Given that many information systems are developed to incorporate a large range of work methods, it is necessary to study how people adapt

[2] Given that our studies do not involve treatments, there can be no hypotheses for mediated moderation and moderating mediation (Edwards, 2011).

their system use in response to learning and internalizing others' system use and work methods.

Future research should consider our finding that task performance factors are not independent of each other—that they may instead interact with and influence one another. For example, mediators can be introduced to explain how *management control* and/or *task innovation* influences *task productivity*. More research along these lines is necessary because the relationships among various dimensions of task performance are relatively understudied, even though they are important for measuring the real impact of information systems in order to justify investment in them.

While our review of the literature hints at possible negative effects of exploitation and exploration in the short term, more formal investigation of the externalities of different forms of systems use merits future research (Burton-Jones & Gallivan, 2007). For example, ASU may have detrimental short-term effects: it is risky and thus may sometimes negatively influence task performance (Ortiz de Guinea & Webster, 2013; Sun, 2012). Investigating the mechanisms through which ASU creates risk for users—e.g., increased time, effort, or emotion—could yield interesting insights into the drivers or inhibitors of IT-enhanced performance (Jasperson et al., 2005; Tyre & Orlikowski, 1994). At the same time, explorative system use, such as ASU, may also lead to a "failure trap" (Andriopoulos & Lewis, 2009). That is, people performing ASU behavior may take escalating risks, tending to ignore the core competencies associated with previous work methods. In addition, a user's adaptation behavior may spill over to peers: one's adaptation often implies changes to existing work routines and thus may be resisted by coworkers (Sun, 2012). Also, it has been shown that system use itself may negatively influence relationships with others (Schultze & Orlikowski, 2004). Further, this research offers evidence that experience changes the relationships in the research model. Thus, consistent with Goodhue and Thompson's (1995) work, our research underscores the need for future research that examines how the contexts of the technology, the user, and the task, shape ASU—such research could deepen our understanding of how to encourage the exploration and exploitation of IT by system users.

Further exploration of the relationship between ASU and USAGE could yield rich insight into the relationship between the amount and adaptations of system use. Two dynamics within the relationship emerged while conducting this research. First, experience through a reasonable amount of system use is necessary for the user to adapt system use. Users must obtain sufficient knowledge about a system before they can start adapting their use of it. This would indicate that USAGE should have a positive relationship with ASU. Second, ASU and USAGE may compete for resources. Facing limited cognitive and time resources, users often have to choose between exploiting more of the currently used features (i.e., USAGE) and exploring the possibility of using new features or using features in novel ways (i.e., ASU). Users' choices may have different effects on short-term and long-term performance, in light of the fact that, as mentioned above, while ASU may lead to longer term benefits, the short-term interaction between USAGE and ASU may be negative. Our research yields some evidence of this; namely, the negative interaction effect of USAGE and ASU on management control in Study 2. Future research could investigate the "tension" between ASU and USAGE.

Overall, when revisiting our original intent to investigate the complicated relationships and mixed findings about system use and task performance, this research has two major suggestions. First, system use itself is a complex composition and needs to be decomposed. This research is one of the first efforts to decompose it from one perspective and identify different facets of it (i.e., exploitative system use and explorative system use). Decomposing system use is a valuable path toward understanding of the complex relationship between system use and task performance factors. Second, this research reveals that instead of insisting on looking for a monotone relationship between system use and task performance factors, we should change our view and take into account the context of system use. Our results suggested that the relationship between system use and task performance is contingent on such factors related to the task, the technology, and the user. Therefore, a comprehensive view is needed to consider the impact of system use on task performance.

6.3 Practical Implications

IT practitioners often feel pressure to justify their investment in IT. One way to do so is to assess how the technology impacts employees' task performance. It is important to understand how system use leads to changes in task performance and work methods to ensure that optimal value is extracted from technology expenditures. This research suggests that two aspects of system use should attract the attention of IT practitioners. First, managers should provide employees with time and support necessary to engage in adaptive systems use. By doing so, managers encourage task innovation and foster management control. The higher-order conceptualization of ASU provides guidance for practitioners to recognize and assess when employees revise their system use. ASU can actually help employees gain more innovative ideas as a result of using the system. Second, managers must be aware that use does not automatically lead to ASU behavior. Use may foster a stronger use routine that may actually suppress ASU behavior. Therefore, practitioners might want to encourage a balance between ASU and amount of use, in order to maximize the performance-enhancing benefits of a system.

For system developers, this research suggests that ASU can help improve task innovation. ASU can be viewed as a way to realize or employ the innovative ideas built into the system. Thus, a system should offer enough features to allow users to incorporate innovative work methods, be they existing or predicted. When engaging in a system's design, in addition to asking questions about work methods, such as "which work method is the best way of doing work?", designers should ask questions such as:

- "Which work method would you love to have?"
- "Imagine some work methods that, albeit impossible in today's work environments, would be great to have one day".
- "How might a system ideally accomplish a complex work task"

Developers should also consider the potential cross-functional and cross-discipline appeal of the system as a way of incorporating innovative work methods. IT practitioners should encourage employees' adaptive system use in the shakedown period right after system implementation so that employees can try various ways of using the system before they form routines of system use. In this way, users can explore innovative work methods that may be facilitated through the new system.

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Appendix A: Instruments

Adaptive System Use (Study 1)

(Adapted from Sun, 2012) Please recall and report below an incident in the past where you adapted your system use (a short description of adaptive system use is provided): ________________________________.

Please indicate to what extent you agree with the following statements about that incident you reported, by selecting a number from 1 to 7, where 1 indicates "strongly disagree", 4 indicates "neutral", and 7 indicates "strongly agree".

Trying new features:

TR1: I played around with features in Microsoft Office.
TR2: I used some Office features by trial and error.
TR3: I tried new features in Microsoft Office.TR4: I figured out how to use certain Office features.

Feature substituting:

FS1: I substituted features that I used before.
FS2: I replaced some Office features with new features.
FS3: I used similar features in place of the features at hand.

Feature combining:

FC1: I generated ideas about combining features in Microsoft Office I was using.
FC2: I combined certain features in Microsoft Office.
FC3: I used some features in Microsoft Office together for the first time.
FC4: I combined features in Microsoft Office with features in other applications to finish a task.

Feature repurposing:

FR1: I applied some features in Microsoft Office to tasks that the features are not meant for.
FR2: I used some features in Microsoft Office in ways that are not intended by the developer. FR3: The developers of Microsoft Office would probably disagree with how I used some features in Microsoft Office products.
FR4: My use of some features in Microsoft Office was likely at odds with its original intent.
FR5: I invented new ways of using some features in Microsoft Office. FR6: I created workarounds to overcome system restrictions.

Adaptive System Use (Study 2)

(Adapted from Sun, 2012) Please indicate to what extent you agree with the following statements about that incident you reported, by selecting a number from 1 to 7, where 1 indicates "strongly disagree", 4 indicates "neutral", and 7 indicates "strongly agree".

Trying new features:

TR1: I played around with features in the video editor.
TR2: I used some of the video editor's features by trial and error.
TR3: I tried new features in the video editor.
TR4: I figured out how to use certain the video editor features.

Feature substituting:

FS1: I substituted other features when appropriate (For example, I may use video import feature instead of dragging and dropping).
FS2: I used different features to get the task done.
FS3: I used similar features in place of other features.

Feature combining:

FC1: I generated ideas about combining features in the video editor to complete my assignments.
FC2: I combined certain features in the video editor to finish my assignments.
FC3: I used some features in the video editor together for the first time.

FC4: I combined features in the video editor with features in other applications to finish my assignment.

Feature repurposing:

FR1: I used some features in the video editor in ways that were not intended by the developer of the video editor.
FR2: The developers of the video editor would probably disagree with me on how I used some features.
FR3: My use of features in the video editor were at odds with the original intent.
FR4: I applied some features in the video editor to tasks that the features are not meant for.
FR5: I applied inventive new ways of using features in the video editor.
FR6: I created workarounds to overcome the video editor feature restrictions to complete my assignments.

Deep Structure Use (Study 2)

(Adapted from Burton-Jones and Straub 2006) Tell us how you used different features in the video editor with the following statements about that incident you reported, by selecting a number from 1 to 7, where 1 indicates "strongly disagree", 4 indicates "neutral", and 7 indicates "strongly agree".

DSU1: I used features that help me with my assignments.
DSU2: I compared and contrasted different features to finish my assignments.
DSU3: I used features that help me test different ways of completing tasks required by my assignments.
DSU4: I used features that help me derive insightful conclusions for my assignments.
DSU5: I used features that help me perform well on my assignments.

USAGE (Study 1 & 2)

(Adapted from Kim & Malhotra, 2005)

Frequency: How frequently do you use Microsoft Office? (less than once a month; once a month; a few times a month; a few times a week; about once a day; several times a day)
Duration: On average, how many hours do you use Microsoft Office every day? (almost never; less than 1/2 hour; from 1/2 hour to 1 hour; 1-2 hours; 2-3 hours; more than 3 hours)

Impact of IS on Task Performance (Study 1 & 2)

(Adapted from Torkzadeh & Doll, 1999)

Measured by a seven-point Likert scale, where 1 indicates "strongly disagree", 4 indicates "neutral", and 7 indicates "strongly agree".

Task productivity:

TP1: Microsoft Office saves me time.
TP2: Microsoft Office increases my productivity.
TP3: Microsoft Office allows me to accomplish more work than would otherwise be possible.

Management control:

MC1: Microsoft Office helps management control the work process.
MC2: Microsoft Office improves management control.
MC3: Microsoft Office helps management control performance.

Task innovation:

TI1: Microsoft Office helps me create new ideas.
TI2: Microsoft Office helps me come up with new ideas.
TI3: Microsoft Office helps me try out innovative ideas.

Personal Innovativeness in IT (Study 1 & 2)

(Adapted from Agarwal & Karahanna, 2000)

Measured by a seven-point Likert scale, where 1 indicates “strongly disagree”, 4 indicates “neutral”, and 7 indicates “strongly agree”.

PIIT1: If I heard about a new information technology, I would look for ways to experiment with it.
PIIT2: Among my peers, I am usually the first to try out new information technologies.
PIIT3: I like to experiment with new information technologies.

Computer Self-Efficacy (Study 1 & 2)

(Adapted from Compeau & Higgins, 1995; Thatcher et al., 2008)
Imagine that you are using an unfamiliar software application, please indicate to what degree you agree with the following statement by circling a number from 1 to 10, where 1 indicates “Not at all confident”, 5 indicates “Moderately confident”, and 10 indicates “Totally confident”.

I could complete the job using the software application…

Internal computer self-efficacy:
iSE1: … if there was no one around to tell me what to do as I go.
iSE2: … if I had never used a package like it before.
iSE3: … if I had only the software manuals for reference.

External computer self-efficacy:
eSE1: …if I could call someone for help if I got stuck.
eSE2: … if someone else had helped me get started.
eSE3: …if someone showed me how to do it first.

Appendix B: Video Assignment

Your Web Presence Assignment

Deliverable:

Post YouTube link to the assignment comment area.

Overview

Within 12 months of its launch, YouTube came from nowhere to be one of the top 10 sites on the World Wide Web. The ability to easily upload videos, and have those videos viewed immediately by millions, has made creating your own video content a valuable skill. While YouTube's success is largely derived from the amateur segment of the video production space, major US and global companies are moving towards incorporating video resumés as part of the application process. "We want to hear your voice.... We want to know what you think", says Joe Maturando, the head campus recruiter for Ernst & Young. It's about "Your Future. Your Vision. Your Video". As both Tom Friedman and Chris Anderson have discussed, the ability to upload content is critical. Friedman called it "the most disruptive force of all", shaping the flat world, while Anderson noted that "user developed content" is fundamentally affecting all aspects of life. The goal of this project involves developing video production skills so that students are equipped to participate in this significant technological movement.

Task

In this project, you are asked to produce a two-minute (max) video biography using Microsoft MovieMaker or Apple's iMovie. Primarily, we want students to produce videos that are creative, interesting, and novel. The contents of your video must be professional. In other words, you are required to produce a video that could be shown to the Dean of the [Redacted School], your parents, or a future employer (e.g., no party pictures). With that in mind, your video needs to address the following questions:

1. Who are you?
2. Where do you see yourself five years from now?
3. How has/is [Redacted School] shaped/ing your life?

Required elements:

- Videos must be 2 minutes in length
- Videos must contain two or more video clips
- Videos must contain at least four still pictures
- Videos must include text over video or still pictures in two places
- Videos must have a title at the beginning with your name (e.g., John W.), [Redacted School] and Introductions to Business Information Systems.
- Videos must have credits at the end (e.g., where the videos, songs, pictures are from)
- Videos must contain at least one song.
- Narrations can be used as a substitute for songs.

To accomplish your objective, we recommend that you follow these steps:

1. *Decide on a "story arc" for the story you will tell.* In this step, you will decide how to sequence the material you will cover in your video. For example, you will choose what information to cover first, what information you want to cover next, etc.
2. *Create a "hook" for your story.* When telling your story, we recommend using a "hook", which gets viewers interested in the person and makes them want to learn more. As an example, the classic movie version of a

"hook" can be seen in the opening sequences of any James Bond movie. To make your "hook" effective, it should occur within the first 10 seconds of your video.

3. *Utilize "triggers" or "obstacles" to tell your story.* A "trigger" or "obstacle" represents an event that occurs to change the course or direction that the main character is going. Stories always seem better when "triggers" or "obstacles" are introduced, as they make stories more compelling. For instance, imagine you have a goal that is moving your life in one direction; the trigger might block that path and force you to go in another direction, changing the course for the character in the story.
4. *Storyboard your video.* A storyboard is a graphical representation of the sequence of events in your video. At this stage in the project, it is best to create a storyboard simply by drawing a set of boxes joined together by arrows, which depict the flow of your video. Your storyboard should outline how the "story arc" will be captured in the video. In essence, your storyboard should show the sequence of scenes, "hooks", "triggers", and "obstacles", and other elements.
5. *Collect the materials that you will need for your video.* In this step, you will collect the necessary materials that you will put in your video. As mentioned in the previous step, you will need to obtain a cell phone, camcorder, or digital camera that can record simple videos. At least two video clips will need to be incorporated into your video. In addition, you will be required to use at least four still photos (in either .GIF or .JPG format) in your video. You will also need access to at least one music audio file (in .MP3 format) or a microphone to record narrations.

	Novice	Competent	Proficient
Required Elements	**3** (30%) Did not have many of the required elements.	**4.25** (42.5%) Was missing some of the required elements.	**5** (50%) Had all the required elements.
Story	**1.5** (15%) It had no story.	**2.13** (21.25%) I could follow the basic story line.	**2.5** (25%) It had a coherent and well thought story line.
Audience	**1.5** (15%) The video content was inappropriate for the audience.	**2.13** (21.25%) The video could have been shown to a professional audience.	**2.5** (25%) The video can be featured on the website.

Figure A1. Screenshot of the Rubric Used to Grade the Assignments

Appendix C: Discriminant Validity

Table C1. Study 1 Hetrotrait-Monotrait Ratio (HTMT)

	ASU	MC	PIIT	Spirit	TI	TP	Usage	eSE	iSE
ASU									
MC	0.407								
PIIT	0.495	0.417							
TI	0.437	0.694	0.477	0.387					
TP	0.361	0.824	0.476	0.290	0.870				
USAGE	0.715	0.616	0.564	0.578	0.618	0.703			
eSE	0.194	0.070	0.163	0.137	0.146	0.121	0.076		
iSE	0.401	0.322	0.629	0.242	0.327	0.350	0.504	0.241	

Notes: TR: trying new features; FS: feature substituting; FC: feature combining; FR: feature repurposing; TP: task productivity
MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy
*Cutoff is 0.90

Table C2. Study 2 Hetrotrait-Monotrait Ratio (HTMT)

	ASU	CSE_ex	CSE_in	MC	PIIT	Perf	TI	TP	Usage
ASU									
eSE	0.187								
iSE	0.116	0.547							
MC	0.581	0.105	0.158						
PIIT	0.242	0.399	0.556	0.245					
Performance	0.403	0.044	0.117	0.245	0.016				
TI	0.558	0.065	0.030	0.648	0.117	0.202			
TP	0.496	0.161	0.121	0.769	0.149	0.275	0.576		
USAGE	0.372	0.047	0.066	0.304	0.102	0.275	0.310	0.269	

Notes: TR: trying new features; FS: feature substituting; FC: feature combining; FR: feature repurposing; TP: task productivity;
MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy
*Cutoff is 0.90.

Table C3. Loadings and Cross-Loading in Study 1*

	TR	FS	FC	FR	Use	TP	MC	TI	PIIT	iSE	eSE
TR1	0.90	0.51	0.53		0.49				0.44	0.41	
TR2	0.89	0.36	0.45								
TR3	0.95	0.52	0.54		0.47				0.44	0.47	
TR4	0.93	0.42	0.49		0.45				0.42	0.45	
FS1	0.49	0.90	0.50	0.46	0.40						
FS2	0.40	0.91	0.61	0.48	0.40						
FS3	0.45	0.91	0.57	0.55							
FC1	0.53	0.55	0.83	0.47	0.5						
FC2	0.48	0.57	0.9	0.54	0.45			0.40			
FC3	0.48	0.47	0.84	0.33	0.40						
FC4	0.40	0.53	0.86	0.47	0.40		0.43				
FR1		0.52	0.61	0.86							
FR2		0.49	0.44	0.93							
FR3				0.84							
FR4		0.43		0.9							
FR5		0.44	0.44	0.89							
FR6		0.57	0.43	0.79							
USAGE1		0.43			0.80						
USAGE2	0.45		0.51		0.90	0.56	0.45	0.45	0.41		
TP1					0.55	0.95	0.76	0.81	0.44		
TP2					0.50	0.95	0.69	0.79			
TP3					0.50	0.91	0.76	0.72			
MC1					0.46	0.75	0.97	0.65			
MC2					0.47	0.77	0.99	0.68	0.40		
MC3			0.40		0.50	0.79	0.98	0.66			
TI1			0.42		0.49	0.83	0.70	0.97	0.46		
TI2					0.46	0.79	0.65	0.97	0.43		
TI3			0.40		0.47	0.80	0.63	0.98	0.41		

Table C3. Loadings and Cross-Loading in Study 1*

PIIT1	0.48				0.47				0.93	0.54	
PIIT3						0.40		0.44	0.93	0.45	
PIIT4	0.44				0.42	0.41		0.42	0.93	0.59	
iSE1									0.52	0.93	
iSE2	0.41								0.5	0.94	
iSE3	0.48								0.55	0.88	
eSE1											0.94
eSE2											0.94
eSE3											0.84

Notes: TR: trying new features; FS: feature substituting; FC: feature combining; FR: feature repurposing;
TP: task productivity; MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy
*Loadings with absolute values less than 0.4 are suppressed.

Table C4. Loadings and Cross-Loading in Study 2*

	TR	**FS**	**FC**	**FR**	**Use**	**TP**	**MC**	**TI**	**PIIT**	**DSU**	**eSE**	**iSE**
TR1	0.90	0.61	0.61			0.49	0.51	0.44				
TR2	0.88	0.54	0.56				0.41					
TR3	0.91	0.57	0.60			0.43	0.44					
TR4	0.93	0.62	0.64			0.46	0.50	0.41				
FS1	0.55	0.88	0.58			0.41	0.46					
FS2	0.63	0.87	0.61			0.42	0.47					
FS3	0.56	0.90	0.59				0.42					
FC1	0.59	0.63	0.86			0.43	0.49					
FC2	0.66	0.63	0.86			0.46	0.50					
FC3	0.62	0.48	0.64			0.45	0.44					
FC4		0.40	0.77									
FR1				0.63								
FR2				0.80								
FR3				0.95								
FR4				0.78								
FR5				0.70								

Table C4. Loadings and Cross-Loading in Study 2*

FR6				0.70								
USAG					0.87							
USAG					0.70							
TP1	0.42		0.41			0.92	0.66	0.46				
TP2	0.50	0.42	0.49			0.94	0.68	0.53				
TP3	0.44	0.42	0.47			0.91	0.66	0.49				
MC1	0.46	0.46	0.48			0.7	0.90	0.54				
MC2	0.50	0.46	0.53			0.69	0.93	0.54				
MC3	0.44	0.45	0.47			0.53	0.85	0.43				
TI1	0.44		0.41			0.51	0.52	0.95				
TI2	0.43	0.40	0.41			0.49	0.52	0.94				
TI3			0.41			0.51	0.55	0.93				
PIIT1									0.90			0.44
PIIT3									0.90			0.46
PIIT4									0.92			0.47
DSU1										0.74	0.40	
DSU2										0.81		
DSU3										0.70		
DSU4										0.74		
DSU5										0.81		
eSE1										0.40	0.92	0.62
eSE2											0.89	0.43
eSE3											0.84	
iSE1									0.52		0.51	0.93
iSE2									0.45		0.43	0.94
iSE3									0.42		0.51	0.88

Notes: TR: trying new features; FS: feature substituting; FC: feature combining; FR: feature repurposing;
TP: task productivity; MC: management control; TI: task innovation; PIIT: personal innovativeness in IT; iSE: internal self-efficacy; eSE: external self-efficacy

*Loadings with absolute values less than 0.4 are suppressed.

Appendix D: Interpretational Confounding of ASU

There is an ongoing debate regarding the use of formative factors (Edwards, 2011; Polites et al., 2012; Shin & Kim, 2011; Howell, & Breivik, 2008). It is still unclear under what conditions and in what forms formative factors should be specified (Kim et al., 2010). One primary issue is interpretational confounding, which occurs when the meaning of a formative construct is a function of its indicators as well as the dependent variables such that when the dependent variables are changed, the formation of the formative construct also changes (Howell et al., 2007; Wilcox et al., 2008). Hence, the stability of the weights between the high-order formative construct and its indicators/subconstructs can swing depending on the dependent variables of the formative construct (Kim et al., 2010; Shin and Kim, 2011).

To assess the interpretational confounding of ASU, this research compares the weights of ASU in Study 1 with those in Sun's (2012) work. In Sun's work, the weights of the second- and first-level factors of ASU are all significant. Consistently, this research shows that all but one weights of ASU's second- and first-level factors are significant, somewhat supporting the stability of ASU's subconstructs. However, the ratio of the subconstructs' weights did vary in these two studies. The RevContent (b = 0.59) / RevSpirit (b = 0.52) ratio in Sun's work is 1.13, while in this research this ratio is 0.58 (=0.38/0.65). The formation of ASU is thus different in these two models.

It is important to note that researchers have different views regarding interpretational confounding. One view on this issue is that it is normal for the weights of the indicators/subconstructs of a construct, formative or reflective, to vary from study to study because any measure is necessarily context-specific and accordingly should not be considered in isolation of the nomological network. It is perhaps "a bit too early to judge the extent to which context-specificity and the associated potential for interpretational confounding constitute a 'fatal flaw' of formative measurement" (Diamantopoulos, 2011, p. 341). Again, the debate over the interpretational confounding of formative constructs is ongoing. So, the formative nature of ASU can be reexamined, if necessary, when more evidence about the use of formative constructs is available. Researchers have provided some remedies for respecifying formative constructs using alternative models with reflective measures (Edwards, 2011). The first-order subconstructs of ASU are measured by reflective indicators. This may help if a respecification of ASU is indeed needed in the future.

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