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TOWARD A DEEPER UNDERSTANDING OF SYSTEM USAGE IN ORGANIZATIONS: A MULTILEVEL PERSPECTIVE[1]

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Abstract

The objective of this paper is to contribute to a deeper understanding of system usage in organizations by examining its multilevel nature. Past research on system usage has suffered from a levels bias, with researchers studying system usage at single levels of analysis only (e.g., the individual, group, or organizational level). Although single-level research can be useful, we suggest that studying organizations one level at a time will ultimately lead to an unnatural, incomplete, and very disjointed view of how information systems are used in practice. To redress this situation, we draw on recent advances in multilevel theory to present system usage as a multilevel construct and provide an illustration for what it takes for researchers to study it as such. The multilevel perspective advanced in this article offers rich opportunities for theoretical and empirical insights and suggests a new foundation for in-depth research on the nature of system usage, its emergence and change, and its antecedents and consequences.

Keywords: System usage, multilevel, construct, configuration, IT impact, longitudinal

Introduction

A basic activity in any research field is to reach a deep understanding of the phenomena it studies. For example, information systems researchers have recently scrutinized phenomena such as users (Lamb and Kling 2003), user competence (Marcolin et al. 2001), and the IT artifact (Orlikowski and Iacono 2001). We examine another core phenomenon: system usage. Although system usage has been studied for many years (Barkin and Dickson 1977), researchers stress how little we know about it (DeLone and McLean 2003). While many aspects of system usage could be studied, we focus on just one, its multilevel nature.

We ask readers at this point to consider how often they read about collectives "using" information systems. We believe that such language is so ingrained in the IS lexicon that we rarely question it. Consider several references to system usage by teams, firms, industries, and nations in the trade press:

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- "Fifteen major league baseball teams use [online ticketing] technology" (The Associated Press 2007)
- "Continental uses IT to chart a new course" (Gareiss 2001)
- "Big media uses technology and the law to lock down culture" (Lessig 2004)
- "China uses [the] Internet as a tool of repression" (Smith 2006)
- "Australia is one of the strongest adopters of IT.…Its use of computer technology is amongst the highest in the world" (Simon and Wardrop 2002)

Like the trade press, IS researchers often write about collectives such as groups (Dennis et al. 2001; Easley et al. 2003), organizations (Devaraj and Kohli 2003; Zhu and Kraemer 2005), and even nations using systems. In a perhaps extreme example, Dedrick et al. (1995, p. 24) write, "several places—the Cayman Islands, Panama, Cyprus, and others—are suspected of using IT-based financial systems to make national industries of money laundering."

As veteran readers, we often skim over such ambiguous statements. But upon reflection, how can any collective really *use* an IS? How is it different from a summation of individual usage or the use of an IS by specific subgroups in a collective? How can researchers study system usage in a multilevel fashion, keeping an eye on the whole *as well as* its parts (Kozlowski and Klein 2000)?

Although researchers have learned a great deal from studying system usage at single levels (e.g., the individual-level, Davis et al. 1989; group-level, Kraut, 2003; and firm-level, Massetti and Zmud 1996), we believe that studying it one level at a time ultimately leads to an unnatural, incomplete, and very disjointed view of how organizations function. For example, a firm may wish to understand the benefit of a new discussion database. Individual-level studies may find that staff use the system frequently and claim the system a success. Group-level studies may find that no ongoing communities emerge, and judge the system a failure. Only multilevel studies can resolve such conflicting results because only they examine the linkages between levels, such as discovering how individual contributions generate and sustain communities (Goodman 2000).

We are not the first to highlight the relevance of multilevel issues when studying system usage. Scholars have long proposed that organizational factors such as top management support influence individual usage (Lucas 1974). Yet, the conceptual and methodological tools to conduct multilevel research have only recently matured and so only recently has in-depth multilevel research become feasible (Goodman 2000; Klein and Kozlowski 2000). For example, consider the unified theory of acceptance and use of technology (Venkatesh et al. 2003). Although this theory includes a construct to reflect "social influence," it is not a multilevel theory because all of its constructs are conceptualized at the individual level. Likewise, in exemplar tests of the theory, researchers measure social influence at the individual level without verifying the actual influence exerted from the collective level (e.g., Venkatesh et al. 2003). Great opportunities exist to extend this theory, and many others in IS research, from a multilevel perspective.

Overall, while the existence of system usage at different levels and the antecedents and consequences of system usage at different levels are widely recognized in IS research, no studies have explicitly scrutinized system usage in a multilevel fashion. The objective of this paper is to fill this gap by (1) presenting system usage as a multilevel construct and (2) illustrating what it takes for researchers to study it as such. By so doing, our aim is to contribute to a deeper understanding of system usage in organizations and provide a platform for research on the nature of system usage, its emergence and change, and its antecedents and consequences.

It is important at the outset that we briefly clarify three potentially confusing issues about multilevel research. First, multilevel research refers to a type of research in *organization science*. Various subfields within social psychology and sociology study similar issues but use different terminology (such as *microstructures*, Lawler et al. 1993; *macrostructure*, Alexander et al. 1987; *collective action*, Oliver 1993; and *interaction order*, Mouzelis 1992). Rather than attempt to integrate the different perspectives of these fields, we simply adopt an organization science perspective.

Second, within organization science, the meaning of multilevel research has *evolved*. A decade ago, multilevel research was considered to be a subclass of a more general class of research; the latter class being termed *mixed level* (Rousseau 1985), *multiple level* (Klein et al. 1994), or *meso* (House et al. 1995) research.[2] However, multilevel research is now used to refer to the broad class of research itself, rather than just one specific subclass. That is, multilevel research now refers to any research that "entails more than one level of conceptualization and analysis" (Kozlowski and Klein 2000,

[2]The subclass referred to as *multilevel* is now referred to as a multilevel homologous model and requires equivalent relationships between independent and dependent variables at two or more levels (Kozlowski and Klein 2000).

p. 79). We adopt this definition. Thus, by examining system usage in a multilevel fashion, we examine what it would take to conceptualize and analyze system usage at more than one level in the same study.

Finally, multilevel research within organization science adopts meta-theoretical assumptions that accord with a relatively *functionalist*, *positivist*, and *variance-oriented* view (Burrell and Morgan 1979; Markus and Robey 1988). For example, all of the seminal multilevel papers (Chan 1998; Klein et al. 1994; Kozlowski and Klein 2000; Morgeson and Hofmann 1999; Rousseau 1985) use terminology such as variables, nomology, construct validity, and true score. While we believe it would be valuable to engage in multilevel thinking from a broader meta-theoretical view, that is not our aim here; we simply adopt the canonical view of multilevel research (i.e., a relatively *functionalist*, *positivist*, and *variance-oriented* perspective).

Literature Review

Past Literature on System Usage from a Variance Perspective

Drawing on a recent review of the system usage literature (Burton-Jones 2005), we summarize in Table 1 the dominant ways that system usage has been examined in past research.

Variance researchers tend to study system usage at three levels—individual, group, and organization—and have considered these levels to be quite separate (Chan 2000). Although some IS studies mention system usage at higher levels (e.g., at the industry or national level), there have been very few detailed studies of system usage at such levels to date.[3] As Table 1 shows, there are many conceptions of system usage at the individual, group, and organizational levels, with most researchers conceptualizing system usage as a behavior (what a user does), cognition (what a user thinks), and/or an affect (what a user feels). At the individual level, most researchers view system usage as behavior, measuring system usage via indicators such as an individual's frequency or duration of usage (Trice and Treacy 1986). Less often, researchers conceptualize system usage as cognition, measuring it via indicators such as a user's level of cognitive absorption when using an IS (Burton-Jones and Straub 2006), or as affect, measuring it via observations of users' wariness when interacting with an IS (Webster 1998). At a group level, researchers generally conceptualize system usage as the aggregation of individual behaviors (Easley et al. 2003), but sometimes as a complex pattern of behaviors, cognitions, and affect that emerge in a group (DeSanctis and Poole 1994). Finally, at the organizational level, some conceptualize system usage as the aggregation of individual behaviors (Devaraj and Kohli 2003), while others examine it in organizational terms, measuring it via the existence of integrated systems and processes among divisions/firms (Massetti and Zmud 1996).

A major problem in past usage research that must be addressed if the field is to embrace a multilevel perspective involves defining usage. Because usage research at each level has been so separate, there are no definitions of system usage encompassing multiple levels. Unfortunately, system usage does not have a rigorous definition at any level (DeLone and McLean 2003; Zigurs 1993). To overcome this problem, we suggest that system usage at any level of analysis comprises three elements: a *user* (the subject using the IS), a *system* (the IS used), and a *task* (the function being performed) (per Burton-Jones and Straub 2006). We draw on these elements to define system usage as *a user's employment of a system to perform a task*.

This definition provides an inclusive starting point to begin multilevel research. For instance, the view that system usage involves these elements is already reflected in research at the individual (Szajna 1993), group (Dennis et al. 2001), and firm (Subramani 2004) levels. The definition also allows researchers to measure usage in a variety of ways. For example, like past research, researchers could measure system usage in a *user*-centered fashion (measuring users' cognition during use), in a *system*-centered fashion (measuring IS features used), in a *task*-centered fashion (measuring tasks for which the IS is used), or in a more holistic fashion, at each level. Finally, the definition does not restrict the meaning of usage to *direct* interaction with a system. As we explain later, it is possible to use our definition to study collectives in which some members indirectly interact with a system by relying on other members who directly interact with it. Thus, the definition allows researchers to study the many ways that information systems are used in practice.

Motivations for Multilevel Research

Despite calls for multilevel research (Chan 2000; Markus and Robey 1988), such studies have been absent in IS research until recently (Ang et al. 2002; Lapointe and Rivard 2005). Multilevel research has two core strengths (Rousseau 1985).

[3]For some exceptions, see investigations at a national level by IS scholars (Dedrick et al. 1995; Dedrick et al. 2003; King et al. 1994) and economists (Jorgenson and Stiroh 1999) and emerging studies at an industry level by IS scholars (Markus et al. 2006) and economists (Stiroh 2002).

Table 1. Conceptualizations of System Usage in Variance-Oriented IS Research

Level	Conception of System Usage: System usage is…	Example Study
Individual	an individual behavior	Davis et al. 1989
	an individual cognition	Burton-Jones and Straub 2006
	an individual affect	Webster 1998
Group	an aggregation of individual behaviors	Easley et al. 2003
	a pattern of individual behaviors, cognitions, and affect	DeSanctis and Poole 1994
Organization	an aggregation of individual behaviors	Devaraj and Kohli 2003
	an intra- (and/or inter-) organizational behavior	Massetti and Zmud 1996

Table 2. Common Fallacies that Occur in Single-Level Empirical Research

Fallacy	Threat	Occurs when researchers…
Cross-level fallacy	Construct validity	neglect to specify the underlying mechanisms by which individual-level phenomena (e.g., individual system usage) give rise to higher-level phenomena (e.g., organizational system usage)
Contextual fallacy	Internal validity	obtain spurious relationships at a lower level (e.g., a positive relationship between individual system usage and individual performance) because they fail to account for higher-level factors that impact the relationship (e.g., group norms)
Ecological fallacy	External validity	incorrectly assume that a relationship found at a higher level (e.g., organizational system usage positively affects organizational performance) exists in the same way at a lower level (e.g., individual system usage positively affects individual performance)
Atomistic fallacy	External validity	incorrectly assume that a relationship found at a lower level (e.g., individual system usage positively affects individual performance) exists in the same way at a higher level (e.g., organizational system usage positively affects organizational performance)

First, it helps researchers to avoid significant fallacies that can occur in single-level studies (see Table 2) (Rousseau 1985). These common fallacies imply that single-level research designs can be valid only if

- none of the constructs being examined emerge from attributes that exist at a lower level;
- none of the constructs examined are affected by correlated variables at a higher level; and
- a researcher need only generalize to a single level of analysis.

Because these assumptions are often violated in IS research, and this problem cannot be resolved with strictly single-level designs (i.e., designs that ignore, or neglect to control for constructs at other levels of analysis), they provide a strong motivation to adopt alternative, multilevel designs.

The second strength of multilevel research is theoretical. As Goodman (2000, pp. 6-7) demurs,

> Our research, how we train each new generation of researchers, and our professional associations display a clear level bias, that is, we tend to focus on one level of analysis and implicitly make assumptions about…other units of analysis.

A multilevel perspective opens up new opportunities for theory (e.g., to understand linkages between levels) and some suggest it may even help generate new organization-specific rather than reference-discipline-specific theories:

> organizational researchers will never be better than psychologists at understanding individuals in general, better than economists at studying large-

> scale market forces, nor better than sociologists at studying social forces. ***Only an organizational science can address effectively the complexities of the relationships between the units at different levels of analysis that comprise organizations*** (House et al. 1995, pp. 74-75).

Although the limitations of single-level research are well known, multilevel designs were not initially feasible due to a lack of methodological procedures. Fortunately, the strengths of multilevel designs spurred much research (Klein et al. 1994; 1999, 2001), to the point that multilevel research is now not only desirable, but also feasible (Klein and Kozlowski 2000).

A Multilevel Account of System Usage

Many guidelines have been advanced for conducting multilevel research: 8 by Klein et al. (1994), 11 by Morgeson and Hofmann (1999), and 21 by Kozlowski and Klein (2000). We draw on Morgeson and Hofmann's guidelines because unlike the other guidelines they focus directly on the nature of multilevel *constructs*. Morgeson and Hofmann offer two sets of guidelines: five for understanding the nature of multilevel constructs in general and six for applying these insights in a given study. We have grouped their 11 guidelines into five general guidelines that we consider necessary to build a complete multilevel theory of system usage (see Table 3).

In the following sections, we present system usage as a multilevel construct by explaining how each guideline applies to system usage and we illustrate how system usage can be studied as such by discussing each guideline in light of an illustrative model (see Figure 1) and a selection of IS studies. Please note that the model in Figure 1 is not fully operationalized and tested in this paper. We merely use it to make our discussions concrete and to provide an example of a model that future researchers could extend or test.

Guideline 1: Function of Usage

Morgeson and Hofmann's guidelines focus on the distinction between individual and collective constructs. In their view, an *individual* is a person, a *collective* is an interdependent and goal-directed group of individuals or collectives (e.g., a team or firm), and a *construct* is a concept that researchers use to describe an individual or collective phenomenon. With these definitions, Morgeson and Hofmann suggest that two concepts—structure and function—help researchers to think about a multilevel construct. The *function* of a construct refers to the effects or outputs of the phenomenon that the construct is used to reflect. The *structure* of a collective construct refers to the actions and interactions among individuals that generate the collective phenomenon that a collective construct is used to reflect. Morgeson and Hofmann suggest that the first step when attempting to theorize about a multilevel construct is to consider whether the function of the construct could be the same at multiple levels even if the structure is different. For example, QuickBooks is an accounting system that can be used by individuals and small businesses. The intended function of using QuickBooks is the same in both cases (i.e., to produce financial statements), but the structure of usage is different (i.e., the mechanisms by which an individual uses QuickBooks and the mechanisms by which a small business uses it will differ, because in the latter case, usage will require coordination among accountants and other staff).

Consider Figure 1. Several studies have relied on task–technology fit theory to explain how system usage affects performance at an individual level (Goodhue and Thompson 1995) and a collective level (e.g., group level in Dennis et al. [2001] and firm level in Devaraj and Kohli [2003]). Using Guideline #1, we can begin to integrate these literatures by proposing an equivalent relationship at each level. "Performance" in Figure 1 refers to an evaluation of the output of an individual's or collective's task (Sonnentag and Frese 2002). The horizontal arrow from usage to performance at each level reflects that, at each level of analysis, use of an IS influences user performance and the link from performance to usage reflects that, at each level of analysis, users actively reflect on the results of their usage and adjust their actions over time (per Goodhue and Thompson 1995). For simplicity, Figure 1 does not specify a direction of effect (e.g., positive or negative) on the links between usage and performance. However, such effects could be specified by drawing on a specific theory. For instance, researchers could draw on the elements in our definition of system usage to propose a positive relationship between usage and performance when a user employs features of the system that fit the task (per Jasperson et al. 2005) and/or when the user is absorbed when using those features (per Burton-Jones and Straub 2006). Likewise, researchers could draw on theories of learning to propose a negative relationship between performance and usage because employees who perform poorly may respond by increasing their use of an IS in the hope that it will help them achieve higher performance (per Lucas and Spitler 1999).

We caution the reader from assuming that Guideline #1 constrains researchers to studying *only* equivalent relationships

Table 3. Guidelines for Studying the System Usage Construct in a Multilevel Fashion

#	Guideline	Brief Description of its Application to System Usage	Cross-Reference to Morgeson and Hofmann's Guidelines*
1	Function of Usage	Researchers can conceive of system usage as a multilevel construct if it has the same functional relationship at different levels.	Guidelines 4, 6
2	Structure of Usage Interdependencies-in-use	Researchers can conceive of collective system usage if their study of interdependencies in the collective suggests that the collective does use the IS.	Guidelines 1, 5, 9
	Form of collective use	When conceiving or measuring collective usage, researchers should determine what form of usage (shared or configural) the collective enacts.	Guidelines 2, 5, 7, 10
3	Context of Usage Function	Researchers should identify contextual factors that affect the relationship between system usage and related constructs.	Guideline 8
	Structure	Researchers should identify contextual factors that affect the existence of or change in system usage at different levels of analysis.	Guidelines 3, 11

*We include Morgeson and Hofmann's guidelines in the Appendix.

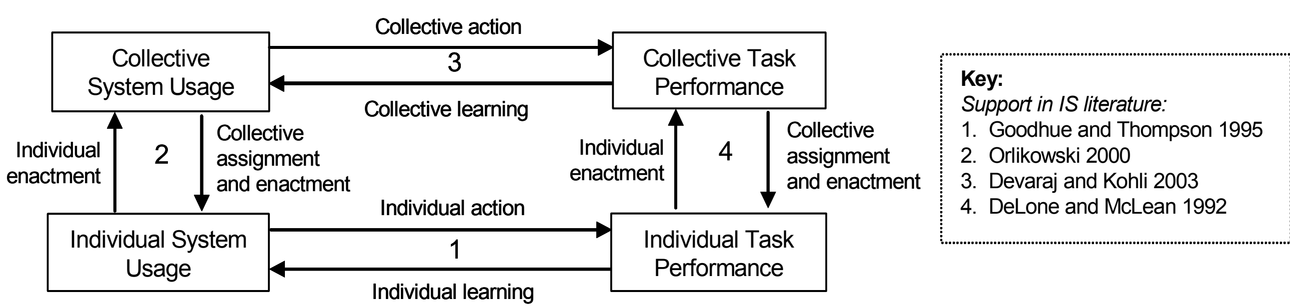

Figure 1. Illustrative Theoretical Model

at each level. Because Morgeson and Hofmann did not discuss this issue, it is possible that readers may interpret their guidelines in this way. Even so, "multilevel homologous models" that have strictly equivalent relationships at each level (such as the threat–rigidity model [Staw et al. 1981], in which individuals, groups, and firms react to threats in the same way) are rare (Kozlowski and Klein 2000). Guideline #1 simply implies that system usage can be theorized as a multilevel construct because it can have the same function at each level. This means that, in addition to having the same function at different levels, system usage can also have different functions at different levels. For example, researchers could propose (1) a multilevel model of usage that includes relationships that cross levels and (2) a multilevel model of usage that includes multiple dependent variables at each level, some of which differ across levels. Vignettes 1 and 2 give examples of how researchers could extend Figure 1 in such ways.

Guideline 2: Structure of Usage

Morgeson and Hofmann suggest that researchers' second step when theorizing about a multilevel construct should be to

Vignette 1: Cross-Level Relationships

Burton-Jones (2005) describes an experiment in which 76 groups of 2 to 5 students used MS Excel to complete a business analysis task. The task required a type of sequential coordination that meant that individual members relied on their group for inputs to some of their tasks. Like Figure 1, Burton-Jones found evidence of a parallel relationship at each level (i.e., individual Excel use affected individual performance and group Excel use affected group performance).

In addition, Burton-Jones found that group Excel use affected individual performance (i.e., in the context of Figure 1, a diagonal line from collective use to individual performance). His explanation was that because members relied on their group for inputs, poor Excel use by the group reduced members' performance. For example, one member might need certain input data to perform her task, but because of poor coordination among users in her group, she may not receive the input data, forcing her to reconstruct the input data as well as perform her task, reducing her efficiency.

Vignette 2. Similar and Different Outcomes Across Levels

Orlikowski (1991) studied the use of a computer-aided software engineering (CASE) tool at a consulting firm. (Because she employed interpretive assumptions, we caution the reader that we have "reconstructed" her arguments into a variance form for this vignette). In her study, the firm and its consultants could both be argued to have used the CASE tool to improve consulting performance (i.e., in the context of Figure 1, an equivalent relationship existed at each level).

However, the firm and consultants also had *other* desired outcomes from CASE usage (i.e., the firm wanted to use the CASE tool to render consultants substitutable whereas consultants wanted to use the CASE tool to learn new skills and make themselves more marketable). In the context of Figure 1, this implies having two dependent variables at each level (i.e., work performance and staff substitutability at the firm level and work performance and marketability at the individual level).

understand the structure of a collective construct by reference to its function. To do so, they suggest that researchers work backward by studying the function of a construct and then discerning what structure might give rise to that effect. When analyzing the structure of a collective construct, Morgeson and Hofmann suggest that researchers consider three issues: interactions, development processes, and context. We discuss the first two here (which we label *interdependencies-in-use* and *form of collective use*) and defer the issue of *context* until later (Guideline 3).

Guideline 2.1: Interdependencies-in-Use

Morgeson and Hofmann suggest that the fundamental difference between individual and collective phenomena is that collective phenomena emerge from lower-level interactions. For example,

> Individual ability allows individuals to receive, process, and respond to information.…It is perhaps self-evident that teams and organizations are also able to receive, interpret, and process information.… Clearly, however, the structure of this ability changes when moving from individuals to some larger collective. The structure of individual ability refers to scripts, schema, and other cognitive and biological factors, whereas the structure of ability for higher-level aggregates not only includes these cognitive and biological factors (since collectives are composed of individuals), but they also involve something more. This something more is the interaction between these individuals (Hofmann 2002, p. 250).

If we apply this logic to system usage, collective usage is not simply the sum of its parts (i.e., the sum of members' usage) because it also comprises interactions. Because interactions that are ongoing and consequential to interacting parties result in interdependencies (Lindenberg 1997), we stress the importance of this attribute—interdependencies—when studying collective usage. Interdependencies are "patterns of action and interaction where two or more [entities] are mutually dependent on each other" (Karsten 2003, p. 408). Because we wish to focus on interactions that are inexorably part of collective usage, rather than general social- or task-related interactions, we focus on *interdependencies-in-use*, that is, dependencies among members of a collective that relate to their use of a system. Accordingly, we suggest that the first step in determining whether collective usage exists is to identify the presence of interdependencies-in-use.

		Strength of Interdependencies-in-Use Among Members	
		Weak or None	**Moderate to Strong**
Proportion of members directly interacting with the IS	**Most**	1. Collective usage does not exist.	3. Collective usage exists.
	Few	2. Collective usage does not exist.	4. Collective usage exists (by proxy).

Figure 2. Scenarios in Which Collective System Usage May or May Not Exist

Consider Figure 2, which illustrates ways that an IS might be used in a firm. Applying Morgeson and Hofmann's logic to this figure, collective usage cannot exist if there are no interdependencies-in-use (or only weak ones). This is intuitive in cell #2, where few individuals are using it, but might be less obvious in cell #1, where most individuals are using it. Even so, a mere collection of users is not a collective. Interdependencies-in-use must exist for collective usage to be a meaningful construct.

A valid criticism at this point would be that in practice everything is related to everything. While this is true, we agree with Kozlowski and Klein (2000, p. 20) that interdependencies vary in "bond strength." Multilevel research is not yet sufficiently mature to have simple thresholds (e.g., 0.7) to determine whether a bond among individuals is strong enough for interdependence to be claimed. Because collectives and collective constructs are social constructions, their existence will always remain fuzzy. To provide guidance, we draw on theories of groups (Arrow et al. 2000, pp. 34-35) to suggest four principles for identifying the existence of a collective and collective usage, shown in Table 4.

As Arrow et al. (2000, pp. 34-35) note, researchers should use judgment when employing the principles in Table 4 because a collective may exist without meeting every principle. Researchers should be especially aware that collective usage can exist in situations where principle #2 is not met but the other principles are met. That is, it is possible that a collective may be using an IS even though not all members consider themselves to be users. This is very likely to occur in practice when some members interact *indirectly*, while others interact *directly*, with the system.

Figure 2 illustrates this situation quite well. This is because in cell #4, members who *indirectly* interact with the system may not consider themselves to be individual users, hence principle #2 in Table 4 would not hold, yet we would still consider the collective to be using the system. For example, consider a research team that needs to use LISREL statistical software. This team may ask one member to directly interact with the software with the other members indirectly interacting with LISREL via this user (e.g., by providing this direct user with data and advice and interpreting the output that he produces). In this case, because most team members do not directly interact with LISREL, they would not consider themselves to be individual users, hence principle 2 in Table 4 would not hold. Yet, because all of the other principles in Table 4 would likely hold, we could say that the team used LISREL. As shown in cell #4 in Figure 2, we label such a situation "collective usage by proxy." We use the term "collective usage by proxy" in this case because it highlights that an error or irregularity could occur that would expose the difference between *assumed* collective usage and *actual* individual usage. For example, if, unbeknownst to the team, the member that directly interacted with LISREL did so in a manner contrary to the team's intentions (e.g., producing fraudulent results), we believe that it would be incorrect to say that the *team's* use of LISREL produced the fraudulent results. It would be more accurate to say that the fraudulent results stemmed from one *individual's* use of LISREL and the team merely failed to detect it.

To summarize, identifying interdependencies-in-use is the key to justifying that collective usage exists—as opposed to individual system usage by one person or by many separate individuals. Given the importance of this attribute (interdependencies-in-use), we provide additional guidance for research in this area. First, interdependencies-in-use can be mediated in several ways. They can be mediated through electronic and/or personal interactions, as well as mediated by a third-party (Orlikowski et al. 1995). Thus, it is not necessary that interdependencies-in-use be mediated directly by the IT itself (e.g., by a GSS or some other networked IT system). An example of a personal interaction would be members of a consulting team verbally helping each other use a new client

Table 4. Principles for Identifying Collectives and Collective System Usage

Type of Principle	Principles for Identifying a Collective (adapted from Arrow et al. 2000)	Principles for Identifying Collective System Usage
Principles assessed by self-assessment	1. Do the individuals consider themselves to be members of a collective (that may, in turn, be part of a larger collective)?	1. Do the individuals consider themselves to be using a system as a collective (that may, in turn, be part of a larger collective using the system)?
	2. Do the individuals recognize one another as members and distinguish members from nonmembers?	2. Do the individuals recognize one another as users of the system and distinguish users from other individuals?
Principles assessed by self- or independent assessment	3. Do the collective members' activities show more tightly coupled interdependence within the group than with others in the larger collective?	3. Do the collective members' usage patterns show more tightly coupled interdependence within the group than with others in the larger collective?
	4. Do members of the collective share a common fate (or consequence) that is not totally shared by the larger collective?	4. Do members of the collective share a common fate (or consequence) stemming from their collective use that is not totally shared by the larger collective?

Vignette 3. Measuring Collective Usage

Devaraj and Kohli (2003) analyzed the relationship between organizational use of a decision support system and organizational performance in a hospital setting. To measure each hospital's system usage, they aggregated (summed) IS use by analysts who separately interacted with the DSS in each hospital. Because only a small number of people in each hospital directly interacted with the DSS, the key to identifying whether the hospitals used the systems would have been to identify interdependencies-in-use among direct and indirect users.

Devaraj and Kohli do not discuss or measure interdependencies-in-use in their study but they do hint that such interdependencies existed in the hospitals they studied by providing a vignette (on p. 279) that describes how a direct user of the DSS and a user of DSS *output* interacted. With this vignette as a starting point, future researchers could extend this study by examining these interdependencies in more depth to determine whether system usage really existed at the hospital level and, if so, examining exactly how hospital usage affected hospital performance.

system. An example of an interaction mediated by a third-party would be the use of a customer support system by call center representatives. Even if representatives handle calls individually with no direct interaction with other representatives, the calls they receive, procedures they follow, and workflow embedded in the systems they use are all centrally coordinated and managed by a higher-level authority for the benefit of the call center.

Second, because interdependencies-in-use are such a core element of collective usage, researchers should be sure to measure them when studying collective usage. When measuring interdependencies-in-use, researchers should be sure to focus on interactions that relate to usage rather than simply general social or task-related interactions among members of the collective. Although research on interdependencies-in-use is sparse, Karsten (2003) has identified three key types of interdependencies: collaboration, communication, and coordination. Thus, when studying relationships such as those in Figure 1, we suggest that researchers measure the collaboration, communication, and/or coordination that occur during usage, and cite these as evidence to justify the fact that collective usage exists—as opposed to just individual usage by several independent actors. Vignette 3 discusses a recent study that could be extended from this perspective.

Third, we draw on Morgeson and Hofmann's advice to suggest that researchers attend to the *function* of usage when determining whether and why interdependencies-in-use exist in a given scenario. For example, the function of usage in our illustrative model (Figure 1) is performance. Thus, if a researcher were to test Figure 1 in a specific firm, the performance goals in that firm would need to be considered and the interdependencies that would need to exist in order to achieve those goals would need to be discerned. Consider the reciprocal relationship (the up and down arrows labeled "2") between individual and collective usage in Figure 1. Certainly, many users will perform work that is purely individual. Such work will not result in or be affected by this reciprocal relationship to and from collective usage. However, many users' tasks will require them to interact with other users. In these cases, a pattern of interdependence-in-use will need to be constructed for the individual users and the collective to achieve their respective performance goals. This will occur either by the collective assigning usage tasks to the individual users (the downward arrow labeled "2" in Figure 1) or by the individual users developing norms for how they interact with other users (the upward arrow labeled "2" in Figure 1). It will often be difficult, *a priori*, to theorize what interdependencies-in-use will exist in any given scenario because individuals and collectives often have multiple, conflicting goals. For example, a firm's management may require that users coordinate their use of a system in a particular way but some users may enact a different type of coordination because it supports their personal performance goals, or because they know better than management what needs to be done to achieve the firm's performance goals. Despite these difficulties, the key point is that if the dependent variable in a research model is performance (or another construct, such as quality-of-life), researchers must demonstrate how interdependencies-in-use serve to generate this outcome. To support such research, we draw on our definition of usage to suggest that, as a starting point, researchers should examine the nature of the *users* (e.g., their relative power and expertise), the *system* (e.g., its set of features), and the *task* (e.g., the jobs that need to be done) to determine the interdependencies that will likely need to occur in order to support individual and collective goals in any given case.

Guideline 2.2: Form of Collective Use

Morgeson and Hofmann suggest that if a collective phenomenon exists, researchers should examine the process by which it emerged. Following Kozlowski and Klein's (2000) notion that different processes of interaction lead to different forms of collective constructs, we suggest that once researchers have justified that collective usage exists, they should examine the *form* in which it has emerged.

Multilevel researchers distinguish between three forms of collective constructs: global, shared, and configural (Kozlowski and Klein 2000). The difference between global constructs, on the one hand, versus shared and configural constructs, on the other, has to do with the difference between a construct's level of origin and the level of the theory (Klein et al. 1994). The level of origin is the lowest level at which the phenomenon exists; the level of theory is the level at which the researcher is theorizing it (i.e., the level at which a "construct" is being used to reflect it). These may be equivalent, or the level of origin may be below the level of the theory. For example, assume that a researcher's level of theory is the *team* and that the researcher is interested in two constructs: ability and age. Hofmann's quote, which we used to introduce Guideline 2.1, suggests that *ability* exists at the individual *and* team levels. Thus, for team ability, the level of origin (the individual) is below the level of the theory (the team). In contrast, for team age, the level of origin *is* the level of theory because team age exists at the team level but has no lower-level analogue (i.e., the team's age—or longevity—is completely independent of its members' ages). Collective constructs are said to be *global* when the level of origin is at the level of the theory (i.e., the collective); in contrast, a collective construct is said to either be *shared* or *configural* when the origin is lower than the level of theory, for example, the level of origin is the individual, and the level of theory is the group or firm (Hofmann and Jones 2004; Kozlowski and Klein 2000).

Applying this distinction to system usage, we suggest that *collective* system usage cannot be a global construct. This is because system usage occurs at the individual level and, as a result, the level of theory of collective system usage (i.e., the collective) will always be higher than its level of origin (i.e., the individual).[4] Accordingly, if a researcher wishes to study collective system usage, it must be conceptualized as either *shared* or *configural.*

Shared constructs originate in the attributes of individuals and emerge at the collective level in the form of homogeneity among the collective's members. For example, a virtual team may develop routines such that each member uses a collaborative system (e.g., e-mail or Lotus Notes) with similar levels of intensity and frequency. Such homogeneous use of the system across group members would be considered the group's shared level of use. In contrast, *configural* constructs originate in the attributes of individual members and emerge at the collective level in the form of a distinct pattern among members of the collective. For example, members of a virtual team may use a system with different frequencies or for different purposes, and these differences among members may exhibit a heterogeneous but stable pattern (e.g., relating to

[4]One exception to this occurs for systems in which there is no clear individual directly interacting with them (e.g., automatic fulfillment systems that are triggered by inputs from other systems and that are not directly invoked by people). While these represent an exception, for reasons of scope, we do not address such systems in this paper.

their individual job roles). The differences may also exhibit a cyclical pattern, relating to certain natural rhythms of project milestones or the business cycle.

The distinction between shared and configural constructs is well-accepted in multilevel research (Kozlowski and Klein 2000) and, in our view, it serves two key objectives: (1) it cautions researchers not to assume that all collective phenomenon are homogeneous; and (2) it requires that researchers justify a collective as exhibiting either shared or configural properties. Some readers, particularly those of the interpretive tradition, may consider the first point to be self-evident. This is not the case for variance-oriented researchers, who have tended to consider only *shared* collective phenomena in the past (Kozlowski and Klein 2000). For such researchers, the simplest and most common way to create a score for a collective construct using scores for lower-level phenomena is to calculate the mean or sum of the lower-level scores. Of course, this ignores any possible heterogeneity among the lower-level scores. When variance-oriented researchers in the past were faced with the challenge of developing measures to represent collective behaviors, they did not create measures to capture heterogeneity within a collective. Instead, they (1) created theoretical reasons to emphasize the importance of homogeneity, arguing that without such homogeneity, the collective phenomenon does not exist (see Klein et al. 2001, p. 4); and (2) developed statistical tests to justify the use of mean values (such as r_{wg}) that identify whether an attribute is sufficiently similar within members of a group and sufficiently diverse across groups to establish homogeneity (Castro 2002; James 1982). As a result, it has become accepted practice in organizational science for researchers to measure collective constructs via means (or sums) and to defend the validity of such values as representing collective phenomena by proving that their data meet the required thresholds for such tests (e.g., Castro 2002).[5]

While some IS authors caution researchers to follow the existing precedents in organization science by demonstrating within-group homogeneity as a precondition to assuming that collective constructs exist (Gallivan and Benbunan-Fich 2005), we would also encourage IS researchers to consider whether the collective phenomena is configural (heterogeneous) rather than shared (homogeneous). The challenge in doing so, unfortunately, is that researchers' focus on shared constructs in the past has meant that there has been little effort to develop measures of configural constructs. As a result, researchers who wish to study collective constructs that emerge from *heterogeneity* do not have good ways to measure their constructs or good tests to justify those measures (Kozlowski and Klein 2000).

Multilevel researchers in organization science have begun to stress the importance of configural constructs (Kozlowski and Klein 2000; Rousseau 2000). Likewise, several qualitative studies suggest that that configural use may be widespread in practice, finding that collectives often contain informal subgroups of users that differ in the degree to which they help each other learn to use an information system (such as *normal users*, *gurus*, and *translators* in Mackay 1990), that differ in their degree of acceptance of the system (such as *nonusers*, *wary users*, and *complete users* in Webster 1998), or that differ in their level of expertise (such as *regular users*, *recognized experts*, and *local experts* in Spitler 2005). There may even be entire groups within an organization that differ in the degree to which they use a system in novel ways (such as groups that exhibit *inertia*, *application*, or *change* in Orlikowski 2000). Even so, no study to our knowledge has examined the downstream consequences of a given collective enacting a particular configuration of usage, for example by comparing whether groups with one configuration, such as groups with stable patterns of regular users, recognized experts, and local experts, learn how to use a system more quickly or more effectively than groups with a different configuration, or no stable configuration at all.

Although we were unable to find explicit examples of configural use in the IS literature, one variance-oriented study that could be characterized as having done so is Lucas and Spitler's (1999) study of how stock brokers and their assistants employed a multifunction broker workstation. Although Lucas and Spitler analyzed the individual system usage behavior of these two types of employees (rather than as members of a coordinated workgroup), a configural pattern of usage is suggested by their explanation that a typical team consists of about four brokers, with each broker working with one or two sales assistants, and their explanation that

> It is clear…[that] different [employee] groups given the same workstation and functionality in a system will have quite different use patterns, depending on their tasks.…[The bank] provided brokers and sales assistants with the same technology. Initial interviews indicated that there were differences between the two groups; for example, sales assistants appear to be involved in more record keeping activities than brokers, whereas this latter group has more contact

[5] In information systems research, the use of such statistical tests to justify the use of means and sums to represent the shared behaviors of members of a collective is not well established. There are a few exceptions where IS authors correctly test for within-group homogeneity before aggregating individual-level data to the group level (e.g., Faraj and Sproull 2000; Yoo and Alavi 2001). Yet, many other IS researchers readily aggregate individual-level data to the group level without conducting the proper tests to ensure within-group homogeneity (Gallivan and Benbunan-Fich 2005).

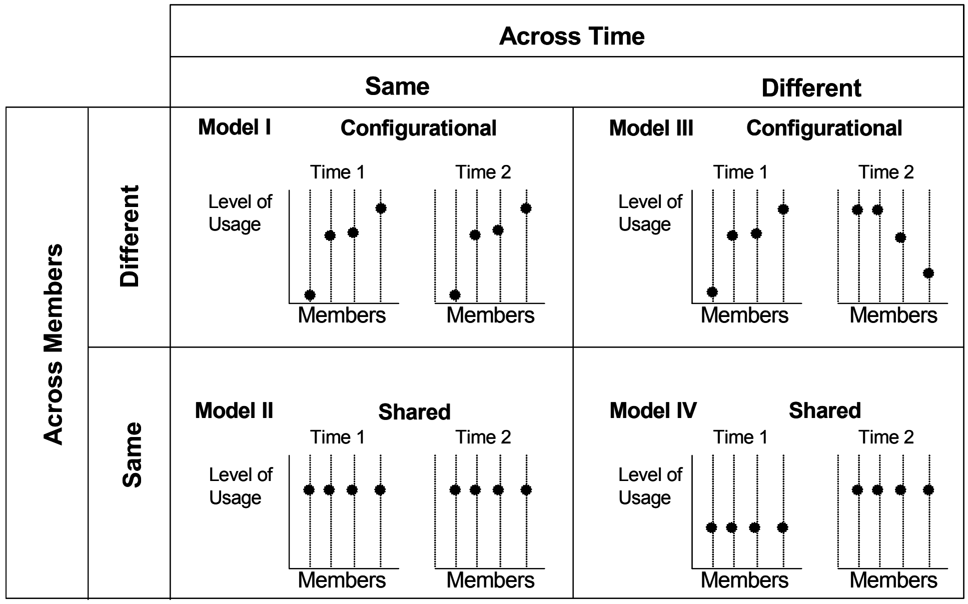

Figure 3. Forms of Shared and Configural Collective Usage

> with customers….[Results] show differing levels of use for brokers and sales assistants (Lucas and Spitler 1999, pp. 299, 305).

Lucas and Spitler did not attempt to demonstrate how different configurations of usage among the various brokers and sales assistants across teams led to better or worse performance at the group level (since their focus was on individual-level use). Nevertheless, their study could be extended in such a fashion and, by reanalyzing data at the group level, it would be possible to demonstrate whether different configurations of use within workgroups led to differences in performance outcomes.

Given the potential relevance of configural usage in IS research, we provide additional guidance to support research in this area. First, we suggest different ways that researchers can conceive of configural use. In our view, the simplest way to conceive of configural collective usage is as a pattern of scores of individual usage across members and/or over time (see Figure 3).

In terms of patterns of scores *across members*, we draw on our proposed definition of system usage to suggest four general ways that researchers can conceive of configural usage:

- *In a system-centered fashion*: for example, a distinct pattern whereby some users use different features of a system than others.
- *In a user-centered fashion*: for example, a distinct pattern whereby some users engage with the system with different cognition (e.g., absorption) or affect (e.g., wariness).
- *In a task-centered fashion*: for example, a distinct pattern whereby some users employ the system for different subsets of a task (e.g., relating to job roles).
- *In a holistic fashion*: for example, a distinct pattern whereby some users employ different parts of a system, for different subtasks, and with different cognition/affect.

As Figure 3 shows, patterns of usage can also vary *over time*. Accordingly, we suggest that whereas shared collective usage occurs when system usage is homogeneous across members at a point in time (per model II or IV), configural usage can be manifested in two general ways:

- *Heterogeneity* among members that is *stable* over time (model I): for example, due to members having different but stable job roles that require the use of different features of an information system.

Table 5. Approaches for Measuring Configural Usage	
Applicable Techniques	**Description**
Induced categories (Lee et al. 2004)	Use the groups' scores to induce categories from qualitative or quantitative cluster analysis and assign groups to their respective categories. At the group level of analysis, compare membership in each cluster to variance in the outcome of interest.
Selected score (Chen et al. 2004)	Use a single score selected from one member of each group (e.g., minimum or maximum) to represent the group pattern (e.g., in situations where a group is only as good as its weakest or strongest member). At the group level of analysis, compare variance in the selected score to variance in the outcome of interest.
Pattern of scores (Kozlowski and Klein 2000)	Use each group's distribution of scores to deduce a single number (for quantitative research) or code (for qualitative research) that reflects the degree of dispersion (e.g., variance) or symmetry (e.g., proportion) in each group's pattern. At the group level of analysis, compare variance in the pattern (or variance in the distance from an ideal pattern) to variance in the outcome of interest.
Combined (Straub et al. 2004)	Use each group's distribution of scores to calculate a single, weighted value (for quantitative research) or a code (for qualitative research) that *combines* the strength of the scores (e.g., mean) and the pattern across scores (e.g., range, variance, or proportion) within the group. At the group level of analysis, compare variance in the combined measure (or variance in the distance from the ideal combined measure) to variance in the outcome of interest.

- *Heterogeneity* among members that *changes* over time (model III): for example, due to members having different and changing job roles that require different uses of an information system.

Second, once a researcher has chosen a way to conceive of system usage, a way to measure it must be chosen. Such measures are not well-developed in the literature. We extend past studies by providing four possible ways to measure configural constructs (see Table 5).

We must note several points about these ways to conceive and measure configural usage. An immediate point to stress is that none of these ways is sufficient on its own to reflect collective usage. Because they identify configurations by accounting for the usage patterns of members, researchers would need to first meet the precondition of demonstrating that interdependencies-in-use exist, before they can proceed to argue that the usage behavior is configural. In fact, interdependencies-in-use will generally be critical in producing and sustaining the patterns of individual use observed in any given case. If no such interdependencies exist, none of the scenarios or measures in Figure 3 or Table 5 would reflect collective usage (whether shared or configural).

It is also important to recognize that an assumption of equilibrium underlies our conceptions of shared and configural usage. It may be obvious that shared constructs require equilibrium, but so do configural constructs because distinct patterns can only emerge if a static or dynamic equilibrium exists (Meyer et al. 1993). Models I and II in Figure 3 represent cases of static equilibrium in which usage is constant over time. Models III and IV represent cases of dynamic equilibrium that follow regular or recurrent patterns over time. Although such equilibria are common in practice (Gersick 1991; Tyre and Orlikowski 1994), they are not universal. Disequilibrium can persist in high-velocity work environments where external forces prevent the formation of equilibrium (Brown and Eisenhardt 1997). If equilibrium is never achieved, the behavior of a collective's members will remain in flux and it will be very hard to measure collective usage. Because it may take more than two periods for equilibrium to emerge and even more for a researcher to conclusively identify the particular pattern of configural usage at equilibrium, this implies that it will also be difficult to identify and measure complex configurations of usage that only become observable over many time periods.

Finally, in our discussion of these ways to conceive and measure configural usage, it is easy to lose sight of the bigger picture of *why* researchers should understand and identify the form of collective usage that a collective enacts. The goal is not to identify configurations for their own sake. Rather, given an understanding of the function or effects of usage (such as the effect of collective usage on collective performance in our illustrative model), the aim is to identify what form of collective usage gives rise to such effects and why it does so. This leads to our third guideline for studying configural usage: researchers should pay attention to *why* a configuration has occurred. Certainly, configurations can result from many forces. They can result from individual decisions (e.g., to self-regulate behavior), collective decisions (e.g., to enable specialization of labor), assignments by authority figures (e.g., to require members to follow assigned roles), and evolutionary forces (e.g., via variation, selection, and retention of patterns over time; Lassila and Brancheau 1999). In all of these cases, a configuration occurs for a particular reason. Research suggests that the most general reason *why* a configuration is enacted in a given situation is that it "fits" or coheres in that context (Meyer et al. 1993; Rousseau 2000).

Knowing the precise reasons *why* a configuration fits in any specific case will require a specific theory. For example, in the case of our illustrative model (Figure 1), theories of learning suggest that one configuration associated with high performance is to strike a balance between exploitation and exploration (Edmondson 2002; March 1991). This suggests that one type of configural use that collectives might adopt is to strike a balance between the extent to which some members exploit their existing knowledge when using systems and other members explore new ways of using systems. For example, Accenture has long had an advanced technology practice in its Chicago headquarters, which experiments with and evaluates emerging technologies before deciding which ones should be adopted by other offices. This represents a distinct usage configuration, since one unit in the firm (the advanced technology practice) uses new forms of technology in a deliberately different manner than other units, which are expected to use them according to prescribed methodologies.

In addition to *specific* theories, the law of requisite variety from general systems theory (Ashby 1958) offers more *general* guidance that systems tend to generate a degree of internal variety (i.e., a configuration) that matches the degree of variety in the external environment. For example, a meta-analysis found that groups in which individuals are homogeneous (in terms of gender, ability, and personality) perform best in simple tasks while heterogeneous groups perform best in complex ones (Bowers et al. 2000). Thus, drawing on the elements in our definition of system usage, we suggest that configural usage is more likely to occur than shared usage if

- the *user* (i.e., collective) is complex (e.g., it has many members with diverse backgrounds)
- the *system* is highly complex (e.g., it contains many diverse features)
- the *task* is highly complex (e.g., it contains many varied subtasks)

An increase in the complexity of any of these elements increases the likelihood that individual differences among members and the modularity of systems and tasks will enable and motivate patterns of usage to emerge to achieve specialization of labor, fit, and synergy (Rousseau 2000). Because users, systems, and tasks in the real world are often complex, this suggests that if periods of equilibrium can be assumed, collective use will often be configural in practice.

Finally, like Morgeson and Hofmann, we recommend that when researchers are theorizing *why* a configuration exists, they should consider the general systems principle of equifinality: the notion that different designs may achieve the same outcome (Meyer et al. 1993). For example, assume that a researcher is studying the relationship between collective usage of GSS and performance in idea brainstorming and finds that

- some groups enact a heterogeneous pattern of use such that half the group members use the system to propose ideas while the other half use it to critique the ideas of other members

- other groups enact a homogeneous pattern of use such that all group members use the system equally, with each one both proposing and critiquing ideas

Note that the pattern of use in both cases is *structurally* distinct because the first type of group represents a configural pattern of collective use (similar to Constant et al. 1996), while the second type of group represents a shared pattern of collective use. However, it is possible that the two patterns of use exhibit equifinality in terms of the dependent variable, that is, they lead to identical performance outcomes (e.g., quality of ideas). If this researcher performed detailed qualitative or quantitative checks and confirmed that the two patterns were indeed equifinal, then the *particular* patterns of use enacted by these groups would not be *functionally* important for the researcher's study. Thus, the same score could be used to reflect the pattern of use in each group, because the heterogeneous (configural) and homogeneous (shared) patterns of use are functionally equivalent.[6] This underscores our earlier argument that researchers should not study configurations for their own sake; instead, they should determine what configurations are important in the context being studied (Rousseau 2000). We summarize this guidance in Table 6.

[6]Please note that the question of whether or not a configuration is functionally important is considered with regard to a *specific* outcome. In our example, the two different configurations have the same effect on the specified outcome: the quality of ideas generated per group. Of course, it may be the case that these two different configurations have vastly different effects on another outcome such as the distribution of power within the group. If the researcher was interested in this other outcome, the pattern of use would be functionally important for that outcome.

Table 6. The Structural and Functional Importance of Usage Measures

Dimension	Description	Reason for Importance	Example of Potential Error
Structural Importance	A pattern of actions is structurally important if it manifests the existence of the collective construct.	If a researcher does not know the structural importance of a pattern of actions, the conclusion may be that a collective construct does not exist when in fact it does.	If a researcher incorrectly assumes that collective usage must be shared, instances of collective usage that exist as configurations may not be identified.
Functional Importance	A pattern of actions is functionally important if it has a stronger or weaker relationship with another construct in the theory (than other patterns).	If a researcher does not know the functional importance of a pattern of actions, inaccurate conclusions about the relationships among constructs in the theory may be drawn.	If a researcher incorrectly assumes that two patterns of usage have the same relationship with task performance, misleading results in tests of the relationship between usage and performance may be obtained.

Guideline 3: Context of Usage

In addition to the preceding guidelines, Morgeson and Hofmann suggest that multilevel theories should account for two types of contextual factors: (1) factors that affect functional relationships among constructs (e.g., the horizontal arrows in Figure 1) and (2) factors that affect the emergence of collective phenomena (e.g., the vertical arrows in Figure 1). We consider these two sets of factors in guidelines 3.1 and 3.2, respectively.

Guideline 3.1: Context – Function

When studying functional relationships among constructs, Morgeson and Hofmann suggest that researchers should be aware that relationships may be indeterminate because various contextual factors may influence the relationship between the structure of a collective construct and its output or function. In practice, this means that multilevel researchers should account for contextual factors that directly affect their dependent variables or that moderate the relationship between the independent and dependent variables in their study. Strictly speaking, contextual factors could include *any* factor that surrounds the phenomenon of interest. Because there could be an unlimited number of such factors, it is not feasible for us to give a comprehensive list. However, it is important to provide some guidance because such factors often go unnoticed in narrowly scoped, variance-oriented studies (Trauth and Jessup 2000). Accordingly, we suggest that IS researchers who wish to study the relationship between system usage and a dependent variable (such as performance in Figure 1) should be particularly aware of two sets of contextual factors.

First, researchers should be aware of contextual factors associated with each *element* of usage (i.e., the system, user, and task). For example, task–technology fit theory suggests that when studying the link between usage and performance, researchers should control for the degree to which user, system, and task "fit" each other (Goodhue and Thompson 1995; Marcolin et al. 2001). Thus, if the degree of fit is not controlled, then researchers might be unable to account for why a given structure of collective usage is associated with different degrees of performance.

Second, a given structure of collective usage could be associated with different outcomes because of differences in *timescale* in the model being studied (e.g., how long a period of time the horizontal arrows in Figure 1 represent). Although researchers often assume that the effect of independent variables on dependent variables is instantaneous, this may not be the case; especially in collectives, the relationship between predictor and outcome variables may take time (e.g., days, months or years) to emerge (McGrath et al. 2000). For example, assume that researchers relied on March's (1991) theory of learning to propose that a balance of exploitation and exploration will be associated with greater performance. March's (1991, 1999) theory suggests that exploration has uncertain benefits in the short run, but more certain benefits in the long run. As a result, a balance of exploitive and exploratory use may have a weak relationship with performance, if measured in the short run; however, as researchers increase the interval over which they observe the relationship, the benefit of a combination of exploration and exploitation on performance should become more apparent.

Vignette 4: The Importance of Context

DeSanctis and Poole (1994) proposed adaptive structuration theory (AST) to explain why new IT can result in a wide variety of outcomes. To explain this, AST posits that sources of structure (e.g., system features) affect social interaction (e.g., IT use and decision processes) that in turn affects group-level outcomes (e.g., decision quality). A sample proposition from the theory is

> Proposition 7. Given AIT [i.e., Advanced IT] and other sources of social structure, $n_1 \ldots n_k$, and ideal appropriation [i.e., usage] processes, and decision processes that fit the task at hand, then desired outcomes of AIT use will result (p. 131).

DeSanctis and Poole discuss several contextual factors that affect the *relationship* between collective usage and its outcomes. For example, Proposition 7 shows that the relationship between IT use and desired outcomes may be indeterminate; researchers should consider whether the decision processes fit the task at hand *in addition to IT use* when studying the effects of IT on group outcomes.

DeSanctis and Poole also discuss contextual factors that affect the way that patterns of IT use *emerge* in a group. For example, they discuss characteristics of the system, task, and group, and argue that time is also a relevant factor, mentioning that appropriation patterns emerge gradually.

Guideline 3.2: Context – Structure

Paralleling our discussion in guideline 3.1, we suggest that two sets of contextual factors are particularly relevant when studying the emergence of collective phenomena. First, we draw on our definition of system usage to suggest that the nature of each *element* of usage (i.e., the user, system, and task) can facilitate the construction of interdependencies-in-use that in turn lead to the emergence of collective usage. Research in this area is sparse, but past studies suggest that collective system usage will most likely emerge when *users* have preexisting affiliations with other members (Lamb and Kling 2003), when *tasks* require multiple units or individuals to coordinate their work (Crowston 1997), and when *systems* have features that facilitate the emergence of interdependencies, such as communication facilities, data storage facilities, maintenance of interaction history, and common responsibility for data (Karsten 2003).

Second, research suggests that *time* is an important contextual factor with collective properties tending to emerge and change more gradually than individual ones (Kozlowski and Klein 2000). For example, the emergence and change of collective usage is likely to be gradual because changes in collective usage require coordination among individuals, dyads, groups, and so on, as the change diffuses across the collective (per the upward arrow labeled "2" in our illustrative theoretical model in Figure 1) (Barley 1990). Thus, studies that examine system usage over too short a period may fail to discern the emergence of collective use, as Karsten (1999) found in her review of groupware studies published in the early to mid 1990s. In contrast, the influence of collective usage on its members' individual use can be rapid or gradual, for example, due to assignment of new policies (rapid) or the evolution of new divisions-of-labor (gradual) (per the downward arrow labeled "2" in Figure 1) (Orlikowski 1996).

In Vignette 4, we discuss how DeSanctis and Poole's (1994) adaptive structuration theory (AST) illustrates the importance of understanding each of the contextual factors noted above when building a theory of system usage. Although AST was not designed as a multilevel theory, DeSanctis and Poole (p. 144) argued that it could be extended in this way.

Because it is challenging to understand the function and structure of a multilevel construct, let alone all of the contextual factors noted above, Morgeson and Hofmann stress that it may not be possible to give a complete account of a multilevel construct in one study. As a final note to this section, we therefore suggest that researchers consider a complete understanding of system usage as a multilevel construct to be something that emerges from a research program rather than a single study.

Discussion

By presenting system usage as a multilevel construct and illustrating what it takes for researchers to study it as such, our aim has been to generate a deeper understanding of system usage and to motivate a new platform for research on its multilevel nature. We discuss several aspects of our research before concluding the paper.

Pros and Cons of Multilevel Theorizing

It is difficult to identify instances of system usage in practice where multilevel issues are *not* relevant, even when one considers systems designed especially for individuals (e.g., individual productivity systems) or collectives (e.g., groupware and ERP systems). This is not to say that all researchers studying system usage must develop multilevel models. Even so, we agree with Klein et al. (1994) that multilevel issues are sufficiently ubiquitous that researchers who build single-level models should explicitly justify why such an approach is appropriate.

Despite the relevance of multilevel research, multilevel theorizing is challenging. The theoretical concepts offered in multilevel and configural research, such as levels, linkages, configurations, and equifinality, stem from systems theories (Arrow et al. 2000; Kozlowski and Klein 2000; Meyer et al. 1993). Although such theories are useful (Lee 2004), they are notoriously general. For example, we drew on general systems theories to propose that configural use would be more likely if the collective, system, or task increased in complexity. Such general predictions may lack accuracy in specific contexts. However, it is difficult to draw on more specific theories, because specific theories in past research are generally single-level ones; there is almost no theory regarding linkages between levels of analysis (Chan 2000; Goodman 2000).

In addition to these theoretical challenges, there are many empirical challenges. For instance, methods for measuring configural constructs are not well developed, while methods for justifying shared constructs (such as tests for within-group homogeneity) that are well known in organization science seem poorly understood within the IS community (Gallivan and Benbunan-Fich 2005). In addition, there are no agreed upon principles for testing the construct validity of shared or configural constructs (Chen et al. 2004; Hofmann and Jones 2004). There is also little in the way of guidance for specifying relevant samples in multilevel studies. For example, common sense suggests that researchers should avoid (1) studying levels too far apart (e.g., the organization and individual level in a large firm, while ignoring intermediate levels such as workgroups) because too many unobserved levels may dissipate the links between individual and collective constructs; and (2) studying a single level of analysis with too many members because relevant subgroups may be overlooked (Chan 1998). Nevertheless, there are no established *thresholds* for determining how close together levels should be, or the size at which a level becomes too large. Finally, multilevel research may shift researchers' attention away from important phenomena such as informal networks of users who are neither strictly independent nor interdependent enough to constitute a true collective.

While we acknowledge these challenges, we believe that they represent research opportunities rather than problems to be avoided. They certainly do not mean that multilevel research is any less rigorous or useful than single-level research because no matter how rigorous one's research design and data analysis, single-level studies cannot make reliable generalizations beyond that level without incurring well known fallacies such as the ecological and atomistic fallacies in Table 2.

Limitations of our Analysis

Our application of multilevel research is limited in several ways. Most importantly, we only engaged in multilevel thinking from a relatively functionalist, positivist, variance-oriented perspective. Although this is consistent with prior precedents in multilevel research (Castro 2002; Kozlowski and Klein 2000; Rousseau 1985), a deeper understanding of the multilevel nature of system usage may benefit from a multi- or meta-paradigmatic account. Certainly, several interpretive field studies of system usage could be said to have "engaged" in multilevel thinking, broadly construed (Barley 1990; Levina and Vaast 2005; Orlikowski 2000; Schultze and Boland 2000). Process theories of group system usage are emerging as well (Sarker et al. 2005). We believe that there are great opportunities to extend our analysis by combining meta-theoretical positions. We urge researchers to consult the literature on multi- and meta-paradigmatic theory building to determine whether it is possible to reach a more integrated understanding and, if so, how to do so (Lewis and Kelemen 2002).

The other major limitation stems from our reliance on Morgeson and Hofmann's guidelines. As we noted earlier, other guidelines for multilevel research have been developed, covering important issues such as different types of theoretical models (e.g., Klein et al 1994) and different statistical techniques for analyzing multilevel data (Kozlowski and Klein 2000). Although we believe that Morgeson and Hofmann's guidelines apply most directly to the multilevel nature of system usage, we acknowledge that other guidelines are also important when undertaking a full multilevel empirical study.

Opportunities for Future Research

We see three key implications for future research on system usage from adopting a multilevel perspective: (1) avoiding errors of inclusion and omission in measurement, (2) forging new research directions in studies of the antecedents and consequences of system usage, and (3) deepening insights into the IT artifact by conceptualizing systems in new ways.

A strong benefit of a multilevel perspective is that it highlights errors of inclusion and omission with regard to measuring usage in past research. Errors of inclusion occur when researchers create a measure of collective usage (e.g., by aggregating measures of individual use into an overall sum or mean value or by asking a key informant about others' use in their group or organization) but do not verify that collective usage actually exists. Such errors are troubling because they can lead to conceptual problems, such as theorizing collective usage when the collective does not in fact use the system (but only a single individual or a mere collection of independent individuals uses it), as well as empirical problems, such as increasing the likelihood of statistically significant results, and hence Type-1 errors, due to inappropriate aggregation (Kozlowski and Klein 2000). Our research points to the need for researchers to present evidence that they are not inappropriately employing measures of collective usage in their studies. Despite the importance of errors of inclusion, errors of omission appear even more prevalent because no prior variance studies in the system usage literature have employed measures of configural usage. As we have argued, there is good reason to believe that configural usage should be the most dominant form of collective use, certainly from a structural perspective and often from a functional perspective. Studying the antecedents of configurations, the processes by which they emerge, and the association between different usage configurations and outcomes (e.g., performance, learning, and quality of life) offers rich research opportunities.

A configural perspective may be particularly helpful for understanding unexpected outcomes from usage, such as when effects at one level lead to no effect or an opposite effect at another level of analysis (Goodman 2000). For example, when a collective's members enact configural usage, it is possible that a change in individual usage practices that deviates from the agreed-upon configuration will improve individual outcomes (e.g., individual performance) but reduce collective outcomes (e.g., firm performance) because such a change may move the collective away from a configuration that best suits the collective's interests. We believe that such outcomes could occur quite often in practice when individual and organizational interests are misaligned.

Another rich research opportunity would be to identify situations when the distinction between individual and collective usage is important and, in such situations, identify antecedents of the emergence of collective usage. Consider the 2004 U.S. presidential election. Many journalists discussed how Internet use by campaigns helped raise unexpectedly large campaign funds. Some commentators suggested that the most successful of these efforts were those in which campaigns engaged in "online organizing," rapidly ramping up from having constituents engage in *individual* usage (e.g., sending donations) to achieving collective usage and "coordinated action" by having online and offline meeting places and coordinated blogs (Cone 2003). We have little theory on how to rapidly mobilize such initiatives or what antecedents are important.

A final important implication of multilevel research is that it reveals new ways to think about IT artifacts. Too many studies insufficiently theorize the IT artifact (Orlikowski and Iacono 2001). Multilevel research offers a unique way to reach insights about one important aspect of systems: *the degree to which systems can be considered in aggregate terms as one considers the usage construct at a higher level of analysis.* To elucidate this point, we have provided guidelines for aggregating system *usage;* other research has provided guidelines for aggregating the *systems* in question (Fichman 2001). We believe that such guidelines are complementary and that IS research would profit from extending these so that they do not merely support studies of collective and configural usage of *single* systems, but rather, collections and configurations of *multiple* systems. For example, due to our requirement that interdependencies-in-use must exist as a precondition for collective usage to exist, it would be challenging to identify any large collective such as a large organization that used any particular system if we define a system as a single *application* (e.g., Microsoft Word or Lotus Notes). However, if the concept of the system were considered in more aggregate terms at higher levels, it would become more feasible to talk about organizational system usage in such cases. Exploring such research would not only provide a deeper understanding of system usage, it would also enable researchers to obtain a deeper understanding of IT artifacts by identifying how organizations can achieve the necessary coordination of IT artifacts *and* usage practices to leverage their portfolios (Zmud 2001) or ensembles (Orlikowski and Iacono 2001) of systems effectively.

Conclusion

In this paper, we advocated a multilevel perspective on system usage that integrates conceptions of system usage at the individual and collective level, and we highlighted the need for research on the linkages between levels of analysis and the means by which system usage leads to downstream consequences. In doing so, we drew on an existing framework for conducting multilevel research (Morgeson and Hofmann 1999) to provide detailed steps for building multilevel theories of system usage, devised guidance for supporting each step, and provided a concrete illustration (Figure 1) and examples for how such research could be undertaken.

Although systems usage has been a key variable in IS research since the 1970s (DeLone and McLean 1992), it has received surprisingly few theoretical assessments. The guidelines that we advance in this paper for studying system usage are designed as an initial platform to support research that can explicitly bridge the gaps across levels of analysis that have been noted in past research (Chan 2000). A multilevel approach appears to be a promising way to obtain rich insights into the nature and use of information systems in organizations (and in higher levels of collectives, such as industries or societies), increase the accuracy of the language we use to describe system usage in research and practice, and increase the rigor and relevance of research on its emergence and change and its antecedents and consequences.

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Appendix

Morgeson and Hofmann's Guidelines

We list below the 11 guidelines that Morgeson and Hofmann (1999) offered for studying collective constructs.

1. The investigation of constructs at the collective level could begin with an understanding of the interaction of organizational members. Because these interactions allow collective constructs to emerge and be maintained, focusing on the interactions that define and reinforce the collective phenomena can provide a better understanding of how collective phenomena arise and continue, particularly in the face of contextual or membership changes. Such understanding is facilitated by explicitly identifying systems of ongoings and events, particularly those events that lend structure to collective phenomena.

2. Because the emergence of some constructs is conditional and of others is inevitable, accounts of collective constructs should provide details about their developmental aspects and should specify the processes through which the constructs emerge, particularly in terms of the importance of critical events as compared to usual ongoings.

3. In explicating the structure of a collective construct, one should acknowledge and understand the context within which individuals operate. Because the context limits the range of potential interaction, it may have a particularly influential role in determining the emergence of a construct and its structure.

4. Explicit consideration of a construct's function may allow scholars to integrate functionally similar (but structurally dissimilar) constructs into broader nomological networks of constructs. This can serve as an integrative mechanism in multilevel research and theory.

5. To understand the structure of a collective construct, it may be helpful to identify the role the outcome plays in the collective, particularly in terms of how it facilitates goal accomplishment. This can help provide insight into why the construct exists and why it persists (or fails to persist) over time.

6. Scholars could begin multilevel theory development with a functional analysis, examining the output of a given construct. This would identify commonalities across levels that could be used to provide insight into the construct's structure at a particular level. That is, identifying the function naturally will lead into a discussion of the processes or structures that underlie the function. The theorist could then articulate the structure of the constructs at each hierarchical level.

7. Because a number of different structures can result in the same function, it is incumbent upon the researcher to specify the particular structure of a construct at a given level. As an area of research matures, identification and acknowledgment of the different structures or processes that account for the function should become a high priority.

8. Because similar structures can result in different functions, it is important for scholars to understand the factors that influence divergence in outcomes. Identification of the contextual factors or structural properties that regulate this divergence is important for an adequate understanding of the phenomena.

9. Scholars should not simply assume that the measurement of collective phenomena is the same as the measurement of analogous individual-level phenomena. There is a host of potentially important factors at the collective level, such as interaction, integration, coordination, and interdependence. In their theories and operationalizations, scholars must take these factors into account in order to fully understand the nature of such collective constructs.

10. When operationalizing collective constructs, researchers may justifiably collect individual-level data. To collect data that are meaningful at the collective level, however, one must have a conceptual rationale for the level of measurement chosen. Inferences at the collective level will be facilitated by focusing on the collective phenomena, framing questions in collective terms, treating individual as informants about collective processes, and focusing on the role of individuals in terms of the wider collective.

11. Researchers should be clear in how they operationalize their constructs with respect to whether they wish to assess the constructs' structure or function. Failure to do so may result in inadequate construct operationalization.