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Adaptive IT Use: Conceptualization and Measurement

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ABSTRACT

IT use is an important concept both in research and in practice. Yet, IT use has been simply defined and measured in IS research. Presently used measurements do not reflect the dynamics of users' IT use behavior, which are important and account for job performance. This research aims at conceptualizing a new construct to capture the changes in IT use and developing an instrument for it. From an adaptive structuration perspective, we propose a new construct named Adaptive IT Use (AITU) to capture use changes in both IT feature set (size, content, and network), and the spirit of IT features. We further propose six dimensions of AITU and corresponding measuring items. After interviews and card-sorting experiments, an instrument of AITU is developed.

Keywords

Adaptive IT use, adaptive structuration theory, instrument development.

INTRODUCTION

IT use has been an important concept in the contemporary IS research and in practice. Unfortunately, existing conceptualizations of IT use show a number of problems. A literature review shows that IT use is simply measured by the amount of time, the frequency, the number of tasks completed, the number of features used, to name a few (Sun and Zhang, 2005). These measurements do not reflect users' active roles in using technology. As a result, the current measurements of IT use do not account for work performance. In short, the problem to date is "a too simplistic definition of this complex variable [IT use]… simply saying that more use will yield more benefits, without considering the nature of this use, is clearly insufficient… researchers must also consider the nature, extent, quality, and appropriateness of the system use…" (DeLone and McLean, 2003 p.16).

As our first step, we approach this problem by studying users' active actions toward technology. Researchers have realized that IT use does not occur in a deterministic fashion, rather it is emergent. Users are gradually considered not passive takers of technology. Instead, they can purposely select, reproduce, and reshape the technology in use. Based upon the adaptive structuration theory (AST, DeSanctis and Poole, 1994, Poole and Desanctis, 1992, Poole and DeSanctis, 1990) and applying Moore and Benbasat's instrument development method (Moore and Benbasat, 1991), this research describes a process of conceptualizing a construct named Adaptive IT Use (AITU) to capture the changes in using IT and developing an instrument to measure it.

CONCEPTUAL DEVELOPMENT

Adaptive structuration theory (AST)

Rooted in structuration theory developed by Giddens (1984, 1979), Adaptive Structuration Theory (AST, DeSanctis and Poole, 1994, Poole and Desanctis, 1992, Poole and DeSanctis, 1990) addresses the mutual influence of the technology and social processes. The mutual influence is based upon the duality in structuration theory: social structure is seen as being drawn on by human agents in their actions, while the actions of humans in social contexts serve to produce, and reproduce the social structure (Jones and Karsten, 2003). Therefore, while the social structure of technology guides, enables or constrains action, action also produces or reproduces the social structure of technology (Burke and Chidambaram, 1999). Social structure of technology and appropriation, two key concepts that compose the central ideas of AST (Reinig and Shin, 2002), are of special value to this study.

Social structures represent formal and informal rules and resources provided by a technology. The technology manifests itself in social structures. The social structures of a technology can be described "in two ways: structural features [feature set] of the technology and the spirit of this feature set" (DeSanctis and Poole, 1994 p.126). The spirit refers to the "general goals and attitudes the technology aims to promote" and can be understood in a manner analogous to the spirit of the law. The spirit is the "official line" that the technology presents to people regarding how to act when using the system, how to interpret its features, and how to fill in gaps in procedure, which are not explicitly specified. Structural features (the feature set) implement the spirit promoted by the system.

Appropriation is the manner in which structures are used by participants (Reinig and Shin, 2002). Appropriations are defined as the "immediate visible actions that evidence deeper structuration processes" (DeSanctis and Poole, 1994 p. 128). Appropriation reflects people's active reshaping of the technology. Appropriation of a technology is not automatically determined by its designs and features, but selected by users. DeSanctis and Poole identified a variety of "appropriation moves" such as

directly using technology structures, combining structures, substituting current structures with other structures, enlarging current structures, and contrasting the structure with other structures, to name a few.

Despite the strength of AST in studying people's active roles in using IT, AST is not beyond criticism. For instance, structuration theory in general is complex and based on general propositions and concepts that operate at a high level of abstraction, and thereby its application in empirical research is widely recognized as very difficulty (Pozzebon and Pinsonneault, 2005). We therefore develop a new concept, namely Adaptive IT Use (AITU), to improve the applicability of structuration theories in empirical research giving using scales is a convenient way to capture AST constructs in a variety of settings (Salisbury and Stollak, 1999).

Adaptive IT Use (AITU)

We borrowed the term, "adaptive", from AST to reflect the rationality of human actions and accordingly define Adaptive IT Use as **users' appropriation behavior of modifying technology's feature set and/or the spirit of the feature set in an adaptive manner**.

Rooted in AST, AITU is, however, different from the appropriation moves proposed by AST. We position AITU at the *individual user* level and for the use of *not necessarily collaborative technologies*.

Suggested by AST, AITU includes changes in IT feature set, in the spirit of the feature set, or both. This would form the following dimensions of AITU (Table 1). In this study, we focus on Quadrants I and II in Table 1. Quadrant III can be studied as a synthesis of Quadrant I and II, whereas Quadrant IV has been addressed by existing measurements (i.e., since neither feature set nor the spirit of it changes in Quadrant IV, we can use the amount of time, the frequency, etc. to measure IT use effectively).

Quadrant I (Changes in feature set). Changes in feature set include changes in the *size, content, and network* of the feature set. First, an individual can decrease the feature set by stopping using certain features and expand the feature set by trying new features. Second, without changing the size of the feature set, he/she can change the content of it by simply substituting currently used features with other features. Third, without changing the size and content of a feature set, the network within the feature set can be changed via combining/recombining. For example, a user reported "I created tables in Excel and pasted them into Word". The table creation feature in Excel and Paste feature in Word that were used separately before, are being used together. In this case, the size and the content of the feature set do not change, but the network among features is changed.

Quadrant II (Changes in spirit). Appropriation moves causing changes in spirit are considered "unfaithful" moves (DeSanctis and Poole, 1994 p.135). Adapted from Chin et al. (1997), the faithfulness of appropriation is defined as the extent to which an individual's use of system structures is consistent with the *original design intent* of the system developers. Accordingly, repurposing can be conceived as the unfaithful appropriation process. For instance, a user applied the drawing feature in PowerPoint to create a diagram that are then copied and pasted as picture to Word documents to make high quality pictures. It is a typical example of unfaithful use (i.e., the drawing feature in PowerPoint is repurposed and applied to a task that it is not meant for).

		Feature set	
		Changed	Unchanged
Spirit	Changed (unfaithful)	**Quad III** Synthesis of Quad I and II	**Quad II** Repurposing
	Unchanged (faithful)	**Quad I** Decreasing feature set Expending feature set Substitutive moves Combining	**Quad IV** Currently used measurements: -- the amount of time -- the frequency -- the number of used features -- etc

Table 1: The Dimensions of AITU

METHOD

An instrument development process requires carefully designed procedures and a constant monitoring of various validity and reliability statistics. We designed our research carefully to address Straub's recommendations on instrument validation (1989). Interviews were used to ensure the content validity, whereas card-sorting experiments and surveys were conducted to examine and enhance various validities and reliabilities. In short, we validated the representativeness of measures (content validity), the meaningfulness of construct as measured (construct validity), and the stability of measures (reliability) (Straub, 1989).

We refer to Moore and Benbasat's method of instrument development, which is appropriate for examining second-order constructs as demonstrated in their original study (Moore and Benbasat, 1991). We made two primary revisions to their method, both of which are aimed to eliminating group effects. At least two possible types of

	1st Round								2nd Round							
	Stopping	Trying	Switching	Repurposing	Combining	N/A	Total	Ratio	Stopping	Trying	Switching	Repurposing	Combining	N/A	Total	Ratio
1. Stopping	**9**		3				12	0.75	**12**						12	1.00
2. Trying		**31**		1			32	0.97		**25**		1		6	32	0.78
3. Switching		2	**21**			5	28	0.75			**21**	1		2	24	0.88
4. Repurposing		7		**37**			44	0.84		2	1	**33**	2	10	48	0.69
5. Combining		3		1	**12**		16	0.75					**20**		20	1.00
	Total Hits (total of diagonal): 110			Total item placement: 132			Overall hit Ratio: **0.83**		Total Hits (total of diagonal): 111			Total item placement: 136			Overall hit Ratio: **0.82**	

Table 2. Hit ratios of first two rounds of card sorting

group effects can be expected. First, in the four-judge card-sorting experiments, judges (participants of the card-sorting experiments) influence each other in the individual sorting task by showing impatience or over attention to the one who falls behind. Second, judges may participate in the group task to different degrees: someone's opinions dominate others'. Moreover, given there are only four judges in each round of card-sorting, it is unlikely that any particular statistical method effect was captured (Chin et al., 1997). To overcome the former group effect, observation method was used to detect the possible group effect. Behavioral cues were recorded and used in evaluating the reliability of the results. To overcome the latter group effect, a debriefing stage was added before the group task so every judge has an opportunity to show his or her opinions regarding the sorting and labeling.

The target technology was Microsoft Office Suite. Including many applications such as Word, Excel, Access, FrontPage, and Visio, to name a few, Microsoft Office is appropriate for this research

INSTRUMENT DEVELOPMENT PROCESS

Item creation

The content validity is a major concern in item creation. We achieved the content validity by basing our items on previously validated instruments and interviews. First, instruments in prior studies, especially those on the "appropriation moves" proposed by AST (DeSanctis and Poole, 1994 p. 135), are referred to and adapted to form the initial pool of measuring items. We ended up with 42 initial items[1]: 3 for decreasing feature set, 11 for expanding feature set (trying new features) (we put the substitutive moves together with trying new features in the initial pool), 8 for combining, and 20 for repurposing.

Then, interviews were conducted with typical users of Microsoft Office with diverse background including five doctoral students, five administrative staffs working in a university environment, and four employees in a local company. Each interview took around one hour. All interviews were recorded and transcribed. Transcripts were analyzed and used for generating new items. Interviewees' judgments were used to evaluate the initial items. Seventeen items were dropped because they received more than three "unclear" marks. Eight new items were extracted from the interviews. As a result, we had five categories including a total of 33 items that went into card-sorting experiments, among which 3 items are for decreasing feature set, 8 items for expanding feature set, 7 items for substitutive moves, 4 items for combining, and 11 items for repurposing.

Item development

Procedure

Two rounds of card-sorting experiments were conducted. Each round had four judges and took around 1.5 hours. In the first round card-sorting, each item was printed on one small card. As a learning practice, a trial sorting was conducted. The judges were told to sort the ten items into categories based on their meanings. They were also told that there was no limit on either the number of category or the number of items in each category. An "N/A" (not applicable) category was included automatically for items that were ambiguous.

Judges were first asked to do an individual task. Every judge was asked to sort the 33 items of AITU. After all judges finished the task, we had a debriefing. Then, the judges were asked to conduct the same task as a group. The group task took around 40 minutes and all judges participated in the task actively.

Items were revised and new items were added based on the first round card-sorting. Thirty-four items then entered the second round sorting. Using another panel of four different judges, the second round card-sorting followed the same procedure. The difference is that all judges in this round were told the names and descriptions of all categories for the trial, individual, and group tasks.

[1] Due to the space limit, items are available upon request.

Results of first and second rounds of card-sorting

We observed strong group effects in both rounds ("Judge 4" refers to the subject influenced by the group effect in each round). Therefore, we also calculated some statistics

without Judge 4's results, which may have been biased by group effects.

Table 2 and 3 show the hit ratios, raw agreements and Cohen's Kappa. For the first round, we have an overall hit ratio of 0.83, an average raw agreement of 0.69, and an average Kappa of 0.65. The results are acceptable because a Kappa score no smaller than 0.65 is considered acceptable (Moore et al., 1995, Jarvenpaa, 1989). Without Judge 4, the raw agreement and Cohen's Kappa was improved significantly to 0.82 and 0.77 respectively.

For the second round, the average of hit ratio is 0.82; the raw agreement is 0.74 (0.88 without Judge 4); and the Cohen Kappa is 0.71 (0.85 without Judge 4).

Table 4 shows the judges' categorizations and labeling. All the four judges and the group in first round card sorting came up with six categories. Their labels were very close to the original categories.

A closer examination of Table 4 indicates that repurposing may have two different aspects: using the features to tasks that they are not meant for, and using features in ways that are not intended by developers. Therefore, we decided to split this category into two separate categories. The former one is about how to apply the features to *new tasks*. That is, the purpose of the feature is changed. Therefore, we label it as "repurposing". The latter one is closely related to the developers' intent. Users recreate or reproduce ways of using the features that are not intended by the developers.

1st Round		2nd Round	
Raw agreement	Cohen's Kappa	Raw agreement	Cohen's Kappa
0.76	0.69	0.88	0.85
0.79	**0.72**	0.82	0.77
0.45	**0.30**	0.58	0.50
0.79	0.74	0.91	0.89
0.85	0.81	0.85	0.81
0.58	0.46	0.58	0.49
0.88	0.85	0.97	0.96
0.36	0.64	0.30	0.46
0.85	0.81	0.88	0.85
0.58	**0.46**	0.61	0.53
Average: 0.69	0.65	0.74	0.71
Average without Judge 4: 0.82	**0.77**	0.88	0.85

Table 3. Raw agreement and Cohen's Kappa

So we label it as "reproducing".

Combined, we ended up with six categories and 32 items.

Item testing

Survey data were collected from a pilot study for testing the reliability and construct validity. Subjects were 106 students in a major northeast university. They were allowed to comment on the items and the questionnaire such as its wording, length, and instruction. The pilot testing also serves for item purification. Items with low item-item and item-scale correlations, which would raise ALPHA if deleted, or which showed low variance (and hence would have low explanatory power in the model) will be candidates for elimination (Moore and Benbasat,

	Judges				
Original categories	**Judge 1**	**Judge 2**	**Judge 3**	**Judge 4**	**Group**
Stopping	Stopping using features	Willingness to stop	Sunsetting features		Ceasing
Trying	Propensity to try new features	Willingness to learn	Trying new features	Feature experimentation	Trying new feature
	Learning new features		Staying with existing features*	Reluctance to experiment*	
				No name	
Switching	Changing features used	Willingness to upgrade	Changing to new features	Upgrade software	Upgrading
Combining	Combining features	Creative combining	Combining features		Combining features
Repurposing	Repurposing features	Creative others	Modifying features	Feature repurposing	Unintended use
		Creative repurposing		Creating new features	Using features in new ways

Table 4: Categorization and labeling

1991). The data are being analyzed.

Items passing the pilot testing will be used in the final questionnaire. A large-scale survey with knowledge workers will be conducted soon.

CONCLUSION

Research efforts directed toward the creation of a richer conceptualization of IT use are few (Boudreau and Seligman, 2005). Users' active roles in using IT are absent from the currently used definitions and measurements. This research addresses this problem by conceptualizing a new construct (AITU) to capture the changes in IT use. The contributions of this research are two-fold. First, from an adaptive structuration theory perspective, a six-dimension concept of AITU was developed and validated. Second, we develop an instrument for measuring AITU. Given most of existing AST studies employs qualitative macro- or micro-coding methods and may not be practical to apply in all circumstances, an easy-to-use instrument is of merit (Salisbury and Stollak, 1999). Methodologically, we improve Moore and Benbasat's card-sorting method. Under the rationality assumption of human behavior, a future direction is to study the impact of AITU on work performance. It also bridges the theoretical gap that current measurements of IT use do not account for work performance.

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