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The Evolution of 'Use': Reconceptualizing the Nature of Information Technology Use

Michael Cuellar
Georgia Southern University, mcuellar@georgiasouthern.edu

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Michael J. Cuellar
Georgia Southern University
mcuellar@georgiasouthern.edu

ABSTRACT

Information Technology Use (ITU) is one of the most under conceptualized constructs in IS research. Historically, ITU has been conceptualized as a behavior: the interaction of a user with technology to accomplish a goal-directed task. However, this conceptualization leads to incommensurable results between studies. It also fails to consider the increase in the capabilities due to improvement in technological capabilities. These new capabilities have created IT Artifacts (ITA) which can replace humans and operate autonomously of humans. This paper reconceptualizes ITU as a structure: *the manner in which an ITA is incorporated into the activities of a work system.* We argue that this conceptualization of use alleviates the issue of incommensurability between studies and allows for conceptualization and measurement of use for modern ITAs. It does this by providing a way of describing use that can be utilized across work systems which enables direct comparison of the performance.

KEYWORDS

Information Technology Use, IT Artifact, Work Systems

INTRODUCTION

Information Technology Artifact Use (ITU) is a key construct in information systems research. It is the "dependent variable" in many areas of research within the field, yet it is generally conceded that ITU is poorly conceptualized and operationalized and we know little about it (Barki, Titah, & Boffo, 2007; Burton-Jones & Gallivan, 2007; Burton-Jones & Straub, 2006; Venkatesh, Brown, Maruping, & Bala, 2008).

The research that has been done has conceptualized ITU as a behavior (Burton-Jones & Gallivan, 2007; Williams & Gupta, 2018). The historical understanding is that of intentional interaction of a user to perform a task (Burton-Jones & Straub, 2006). Burton-Jones and Straub (2006) define use as "an activity that involves three elements: (1) a user, i.e., the subject using the IS, (2) a system, i.e., the object being used, and (3) a task, i.e., the function being performed." (p. 231). It suggests that there is a user who uses an IT artifact to perform a goal directed activity. This calls to mind the idea of a person sitting at a computer using an MS Office product. While this provides a clear definition, when it is operationalized, we encounter some significant difficulties. First, using Burton-Jones and Straub's (2006) proposed two-step approach, leads to incommensurable results between studies as different studies will use different measure based on content and context. Researchers have used different measures both objective and subjective measures (Venkatesh et al., 2008).

Second and more importantly, this definition does not consider the progress of information technology over time. Information technology artifacts (ITA) have become increasingly sophisticated and possess more capabilities. Input/output media has changed from paper tape, punch cards and 11x14 greenbar paper to video display terminals to the Windows-Icon-Mouse-Pointer (WIMP) interface to touch screen and haptic interfaces. Processing capabilities have progressed from the simple symbol processing capabilities seen by Simon (1996). Modern information technology artifacts (as of this writing) can, for example, utilize Big Data to identify patterns in data and using artificial intelligence capabilities make decisions as to what should be done to respond to these patterns.

These changes in technology capability and roles challenge our understanding of ITU. The definition of use as the interaction of a user with a technology to accomplish a task is simply inadequate to account for use of either the more primitive information technology of the 1950s through 70s or the coming autonomous AI driven technologies of the future. A new conceptualization and measurement technology are required.

In this paper, we propose an alternative conceptualization of ITU that will resolve both issues that of incommensurable results between studies and that can account for use of the new autonomous AI driven artifacts. This new conceptualization conceptualizes use as a *structure* instead of a behavior. Use occurs when an ITA is embedded in a

work system and performs certain activities in the execution of the work system. We believe that this conceptualization not only supports the conceptualization of a person using an MS Office product but also is able to describe the use that occurs when an IT artifact is embedded in other artifacts such as automated vehicles and Fitbit devices.

This paper proceeds as follows. First, we review the recent literature on IS use showing that the idea of use is that of behavior, a user interacting with an information system. Then we demonstrate counter examples where this definition fails to fully explain the phenomena. Then we develop our conceptualization of use. Based in Work Systems Theory (Alter, 2013, 2015), we argue that an IT artifact occupies a position as a participant in a work system performing activities in support of the work system function. This position can include various roles within the work system from monitoring the function, the enabling the function, co-executing the function or fulling performing the activities (M. J. Cuellar, McLean, & Johnson, 2006). We then discuss how the IT artifact is integrated within the work system through the use of Environment Interface Points and interfacing activities.

LITERATURE REVIEW

In this section, we discuss the traditional view of IS Use and discuss its issues and limitation.

The Traditional View of Information Technology Use

Information Technology Use (ITU) has traditionally been conceptualized as the behavior of users in relation to technology (Burton-Jones & Gallivan, 2007). Burton-Jones and Straub (2006) surveyed the literature up to 2006. They found, in contrast to other frameworks such as the Delone and McLean IS Success Model (Delone & McLean, 1992, 2003), there had been little theorization, instrument development or validation for the Use construct (pp. 230-231). To resolve this theoretical gap, they proposed a "staged approach for reconceptualizing system usage" (p. 231). The offered a definition "an activity that involves three elements: … a user … a system …. and …. a task." (p. 231) and individual use as "an individual user's employment of one or more features of a system to perform a task." (p. 231). User here refers to an individual although it could refer to a social actor. System refers to an IT artifact. Task refers to a goal-directed activity. Measuring usage, however, is not so clear cut. "… system usage can be attributed with a precise definition, but the definition refers to a broad range of content, only a subset of which will be relevant in a specific study. … one cannot create a single measure of usage, but one can define an approach for creating measures … that … capture the most relevant content for a specific context." (p. 232). They then provided a two-step method for selecting measures based on structure, the elements of usage that are the most relevant for the research context and function, the measure that most closely tie the selected constructs to the nomological network. Burton-Jones and Gallivan (2007) applied the concepts from Burton-Jones and Straub (2006) at the organizational level. They conceptualized organizational use as a multi-level construct between behaviors at different levels of analysis.

Williams and Gupta (2018) surveyed the literature in the AIS Senior Scholar's basket and identified three different categories of use:

	Initial Use	**Continued Use**	**Novel Use**
Common terms used in existing research	Adoption	Post-adoption or continued use	
Goal	Increased Usefulness	Time Efficiency, Minimize Cognitive Effort	Effectiveness
Cognitive effort (interaction)	High to learn new technology	Low (habits)	High (innovation)
Technology and features	Limited but growing set of features	Only features habitually used	new features

Table 1: Characteristics of Use Types (Table 1 from (Williams & Gupta, 2018))

Issues with the Behavioral Conceptualization of Use

While it is clear that the field seems to be agreed that use is a form of behavior. This conceptualization is not without its problems. Burton-Jones and Straub (2006) have indicated that measuring usage is not clear cut. "… system usage can be attributed with a precise definition, but the definition refers to a broad range of content, only a subset of which will be relevant in a specific study. … one cannot create a single measure of usage, but one can define an approach

for creating measures … that … capture the most relevant content for a specific context." (p. 232). This leads us to the realization that even using Burton-Jones and Straub's (2006) two-step process we could have studies using different measures to refer to the concept of ITU leading to incommensurability.

The Development of the Information Technology Artifact

The literature on ITU has also not recognized the development of the capabilities of the IT artifact over time. Over the sixty years of progress in developing information technology, information technology has steadily grown in capability and ability to operate autonomously. Early information technology did not directly interface with users relying on punch cards and paper reports as an interface. Starting in the 1970s, users began to interact with information system through first the use of character-based screens and later Windows-Icon-Mouse-Pointer (WIMP interfaces). These interfaces allowed real-time interaction. Following on from those interactive systems, the technology gained more capability to operate autonomously, being able to operate on its own, given inputs of a fixed nature and providing outputs. Today we see with the introduction of artificial intelligence an increased ability to operate autonomously and to learn to adapt the less structured environments. In the future, we can look forward to a convergence of artificial intelligence, business analytics, robotic process automation and the internet of things to create technology artifacts that even more easily interact with humans: digital workers.

There has been and there appears to continue a trend toward more autonomy in the ITA. As technology has become more sophisticated, there has been continual employment of this new technology to give IT more power and more ability to perform desirable tasks. The primitive ITAs were limited by their interfaces to punch cards and printed reports. The development of the WIMP and similar interfaces create the ability to interact with humans in a restricted manner. Additionally, primitive ITAs needed extensive support and control by humans. This requirement decreased with the interactive interfaces but still required continuous interface. The drive toward autonomous technology has reduced this interaction requirement further and we predict that the role of the human in the performance of the ITA will decrease still further.

The existing literature on ITU has been developed during the interactive phase and thus focuses on the capabilities common during that time period but has not considered how ITA capabilities are changing or will change over time.

In the sections that follow, we proffer a new definition for ITU that we believe resolves these issues.

RECONCEPTUALIZATION

We would argue that the problems of incommensurability of results and inability to properly measure ITU for ITAs that operate independently of humans exist because the current definition "the interaction of a user with information technology to accomplish a task" assumes a set of characteristics of the ITA which do not apply to ITAs other than the interactive ITAs. Second, it does not properly consider the context of ITU. The examination of the conceptualization of ITU to the present shows it is focused on atomistic human behaviors and does not properly conceptualize the context of use or the impact the surrounding environment of use has on ITU.

We argue we need to adjust the level of analysis from focusing on individual users and their actions to the instantiated context of use, that of the work system (Alter, 2013). By so doing, we move our analysis from atomistic individual behaviors to the *structure* of ITU. Focusing on the structured context of use, will allow us, as will be shown below, to overcome the increasing fragmentation of theorization to restore a single definition and measurement of use. A structured context of use will create commensurability in measurements which will allow us to examine such questions as "which configuration of use is the most effective" for a particular purpose.

We propose that IT Use be defined *as the manner in which an Information Technology Artifact (ITA) is incorporated into the activities of a work system* (M. Cuellar, 2011). Viewed in this way, ITU is the relationship between the ITA and activities that are done to produce the goods and/or services of the work system for the work system's customers. This structure defines how the ITA is used when the work system is executed.

IT Incorporation into Work Systems

Our central argument is how the ITAs are structured in the processes and activities of a work system constitute how it is used. In this section we describe a work system and its components and then describe how the ITA is structured in the work system. For the purposes of developing our conceptualization, we focus on organizations as they are more readily understandable.

Work System Theory (WST) (Alter, 2013) provides a framework (figure 2) to describe how ITAs may be used. A work system is defined as "*... a system in which human participants and/or machines perform work (processes and*

activities) using information, technology, and other resources to produce specific products/services for specific internal and/or external customers." (Alter, 2013, p. 75).This well-known theory suggests that work systems are teleologic structures in which participants (which can be human or non-human actors) perform activities using information and technology to produce goods and services for a customer. There are 9 different components to a work system. The four internal components are the most important for our consideration here.

Processes and Activities: This is the actual work that is done to produce the goods and services. The processes and activities are performed by the participants utilizing the information and technologies. The term indicates that we are not always dealing with structured and well-defined processes. Often these are only semi-structure or informal activities to accomplish the goal of the Work System.

Participants: These are the actors, both human and non-human that perform the processes and activities.

Information: These are informational entities that the work system uses, displays, manipulates, creates, deletes or transmits in the process of performing the processes and activities.

Technologies: These are tools used by the work system participants.

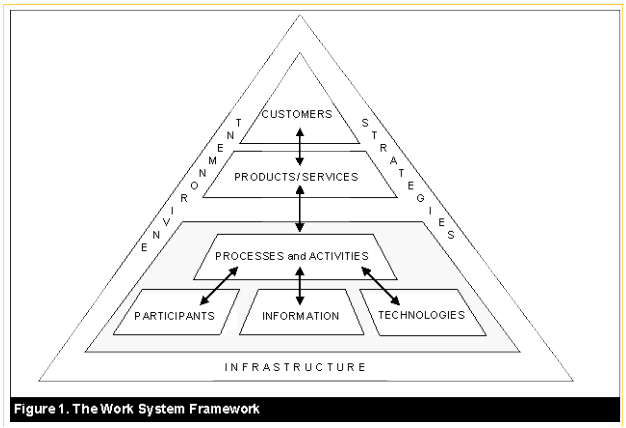

Figure 1: Work System Framework (Figure 1 from Alter (2013))

We argue that ITU can be conceptualized as the relationship between the ITA and the other participants in executing the processes and activities of the work system. Cuellar (2011) argued that ITAs are non-reflexive actors. However, our discussion of the progress of ITA capability above shows that while this may have been true in the past, it is increasingly not true. Components such as artificial intelligence are increasingly incorporated in ITAs which creates the capability for the ITA to be reflexive on its method of working. Thus, given the capabilities and affordances of the ITA, it may take on more or less of the processes and activities of the work systems. Additionally, how the human participants choose to allocate the processes and activities will determine how much of the work system the ITA will be responsible.

Incorporating an ITA within a work system will also require more or less *implementing processes and activities*. Implementing processes and activities can be considered as activities required to interface the ITA with other participants within the work system. More primitive ITAs might require more implementing activities than others. E.g. an ITA using punch cards for input and paper reports for output would require activities such as writing inputs on coding, pads, key punching cards, formatting the deck, submitting the cards, etc. Such activities would not be required for more interactive ITAs which would require only keying such inputs. The features of an ITA that are used, its implementing activities and the processes and activities that the ITA performs within the work system form a profile of use that allows us to describe how the ITA is used within the work systems. The description of incorporation provides a profile of use that allows us to identify and compare use across different work systems.

Figure 2 illustrates how an ITA and human participants may join in executing a process. The human participants execute the activities illustrated by the tan squares. The ITA (surrounded by implementing activities, symbolized by the purple box) executes the activities in the blue squares and provides information to human participants. We can then see a profile of use for this ITA. Humans execute 60% of the activities, while the ITA executes 40%. Both of the affordances of the ITA are utilized in executing this process. Implementing activities are used to integrate this ITA into the work system. We see then a usage profile can be created that describes ITU in terms of the proportion of

activities executed by the ITA, the proportion of the ITA's affordances used by the work system, the amount of implementing activities required to implement the ITA within the work system.

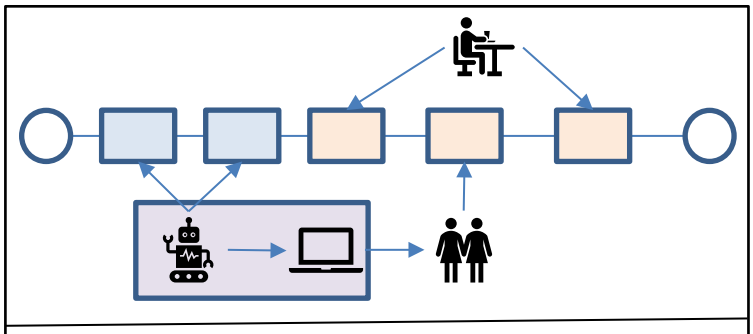

Figure 2: ITAs and Humans Participating in a Process

The reconceptualization of ITU as a structure also allows us to characterize and type use into different forms. For example, ITAs can be used to monitor the performance of the work system. In this way, it is used to *monitor* the effectiveness/efficiency of the work system in order to determine if the work system is performing adequately or needs to be corrected. For example, a plant floor monitoring system ensures that the manufacturing process is operating with specification. Another form of structure is that of being an *enabler* of the work system. In this situation, the ITA makes it possible for the work system to operate. An example here is that of the internet or an email system which makes it possible for work system participants operating at a great distance to work together. In both of these, the IT does not actually execute any of the process but makes it possible for the Work System to function effectively and efficient. The ITA may also be a *co-executor* of the work system. In this case the ITA performs part of the activities that create the end good or service in the work system. An example here would MS Word in which the software performs such routine activities as pagination, margin control, grammar and spelling check which the author performs the creative activities such as determine which text should be in the document and entering it into the system. Finally, the ITA may substantially *execute* the process. This is similar to the co-execution function except that the ITA performs quantitatively all or almost all of the activities in the work system. An example would be a modern claims processing system in which from the time the doctor electronically submits the claim to the system to the time the payment information is sent to the doctor's bank, the system processes substantially all of the tasks except for when a rare exceptional situation that requires human intervention occurs.

DISCUSSION

We suggest this reconceptualization provides a resolution to the two issues in ITU conceptualization identified above. This conceptualization can provide consistent measurement of use across many different environments. By determining the configuration of activities performed, implementing activities and features utilized we can come to a description of how the ITA is used. This method of describing a use profile should apply across different ITAs and work systems. For researchers and practitioners, this conceptualization

1. Provides commensurability between studies.

Using the interactionist approach, we have a multiplicity of different measures across the studies. Utilizing the approach articulated here, by describing a consistent profile of measures, use can be compared between studies to be able to directly compare use profiles. This commensurability directly contributes to the next contribution

2. It can be used to compare the performance of the different configurations of use

By comparing the performance of different configurations of use of the same technology artifact in work systems producing the same good or service, it can be shown the certain use configurations are more efficient or effective than others in producing results within a work system. For example, if the SAP ERP system has a certain configuration of use in a work system producing service X, it can be compared to a different work system producing the service X but utilizing a different configuration. By assessing work system level performance such as cost/service or services performed per hour or percentage correct processing, we can assess which configuration of use provides better results.

3. Points to a new idea of success.

Success in terms of work system improvement activities or ITA implementation activities can be considered to have been achieved if the performance of a work system improves. It also provides us an indication of the amount of success by assessing the level of improvement in work system performance between a prior work system configuration and the new one.

4. For adoption studies, it allows us to assess various methodologies of implementation.

We can examine a case in which a certain set of actions in a certain environment yielded a certain configuration of use, while a different methodology produced a different configuration. Explanation can then focus around the question of why certain configurations were obtained vs. others.

CONCLUSION

In this study, we have argued that the existing conceptualization of information technology use is a interactionist one, "an individual user's employment of one or more features of a system to perform a task." (Burton-Jones & Straub, 2006, p. 231). We further demonstrated that this conceptualization had two problems. First, it cannot develop a consistent set of measures resulting in incommensurable results across studies. Second, it does not consider the development of the information technology artifact over time. This conceptualization does not work for those ITAs too primitive for direct human action or too advanced to require human interaction because they can operate independently of people.

To remedy those problems, we suggested that ITU be reconceptualized as the manner in which an Information Technology Artifact (ITA) is incorporated into the activities of a work system. Based on Alter's Work System Theory, we proposed that use is the configuration of processes and activities within a work system performed by the ITA, the affordances of the ITA used in the performance of work system activities and the type of implementing activities required to interface the ITA to the other participants, technology and information of the work system.

This conceptualization of use leads to a consistent method of describing profiles of use across work systems which leads to not only the ability to directly compare use profiles but also ways to compare work system performance, new conceptualizations of success and new ways to study the adoption of information systems.

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