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Reconceptualizing System Use For Contemporary Information Systems

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RECONCEPTUALIZING SYSTEM USE FOR CONTEMPORARY INFORMATION SYSTEMS

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Abstract

System use is a centrally important construct in a plethora of research. Yet for all its importance, and still consistent with observations of DeLone and McLean (1992), system use suffers from a "too simplistic definition". Much of prior conceptualizations of use have been idiosyncratic and unsystematic. *This study examines contemporary systems use and thereafter, introduces a framework for selecting system use constructs and measures based on three critical considerations: typology of the system-in-use, level of process automation, and system lifecycle. Measures are then recommended for system typologies under three types of system use: frequency, depth and explorative use. Our empirical investigation validates the framework using data from operational users of an archetype of contemporary systems- Enterprise System. Analysis of six PLS models: identify system use as an antecedent of individual-impacts, confirm the importance of depth of use, role of explorative use at early stages of a lifecycle, and alludes to issues in employing popular frequency based use measures. The study advocates several insights towards a deeper understanding of contemporary systems use. Nonetheless, future research can be directed towards a larger quantitative study to facilitate a broader theoretical and empirical treatment, and a consolidated set of prescriptive actions for practitioners.*

Keywords: System Use, Information Systems Success, Enterprise Systems

1 INTRODUCTION

System use (synonyms with usage) has been a key concept of discussion in Information Systems (IS) discipline for several decades (Bokhari 2005; Schwarz and Chin 2007). It is one of the few constructs that has been employed across multiple domains, including; IS success, IS acceptance, IS implementation and IS decision making (Burton-Jones and Straub 2006). Yet for all its importance and applications in a plethora of research domains, system use suffers from a "too simplistic definition", and the measurement of the construct seems to be still problematic (DeLone and McLean 1992, 2003).

Information Systems have evolved substantially over the last decade. Contemporary forms of systems have become prominent, while some traditional systems have now become archaic. Despite the vast changes associated with the evolution of IS (e.g. their characteristics, configuration, system lifecycle, user groups, and their experiences), contemporary research do not seem to capture effects of system transformations when measuring use. When system use is measured – with few exceptions – its process and selection of measures are often idiosyncratic and lacking credibility or comparability. From this, two inter-related research questions guide our activities, (1) what are the considerations when conceptualizing contemporary (IS) use? and (2) What are dimensions and measures of contemporary (IS) use?

To address the above research gaps and questions, we seek first to define system use as "*The extent to which an Information System is incorporated into the user's business processes or tasks"*. We propose a framework for selecting four dimensions of system use, that must be selected carefully taking into account the types of Information Systems, their characteristics, configuration, system lifecycle, users, and user experience for Information System success research (e.g. DeLone and McLean 1992; DeLone and McLean 2003; Gable, Sedera and Chan 2008). Our framework and approach are validated in the context of Enterprise Systems, an archetype of contemporary IS. We envisage that insights from this study will inform future research and construct a better understanding of contemporary systems use.

The paper proceeds in the following manner. The next section summarizes past attempts at conceptualizing system use. We evidence obsolesce of prior system use conceptualizations in their *definitions* and *measurement*. Four salient gaps in system use literature are identified and discussed. We next propose a new conceptualization for system use, demonstrating the influence of three critical considerations (highlighted above). The subsequent empirical tests results demonstrate the validity and application of the use dimensions, each selected based on the three critical considerations. Our results presented next, highlight the strengths of our approach in selecting use measures, application of the measures of system use. The paper concludes with summary findings and research outlook.

2 LITERATURE REVIEW

2.1 Evolution in Conceptualization and Measurement of System Use

With the exception of a few studies — such as Burton-Jones and Straub (2006) and Burton-Jones and Gallivan (2007) — there has been very little emphasis on understanding the structure, ontology and its application of system use. An in-depth understanding of 'system use' is especially important today, given the evolution, innovations and inceptions of 'systems' in the history. Straub et al. (1995) report that the most common forms of use measures include self-reports of use and computer-reported figures. Similarly, Lee, Kozar, and Larsen (2003) in their review of the TAM literature from 1986 to 2003 stated that behavior (use) was "usually measured using frequency of use, amount of time using, actual number of usages and diversity of usage" (Lee et al., 2003, p. 759), using self reported data. In addition, Venkatesh, et al. (2003), measured intention to use with Davis's (1989) scales and actual use as duration of use gathered via system logs. Landrum, Prybutok et al. (2008) measure use with the number of times a person has used a library online catalogue employing a five-scaled category (1=none, 2=once, 3=2 to 5 times, 4=6 to 10 times, 5=11 or more times).

There is, on the other hand, a growing emphasis on new dimensions system use. One dimension highlights the importance of users' psychology. For example, Hong, Thong et al. (2001), postulate three interdependencies in system use: (1) a user's psychological state during system interaction, for example stimulation, arousal, and challenge; and (2) plausible views (as opposed to psychological) of system interaction, for example familiarity and usefulness; to add to (3) functions of objective characteristics (like frequency or duration). Another dimension measures the 'depth of use', 'extended use' and 'exploratory use' – all purportedly measuring the 'quality of use' (see Burton-Jones and Straub (2006); Petter et al. (2008)) For example, Saeed and Abdinnour-Helm (2008) used extended and exploratory use to capture post implementation system usage. Where 'extended usage' captures the breadth and frequency of using different IS features and functions, 'exploratory usage' captures active examination of new uses of IS.

2.2 Gaps in Conceptualizing the Use Construct

Despite the recent nominal shifts towards capturing system use, there exist several gaps in prior studies through an archival analysis of 55 studies published between 1985 and 2008 (see Appendix A for details). We attribute the lack of a clear rational for the choice of system use constructs and measures employed as the main cause for gaps in prior studies. These gaps are as a result of: (1) use measures do not reflect the shift in nature of the contemporary IS environment, (2) lack of attention to the lifecycle phase or user experience, (3) focus on use measures of frequency and (4) lack of relevance to its nomological net.

First, we discuss three fundamental changes in contemporary IS environment that have been largely ignored in prior use measurement studies; (1) changes and innovations in systems, (2) transition to a business process orientation, and (3) the involvement of multiple employment cohorts in a single IS application. The transition from in-house, custom-made, stand-alone applications to integrated, customizable packages and the proliferation of web-based systems have changed the way users employ systems in a contemporary organization. Therefore we argue that when measuring *'system'* use, one must pay high diligence to the innate characteristics of the system it-self. For example, users of an organizational system (where Enterprise Resource Planning System is an archetype of) would now typically take part in a business process (as opposed to working in functional areas) (Markus 2004; Liang, Saraf et al. 2007). These process-based systems provide strict prescriptive patterns of system use that are largely automated for its users. In such systems, users are given less latitude to deviate from the core (mandatory) business functionality. Moreover, most organization-wide systems are being used by multiple key-user-groups (KUGs)[1] (Anthony 1965; Hirt and Swanson 1999; Wu and Wang 2007). However, most prior studies ignore the tautological differences in system use where each KUG employs the 'same' system for different business purposes – resulting in completely different types of system use.

Second, we highlight the relation between lifecycle phase and user-experience. The (systems) lifecycle phase that the system user is in or more specifically user-experience within these phases contributes to differences in the way that end-users employ a system. When measuring system use at the early phases of the lifecycle, scholars must take into account the pre-mature nature of use by employees. As identified by many (including Markus (2004) and Ross et al. (2000)), users face a morass of challenges and issues at early stages of the lifecycle. A user faces similar issues when s/he is required by a new role to use new system features and functionality. At the early lifecycle phases (or when the user is assigned a new role in relation to a system), users tend to explore the system more, while more experienced users or in the latter parts of the lifecycle, such behavior may not be desirable. We highlight that such differences system use during phases of the lifecycle (early vs. late) and the level of user experience (experienced vs. inexperienced users) may only be prevalent in relation to some system types.

[1] We use key user groups here to refer to employment cohorts or stakeholder groups, akin to suggestions in Gable et al. (2008) and consistent to Anthony (1965). Examples include: Managers, Operational Staff, Technical Staff and Strategic Staff. We note a slightly different use of the same term 'key user group' by Hirt and Swanson (1999) and Wu and Wang (2007) where they use the same term for those employees with high business process and domain knowledge.

Third, we discuss the attention on measures of frequency. Frequency and duration of system use are the two most commonly employed measures of system use. Our archival analysis in Appendix A shows that 76% of past studies (42/55 studies) and 42% of all measures (94/226) examined are related to frequency of use. DeLone and McLean (1992, p. 68) suggest that "usage, either perceived or actual, is only pertinent when such use is not mandatory." When use is mandatory, the frequency and duration of use of a system conveys little information about the impact of the system (Welke and Konsynski 1980; Seddon 1997). While we believe the volitional or non-volitional nature of system use is an important consideration in the measurement of use, such measures should be employed with a clear rational, with only the appropriate systems. Attempts at measuring use with metrics such as self-reported use and analysis of computer logs are also problematic (Burton-Jones and Straub 2004). These kinds of metrics do not have the ability to discriminate among experimental uses, use on other than corporate-approved tasks, and actual productive use. Spector (1992), cited in Burton-Jones (2004, p 337) estimate, that many self-reported measures in organizational behavior capture only 10-20% of a construct's true variance.

Lastly, we highlight role of use for its nomological net. In the case of system success, we argue that the definition of system use (followed by the constructs and measures) should explicitly demonstrate how system use contributes to one or more dimensions of system success. Therefore, we do not anticipate a single all-purpose definition for system use for all domains. Quite the opposite, we intend to build on other definitions of system use including: "a user's employment of one or more features of a system in a task" (Burton-Jones and Straub 2006 p.231) and 'the degree and manner in which staff and customers utilize the capabilities of an IS' (Petter et al. 2008, p.239). We maintain the view that there's nothing conceptually wrong with many of the prior definitions of use; despite this, using some simplistic definitions such as "employing technology in completing tasks" (Goodhue and Thompson 1995; Burton-Jones and Straub 2004) permit the inclusion of measures that gauge incidental or casual use. Our preposition is that, experimental or casual use in which a system is not regularly incorporated into the user's processes does not provide the long-term effects on the business and cannot therefore be considered use for this purpose.

3 PROPOSED DEFINITION OF SYSTEM USE

Given the gaps outlined above, we conceptualize system use for IS success domain as; *"The extent to which an Information System is incorporated into the user's business processes or tasks".* The main emphasis of this conceptualization is that of *incorporation.* In measuring the effectiveness or success of an system, we are interested in the short and long-term effects on the user's capabilities or performance. We hold that the only type of use that produces these effects is that in which the system has become a part of the user's standard operating procedures (i.e., has been internalized and become part of the user's process knowledge). Experimental or casual use in which a system is not regularly incorporated into the user's processes does not provide the long-term effects on the business and cannot therefore be considered use for this purpose. A "user" in this definition may be considered as an individual, group, or organization. An additional consideration here is that incorporation includes regular use in a process that might not be executed on a continuous or even daily basis. Examples of this type of use would be an accounting system month-end process, which is executed monthly or a system used in containment of a runaway nuclear reaction that would be executed only on an infrequent, and exceptional basis.

In light of our conceptualization, our definition and gaps in past research, we argue that any measurement selection for system use must carefully consider the following three key considerations: (1) the type of the system, (2) the level of system automation of the business work process and (3) phase of system lifecycle (or user proficiency) - *where one, two or all three considerations influence the selection of constructs and measures employed in gauging system use*.

3.1 Contemporary Systems Typology

A contemporary IS portfolio includes applications that range from Spreadsheets to email applications to complex Enterprise Systems. We employ the system typology and a related discussion of McAfee (2006) who classifies systems into three distinct categories to illustrate the contemporary IS portfolio of work systems: (i) Function IT, (ii) Network IT and (iii) Enterprise IT. To a large extent, the types of the IS outlined above determines the manner in which the users are *allowed* and *expected* to use the system. The definitions and examples of each of these three system types are illustrated in Table 1. Observing the examples and characteristics of systems (McAfee 2006), it is clear that when developing usage measures, researcher needs to be aware of the system type under evaluation and its characteristics. In the case of Enterprise IT, use can be vastly different between its multiple Key-User-Groups. A typical Enterprise IT includes many diverse Key-User-Groups ranging from senior executives to data entry Operational staff using the same Enterprise application, purportedly using the system in a diverse manner. For example, the Operational level staff uses the system for completing a business transaction on a day-to-day basis, while the senior management sporadically engages with the system for management decision making. Table 1 below summarizes our main prepositions (discussed subsequently) in relation to (underpinning) system considerations across the three system typologies (McAfee 2006).

Category	Function IT	Network IT	Enterprise IT
Definition	Assist with the execution of discrete tasks	Facilitates interactions without specifying their parameters	IT that specifies business processes
Characteristics	Can be adopted without complements*. Impact increases when complements are in place.	Does not impose complements*, but lets them merge overtime. Accepts data in many formats, Use is optional	Imposes complements* throughout the organization. Define tasks and sequences. Mandates data formats. Use is mandatory
Examples	Spreadsheets, Computer Aided Design, Statistical Software	Emails, Instant messaging, Wikis, Blogs and Mashups	ERP, CRM and SCM
Automation	Some degree of automation (e.g. Spelling check)	Very low level of automation	High level of automation
KUGs	More likely to have a single KUG	More likely to have a single KUG	Multiple KUGs using the same system very differently.

Table 1: System Influence on Use Measurement

* Complements are defined by McAfee (2006, p. 142) as *"organizational innovations, or changes in the way companies get work done"*. Examples of complements that allow working performing technologies, according to McAfee (2006, p. 143) are better-skilled workers, higher levels of teamwork, redesigned processes, and new decision rights

3.2 The Level of Automation

The level of automation is the extent to which a business work process is dictated by an IS. The proportion of the business process encoded in the IS can be labeled as the *automation level.* As described above, a system can execute a varying amount of the process or tasks, hence reducing the need for users to perform little or no mechanical/ mental work. Some systems automate significant proportion of a business process, (e.g., a claims-processing system performs most of the work of handling a health-care claim) while in other systems, users' handle the exceptions that the system is unable to process. Other systems co-operate the process with the participants, for example in Function IT, MS Word handles such things as formatting margins, spelling and grammar checking; still other systems, such as a plant floor monitoring system, while collecting information from the manufacturing process, do not perform any of the work in that process. In cases such as where *"the system is the process",* use is near-*mandatory* as the system performs most of the key processing required by the system with the users providing support. In these cases, the users employ the system to support the business process. At the opposite end of the spectrum, where the system monitors the process, the process may be executed without reference to the system and therefore the system does not perform the process. In all instances, regardless of the level of automation, a user have an opportunity to *add value* to the business process / task by engaging in tasks beyond the automated process. When measuring system use, not only that one needs to be aware of the level of automation in the process of measurement, but also needs to be aware of the value-adding tasks within a process.

3.3 The System Lifecycle Phase or User Experience

Seddon, Staples and Patnayakuni (1999) following recommendations of Cameron and Whetten (1983), suggest that IS researchers consider the implications of lifecycle phases in system evaluations. In relation to Enterprise IT applications, Ross and Vitale's (1999) lifecycle model predicts a dip in organizational performance/system success post-*go live* (original 'go-live' and major upgrades, followed by steady growth). Many attribute this dip in performance in organizations to factors arising from users' unfamiliarity of the new system (Sumner 2000). Most Enterprise IT users face a steep learning curve at the early stages of the lifecycle and could take years to 'master' features and functions of the software. Thus, system use at the early phases of the lifecycle will be substantially different to the use in later phases. We therefore suggest that, especially at early phases of the lifecycle, users' *attitude towards system use* would provide valuable insights into how systems will be used in later phases of the lifecycle. Given that an average employee has a high IT proficiency in such applications like emails and word processing, partly due to the higher proliferation of these applications in society and the workplace, we do not anticipate substantial implications of the system lifecycle phase on the Function IT or Network IT. Therefore, we argue that the implications of the system lifecycle phase are less likely to influence Function IT and Network IT.

4 DEVELOPING MEASURES OF SYSTEM USE

Having discussed the critical considerations, we now introduce two salient types of system use that are common across all three system typologies. We argue that, when studying system use one must recognize the differences in (1) *requisite use* or (2) *value-adding use*. The requisite use synonyms with basic, mandatory, essential and obligatory use, and denotes one's use of the system to complete the minimum requirements of a business process / task. Often 'requisite use' parallels with the automated system functions and features. Such system use will be near mandatory or compulsory. The value-adding use is volitional and must be conducted to achieve a specific value-adding objective. Value-adding use captures the additional (none-core, non-automated and/or non-compulsory) use by the user conducted to enhance the output or impact. We argue that these two types of use must be measured using different measures, each capturing a unique aspect of use.

Measures of *frequency of system use* in general are appropriate for 'requisite use', while for 'value-adding' use, measures that capture *depth / extent of system use* are appropriate. These two types of use measures, though not identified in a systematic manner have been employed in prior studies (see Appendix A). The two classes of measures make a broad categorization of measures according to the *efficiency* (through *frequency*) and *effectiveness of use* (through *depth / extent* of use). As ancillary constructs, we also see the value of understanding the *exploratory use* at the early phases of the lifecycle (or when the sample is predominantly new users). As outlined in Abdinnour-Helm and Saeed (2006), exploratory use captures how users explore IS for their needs and tasks. Moreover, one must not be using exploratory usage measures to capture value-adding measure as such use does not have a specific value-adding preposition. Some researchers may argue for a finer differentiation between extent, depth of use and thoroughness of use. However, we argue that such distinction would add unnecessary complexity and do not see a logical, repeatable and easy to understand distinction for the respondent. The type of measurement employed in a research must be selected with regards to the system considerations discussed in the section above (see Table 1). Finally, akin to arguments of Markus (2004), where she highlighted the importance users' attitudes to avoid (or minimize) backlashes and resistance when systems are operationalized, we consider the importance of users' *attitude* towards the system, especially at the early stages of the lifecycle. Note that we *do not* suggest attitude as a construct of system use, rather conceive it as an antecedent of success.

In summary, we present a 6-step prescription for measuring system use. Akin to Burton-Jones and Straub (2006), we too see the risk of having omnibus measures when measures are selected without a clear rational. Steps 1-4 provide signposts to researchers in determining the salient considerations for system use, while steps 5 and 6 determine the appropriate type of measure for the context.

1.	Determine the system typology (i.e. FIT, NIT or EIT)
2.	Determine the level of automation (for e.g. High, Medium, Low)
3.	Determine the characteristics of the KUG (especially important for EIT)
4.	Determine the phase of the system lifecycle or user experience (especially important for EIT)
5.	Determine the type of usage you want to measure (i.e. requisite or value adding or both)
6.	Select the appropriate type of measure (i.e. frequency based or depth / extent)

Table 2: Steps in developing measures for System Use

4.1 Positioning against Burton-Jones and Straub's (2006) Study

In 2006, Burton-Jones and Straub presented a conceptual re-thinking of the use construct for IS domain. Given its currency and its substantial contributions, we highlight strengths and weaknesses of their conceptualization, positioning it against our views of system use. We concur with the 'Definition stage' of Burton-Jones and Straub (2006, pg. 231) which highlights the range and scope of use and the need of having an accepted *approach* for systematically developing conceptualizations of use for specific contexts and selecting measures in a theoretically rigorous manner. We hold that the identification of the three considerations above makes a direct contribution to the 'definition stage' of Burton-Jones and Straub (2006). Moreover, similar to Burton-Jones and Straub (2006), we too share the same notion that measures of system use should not include aspects related to information use. Finally, though our conceptual arguments are different, we agree with the arguments surrounding omnibus measures.

On the other hand, there are aspects of Burton-Jones and Straub (2006) that we disagree with. First, in contrast to Burton-Jones and Straub (2006), we argue that the system and its users will *define patters of system use*, where the type of the system and its user cohorts determine how users interact with the system and whether the manner in which the system is being used is appropriate and adequate for the success of the system. We further argue that, at least in the case of Enterprise IT (McAfee 2006), the 'tasks' users involved are addressed *through the business processes that are defined by the system*. These considerations of the system and user cohorts therefore, shape the measures. Secondly, Burton-Jones and Straub (2006) argue that their intention is not assess the quality of measures, but only to gauge the level of use. Our conceptualization goes beyond the simple measurement use. In light of the definition employed in this study, we argue that the 'quality of use' is necessary and vital when measuring use as a 'success' dimension. We argue that when one uses only the bare minimum functions of a system, without utilizing, exploiting and adhering to the capabilities of the system, the contributions that it [the use] has for system success is minimal.

5 EMPIRICAL INVESTIGATION

To demonstrate our approach in identifying measures for system use, a number of experiments were executed. Given the differences in characteristics of the three systems typologies together with the level of automation, key-user-groups and their levels of experience, we were loathed to conduct three separate investigations for the three types of the systems. Due to space limitations, this paper only concentrates on the procedures, findings and interpretations associated with an Enterprise Systems. It is an appropriate selection of a system, given its substantial influence through the level of automation, the range of key-user-groups and the impact of the lifecycle phases. The process selected for the exercise was the Procurement and Order Fulfilment process. The process of procurement and order fulfillment (henceforth referred to as procurement for simplicity) is one of the most commonly used business processes. Organizations with Enterprise Systems typically automate the requisite features and functions of procurement process, while allowing latitude for value-added functionality. We restrict our test sample in this paper to system use of the *operational* staff in a tertiary education institution- some less experienced users. We recognize that all key-user-groups may take part in the procurement process. Inclusion of other user cohorts in this experiment required deriving and emphasizing on new system use measures.

Figure 1 demonstrates the research model. A nomological net is developed using three interrelated constructs. The empirical investigation includes: (1) *attitude towards system use* as an antecedent and (2) *individual impact* as a consequence of system use and (3) *system use* as the central construct of interest. As per our conceptualization, system use is considered as a higher order construct determined by frequency, depth and exploratory use dimensions. The inclusion of attitude towards use allows us to better understand users' behavior at the early stages (Wu and Wang 2006). The formative Individual Impact has been suggested as a consequence of many IS success studies (Igbaria et al. 1997; Gable et al. 2008).

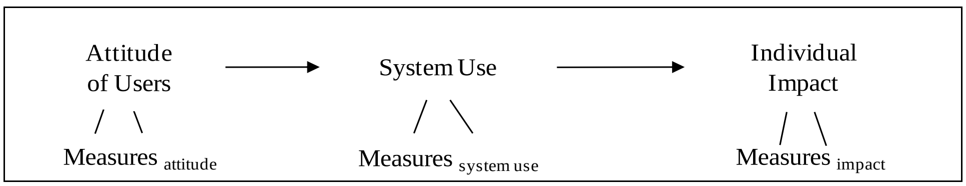


Figure 1: Research Model

5.1 The Instrument and Data Collection

The survey included 15 questions[2] capturing use, attitude, individual impact dimensions and their measures - all measured in a 7-point Likert scale. Participants were asked to state the number of days / times on the frequency of system use. Two criterion measures were also included to canvass the overall (1) use and (2) impact of IS. The data was collected through a carefully executed experiment using the procurement process executed through SAP ECC 6 Enterprise System. A total of 103 users participated in the experiment. All participants 'assumed' the role of a procurement officer in a case scenario that involves purchasing, receiving several raw materials and trading goods and paying several customers for those goods ordered. The procurement process in the SAP system was pre-configured and automated to receive minimum mandatory input from users in completing; (i) purchase requisition, (ii) purchase order, (iii) goods receipt and (iv) invoice verification. The subjects were provided with 90 paged step-by-step instructions for requisite steps, but were given latitude to add value to the business process by completing additional (voluntary) steps[3]. Given the length of the experiment instructions, data collection occurred eight (8) weeks after the subjects were being provided with the step-by-step instructions. This allowed subjects to appreciate the business process, develop an attitude in relation to system use and confidently comment on the Individual Impact.

5.2 Descriptive Statistics and Measurement Model

Table 4 illustrates the study descriptive statistics and results of the measurement model. Items belong to five constructs of the research model; FQ: frequency, DP: depth, AT: attitude, EP: exploratory and II: individual impact (see Table 3).

[2]Actual measures are not shown here due to space limitations. They are available on request from the authors

[3] Examples of optional value-adding tasks include: (i) vendor selection, (ii) invoice reconciliation, (iii) payment determination and (iv) configuring and customizing user parameters and customer profiles (Tan and Sedera 2008).

Perspective	Measure	Source
Frequency (FQ)	(1) *Frequency in days:* I spend X number of days per week, on the system completing my procurement tasks. (2) *Duration in hours:* I spend X number of hours per sitting, on the system completing my procurement tasks.	(Cheung and Limayem 2005) and (Venkatesh et al. 2003)
Depth (DP)	(1) *Non-compulsory uses:* I use system features to perform (non-compulsory steps) configuring organizational and user parameters in procurement. (2) *Strategic uses:* I use system features to perform additional tasks (which I think adds strategic value for procurement).	New Scales
Exploratory (EP)	*Extent of exploration:* I have explored additional system features in the system beyond the given specifications.	(Abdinnour-Helm and Saeed 2006)
Attitude (AT)	(1) *Comfort:* I feel confident and relaxed when engaging with the system. (2) *Achievement:* I find the procurement tasks rewarding and fulfilling. (3) *Interest:* I find the procurement exercises interesting and attractive. (4) *Challenge:* I am willing to challenge myself and excel at using the system for procurement tasks. and (5) *Willingness to complete:* I am willing to put in as much effort as required to complete procurement.	(Gopal and Bostrom 1992) and (Kim and Soergel 2005)
Individual Impact (II)	(1) *Lessons learnt:* I have learnt much about procurement through the system. (2) *Awareness:* What I completed in the system increased my awareness of procurement. (3) *Effectiveness:* The system has enhanced my effectiveness in procurement. (4) *Productivity:* The system has increased my productivity in procurement. and (5) *Performance:* System has increased my overall performance in procurement.	(Gable et al. 2008)

Table 3: Survey Dimensions and Measures

	Mean	Std. Deviation	Loadings (L) / Weights (W)	Reliability*/ VIF**
AT1[R]	4.26	1.357	0.84 (L)	CA: 0.87 CR: 0.90
AT2[R]	4.45	1.571	0.84 (L)	
AT3[R]	5.53	1.333	0.74 (L)	
AT4[R]	4.43	1.576	0.82 (L)	
AT5[R]	5.30	1.274	0.80 (L)	
FQ1[F]	2.30	.610	0.89 (W)	1.14
FQ2[F]	1.87	.624	0.40 (W)	1.04
DP1[F]	4.89	1.151	0.75 (W)	1.49
DP2[F]	4.95	1.211	0.38 (W)	1.41
EP[F]	3.89	1.616	1 (W)	1.27
II1[F]	4.77	1.495	0.18 (W)	3.02
II2[F]	4.97	1.360	0.74 (W)	3.31
II3[F]	4.77	1.378	0.29 (W)	10.61
II4[F]	4.68	1.435	0.52 (W)	9.72
II5[F]	4.76	1.350	0.36 (W)	10.79

Table 4: Descriptive Statistics and Constructs Validity

R = Reflective; F = Formative; * CA: Cronbach Alpha, CR: Composite Reliability
**VIF: Variance Inflation Index scores from FQ1 to II5

Firstly, Skewness and Kurtosis tests on use dimensions support distribution normality. All measures in table 4 were used for construct validation. For the reflective measure of 'attitude', exploratory factor analysis resulted in item loadings above 0.70 (Hair, Anderson et al. 1998), with 65.8% variance explained. The attitude scale demonstrated a Cronbach alpha score of 0.87 and a composite reliability score of 0.90, demonstrating high reliability (Nunnally 1978). For formative constructs of system use and Individual Impact, following guidelines of (Diamantopoulos and Winklhofer 2001), Variance Inflation Factors (VIF) scores were first calculated (see Table 4). The VIF scores for frequency, depth and exploratory ranged from 1.04-1.4, indicating no significant multicollinearity (Diamantopoulos and Winklhofer 2001; Mathieson, Peacock et al. 2001). Some degree of multicollinearity is recorded for impact measures of task effectiveness and task performance- their VIF scores slightly over the heuristic of 10. However, following guidelines of (Petter, Straub et al. 2007), who argue for more inclusive measurement, we decide to retain them for model testing.

5.3 Structural Model Validity and Discussion

Table 5 shows the results of six (6) PLS structural models. Given the research gaps, we test six models to demonstrate the structural validity of the potential system use measurement types in its nomological net. Consistent with suggestions by (Mathieson, Peacock et al. 2001) and exemplified in Burton-Jones and Straub (2006), we compare R^2 values and path coefficients of the constructs using SmartPLS (Ringle, Wende et al. 2005) software. Our efforts of testing the six PLS models attempt to distinguish the effects of requisite use, value-adding use and exploratory use in our research model in Figure 1.

The following observations are made from our analysis in table 5. Model 1 tests the relationship between frequency of (requisite) system use and individual impact. The results indicate a small (and not significant) negative impact of frequency on individual impact ($B_{Use} = -0.23$). Model 2 tests the relationship between individual impact and depth (value-added) usage and individual impact. The results indicate a high effect on individual impact and a larger effect size (the variance yield is nearly 10 times more than that of model 1). We next test (model 3) the effect of exploratory use and individual impact. The results indicate a moderate impact and a reasonable r-square for individual impact. Model 4 treats each system use construct as individual independent variables, where as model 5 is a composite higher order use model that conceives each construct as a dimension of the overarching system use. When comparing model 4 and 5, it is evident that model 4 (the component model) depicts the best R-square value for individual impact, with 57% of variance explained. Model 6 demonstrates the relationships between attitude towards use (as an antecedent), system use and individual impact, where attitude towards use explains 29% of variance in system use. In addition, a test of higher order model (model 5) where system use is measured by requisite, value-added and exploratory measures, it is revealed that exploratory use demonstrates the highest weight (followed by depth of use, then frequency).

The PLS results confirm our conceptual prepositions of system use and the three critical considerations. In summary, (1) through model 5 results evidenced the existence of three distinct types of system use, (2) demonstrate the inadequateness in using frequency based assessments for Enterprise IT (model 1), (3) value of measuring explorative use (model 3) at early stages of the lifecycle and (4) the importance of measuring depth of use for higher individual impacts through Enterprise IT. The results also concluded that (5) user attitude towards use has a strong and significant impact on system use. The emphasis seen on frequency of use may also relate to the operational key-user-group and the highly automated procurement process studied herein. If the same study were to be conducted with *management staff* (instead of operational staff) using the same business process, we recommend a strong emphasis on depth of use measures (possibly withdrawing frequency based measures).

As regards to the research gaps (see section 3), our analysis demonstrates that to measure system use for its nomological net of study (IS success in this case), employing only frequency measures is inadequate and researchers must incorporate considerations of system type (ES in this case), the potential for value-adding processes at automation level and users attitudes at a specified lifecycle phase. In other words, capturing the extent to which an IS is incorporated into the user's business processes or tasks, highlighting the above factors is a more holistic and in-depth approach to system use measurement.

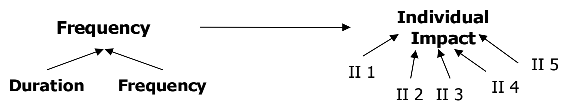
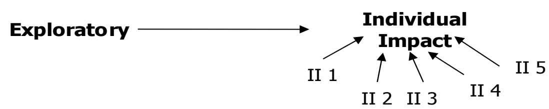
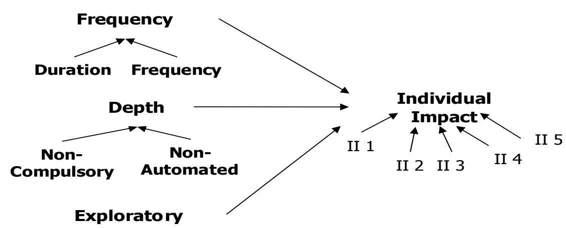
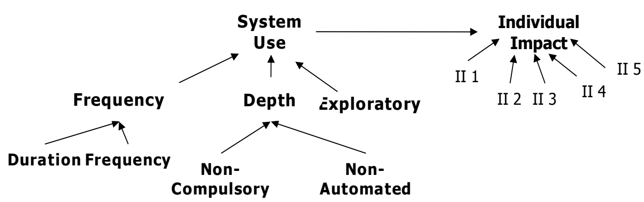
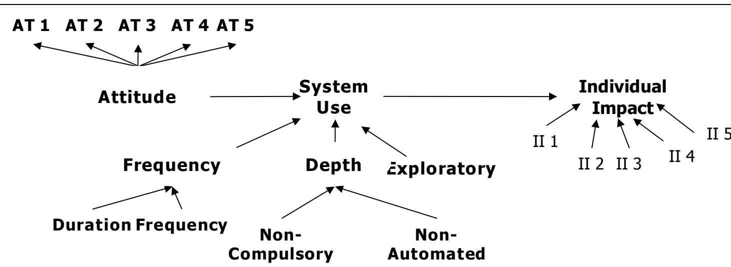
Type[a]	Models[b] Tested	Results [c]
1		$B_{Frequency} = -0.23$, $t = 0.7$, $R^2 = 0.054$
2		$B_{Depth} = 0.751$, $t = 12.40$, $R^2 = 0.564$
3		$B_{Exploratory} = 0.388$, $t = 4.34$, $R^2 = 0.151$
4	Component Model 	$B_{Frequency} = -0.06$, t=0.569 $B_{Depth} = 0.721$, $t = 10.81$, $B_{Exploratory} = 0.069$, t= 0.932 $R^2 = 0.573$
5	High Order Model** 	$B_{Use} = 0.555$, $t = 7.28$, $R^2_{Use} = 0.286$ $R^2_{Impact} = 0.31$ Weight $_{Frequency} = -0.1$ Weight $_{Depth} = 0.219$ Weight $_{Exploratory} = 0.31$
6		$B_{Attitude} = 0.731$, $t = 8.508$, $B_{Use} = 0.555$, $t = 6.91$, $R^2_{Use} = 0.286$ $R^2_{Impact} = 0.31$

Table 5: PLS Structural Models

a: Measurement Approach: type 1- requisite use; type 2- value-adding use; type 3: exploratory use as single item construct; type 4: requisite, value-adding and exploratory usage; type 5- type 4 use as a higher order construct; type 6- effects of attitude as an antecedent of system use and individual impact;
b: Horizontal arrows depict paths, vertical arrows depict indicators
c: B represents Beta (Path) Coefficients between an antecedent and dependent variable, t represents t-statistics (t-stats more than 2 represents significant effect of independent on dependent variable).
****:** Higher order construct of system use were formed with the survey criterion item score. We also used regression factor scores of each component (Garson 2010) to verify the models and found no substantial difference in the results.

6 CONCLUSION AND OUTLOOK

Despite its recognition in IS research, this study have found for system use; little consensus on its definition, its sub-dimensions and measures in numerous studies spanning the last three decades, hence drawing much discussion and recent criticisms. Based on these weaknesses, this study presents a new conceptualisation of *IS use*; one that defines *the extent to which an IS is incorporated into a user's business processes and tasks*. Central to this conception is a *process-systems centric* approach that gathers the relationships between modern day *system types*, *key user groups*, *automation level*, *system use lifecycle or user experience*. We then argue that *requisite* and/or *value-added use* measures must be selected to distinguish ways that users use a system. As an ancillary measure, we also demonstrate the value of employing exploratory use – especially at early stages of the lifecycle. We gathered data in relation to the three system typology of McAfee (2006). Herein are presented data analyses pertaining to Enterprise IT. Enterprise IT data was gathered from an experiment suing operational staff perspective, in an SAP Enterprise System completing the procurement process. Six PLS models were derived and tested for use constructs: depth of use (to capture value-added use) and frequency of use (to capture requisite or basic use) and exploratory use. Their nomological net was tested using Individual Impact as a consequence of use and attitude towards use as an antecedent of system use. The investigative models found that although frequency of use is favored in prior studies, it does not have a strong effect on users' individual impact. On the other hand there is strong support for the inclusion of depth of use and exploratory use measure of system use. Our results also demonstrate the value of attitude as an antecedent to capture the extent of incorporation or how users embrace their system at still an initial phase.

The study of Enterprise IT has two main limitations: (i) relatively small sample size and (ii) limitations with measurement items. Firstly, the sample of the current study may be perceived small with 103 respondents. Though it is adequate compared to the measurement items employed, it falls short of such studies like (Kim, Malhotra et al. 2005)'s study of Network IT on utilitarian, hedonic and social value of news where the sample was 2075 responses. The second limitation pertains to the number of measures associated with each construct. Given our formative conceptualization of the usage constructs, especially for *exploratory use*, more validated measures provide added confidence to findings. Using the approach, the study model can improve its external validity through replications across *different systems* at *different lifecycle phases*, and *other key-user-groups*. The study model could also include other antecedents of system use, including; *Computer self-efficacy*, *pre-usage beliefs* and *control mechanisms, subjective* and *behavioural norms* (Compeau and Higgins 1995; Taylor and Todd 1995; Bhattacherjee 1996) and could be tested with various success dimensions of system use. Though our approach is derived through (and derived for) the *IS success domain*, wider application through generalisability is possible. We intend to follow up this theoretical treatment with the further development of this concept, including the testing of metrics for each proposed dimension of system use and an overall measure that synthesizes these dimensions into a single measure. Another area of follow-on research that might be extended on this methodology would be that of measuring the *success* of the system. A system that is incorporated into a process may improve the performance of the process or it may even degrade its performance. These metrics would provide a way to determine whether poor performance was related to lack of use or whether the system itself was deficient in providing the capability or usability needed.

APPENDIX A: ARCHIVAL ANALYSIS** OF USE IN PRIOR STUDIES

Type of Use Dimension* --->					Requisite	Value-adding	Exploratory	Attitude	Others
Example of dimension(s) --->					e.g. frequency and duration of use	e.g. I use additional system features to add value to process	e.g. I explore other features and functions of the system	e.g. I feel comfortable with using the system	e.g. varieties of uses for system, dependence on system
Study	^ No of measures examined	FIT	NIT	ES					
(Barki and Huff 1985)	1	✓	×	×	✓	×	×	×	×
(Mahmood and Medewitz 1985)	8	✓	×	×	✓	✓	×	✓	×
(Raymond 1985)	1	✓	×	×	✓	×	×	×	×
(Srinivasan 1985)	2	✓	×	×	✓	×	×	×	×
(Raymond 1990)	2	✓	×	×	✓	×	×	×	×
(Liker 1992)	1	✓	×	×	×	✓	×	×	×
(Adams, Nelson et al. 1992)	2	✓	✓	×	✓	×	×	×	×
(Szajna 1993)	6	✓	×	×	✓	×	×	×	×
(Leidner and Elam 1994)	2	✓	×	×	✓	×	×	×	×
(Rice 1994)	1	×	✓	×	✓	×	×	×	×
(Thompson, Higgins et al. 1994)	4	✓	×	×	✓	×	×	×	✓
(Taylor and Todd 1995)	3	✓	×	×	✓	×	×	×	✓
(Compeau and Higgins 1995)	2	✓	×	×	✓	×	×	×	×
(Straub, Limayem et al. 1995)	3	×	✓	×	✓	×	×	×	✓
(Xia 1996)	3	✓	×	×	✓	×	×	×	×
(Choe 1996)	2	✓	×	×	✓	×	×	✓	×
(Igbaria, Parasuraman et al.	2	✓	×	×	✓	×	×	×	×
(Gill 1996)	1	✓	×	×	✓	×	×	×	×
(Massetti and Zmud 1996)	4	×	✓	×	×	✓	×	×	×
(Collopy 1996)	2	×	✓	×	✓	×	×	×	×
(Guimaraes and Igbaria 1997)	2	×	✓	×	✓	×	×	×	×
(Igbaria and Tan 1997)	2	✓	✓	×	×	×	×	×	✓
(Li 1997)	1	✓	×	×	✓	×	×	×	×
(Seddon 1997)	5	✓	×	×	✓	×	×	×	×
(Gelderman 1998)	4	✓	×	×	✓	×	×	×	×
(Doll and Torkzadeh 1998)	30	✓	×	×	×	×	×	×	✓
(Bhattacherjee 1998)	3	✓	×	×	✓	×	×	×	✓
(Lucas and Spitler 1999)	15	✓	×	×	×	×	×	×	✓
(Tu 2001)	21	✓	×	×	×	✓	✓	×	×
(Skok 2001)	2	✓	×	×	×	✓	×	×	✓
(Staples, Wong et al. 2002)	8	✓	×	×	✓	×	×	✓	×
(Rai, Lang et al. 2002)	1	×	✓	×	×	×	×	×	✓
(Pflughoeft, Ramamurthy et al.	6	×	✓	×	×	×	×	×	✓
(DeLone and McLean 2003)	4	×	✓	×	✓	×	×	×	×
(Devaraj 2003)	3	✓	×	×	✓	×	×	×	✓
(McGill, Hobbs et al. 2003)	1	✓	×	×	✓	×	×	×	×
(Mao and Ambrose 2004)	4	×	✓	×	✓	×	×	✓	×
(Gebauer 2004)	4	×	✓	×	×	×	×	×	✓
(DeLone and McLean 2004)	8	×	✓	×	✓	×	×	×	✓
(Djekic and Loebbecke 2005)	7	×	✓	×	✓	×	×	×	×
(Cheung and Limayem 2005)	2	✓	✓	×	✓	×	×	×	×
(Kim and Malhotra 2005)	1	×	✓	×	✓	×	×	×	×
(Jain and Kanungo 2005)	5	✓	✓	×	✓	✓	×	✓	×
(Kim, Malhotra et al. 2005)	1	×	✓	×	✓	×	×	×	×
(Almutairi and Subramanian	20	✓	×	×	✓	×	×	×	✓
(Iivari 2005)	2	×	×	✓	✓	×	×	×	×
(Abdinnour-Helm and Saeed	10	✓	×	×	×	✓	✓	×	×
(Wu and Wang 2006)	5	✓	×	×	×	×	×	×	✓
(Burton-Jones and Straub 2006)^	17	✓	×	×	×	✓	×	✓	×
(Sabherwal, Jeyaraj et al. 2006)	4	✓	×	×	✓	✓	×	×	×
(Wang, Wang et al. 2007)	3	✓	×	×	✓	×	×	✓	✓
(Chien and Tsaur 2007)	8	×	×	✓	✓	✓	×	✓	✓
(Tsai and Chen 2007)	5	✓	×	×	✓	×	×	×	✓
(Halawi, McCarthy et al. 2007)	6	✓	×	×	✓	×	×	✓	✓
(Landrum, Prybutok et al. 2008)	1	×	✓	×	✓	×	×	×	×
Count --->	**273**	**38**	**19**	**2**	**42**	**10**	**2**	**9**	**19**
Percentage of Studies --->		**69%**	**35%**	**4%**	**76%**	**18%**	**4%**	**16%**	**35%**

** Results depict that 69% and 33% of studies reported on functional (FIT) and networking (NIT) systems respectively, while there are only two studies that focused on enterprise systems (EIT).

* Examples of *value-added* measures are "I try new features in e-mail/spreadsheets to make me more efficient and do things differently than others" (Jain and Kanungo, 2005, p. 121) and "When I was using MS Excel, I used features that helped test different assumptions" (Burton-Jones and Straub, p. 237). *Other* use items reported includes "number of assignments completed" (Taylor and Todd 1995, p. 156) and "user type (average, heavy or light)" (Srinivasan 1985, p. 248).

^ Some studies have not published the full instrument; as such only reported measures are examined.

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