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When Good Fit is Bad: The Dynamics of Perceived Fit

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Abstract

In the "quest" (Delone and McLean 1992) for reliable and practical measures of IS success, a growing stream of research has argued that a key predictor of performance impacts is user evaluations of fit between task requirements and characteristics of the system or technology (Goodhue and Thompson 1995; Vessey and Galletta 1991; Jarvenpaa 1989; Goodhue 1988). The argument is that a better fit produces better performance — good fit is desirable. It has also been argued that users are quite capable of reliably evaluating fit (Goodhue 1995). While both intuitively and empirically there is some support for these notions, evidence presented in this research suggests that users can misperceive their fit with technology. Furthermore, it is argued that such misperceptions of fit can inhibit learning and productivity with technology (generativity), and at the extreme may lead to catastrophic decision making by users (Weick 1990). The basis for these arguments draws on work in ecological psychology, cognitive science, and organizational theory to identify four types of fit, and focuses particularly on the process dynamics of how fit emerges from user-technology interactions.

1. INTRODUCTION

Out of a desire to provide a means to justify and guide the large expenditures organizations make on information technology, information systems researchers have for many years devoted attention to evaluating IS success (Delone and McLean 1992). Despite the research interest, assessing IS success has been problematic. Measuring objectively the individual performance gains (if any) from technology usage is often difficult (Goodhue 1995). As a result, researchers have resorted to user evaluations of systems as surrogates for IS success. However, these more subjective measures have been strongly criticized as lacking a theoretical basis (Melone 1990) and consistent empirical support (Goodhue 1995). To overcome these criticisms, "what is needed is *the identification of some theoretical perspective that can usefully link underlying systems to their relevant impacts*" (Goodhue 1995, p. 1828).

A growing stream of research has suggested that a "task-technology fit" perspective is appropriate for understanding system impacts. For example, Vessey and Galletta (1991) provide evidence that cognitive fit (the fit between task requirements and the manner in which information is represented) improves task performance. Similarly, Jarvenpaa (1989) demonstrates that incongruence between task demands and the format of information presented by a system affects both decision processes and outcomes. More specifically, Goodhue (1995; 1992) defines task-technology fit (TTF) as the fit between individual abilities, task requirements and technology characteristics (i.e., there are three aspects to TTF: individual-task fit, individual-technology fit, and task-technology fit), and argues that the TTF construct is a good predictor of individual use and performance with IT/IS. Both intuitively and empirically there appears to be some support for the notion that better fit produces better performance. Furthermore, although objectively measuring fit is difficult, Goodhue (1995) presents arguments and evidence that suggests that users are capable of reliably evaluating fit.

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The purpose of this research is to explore the emergent nature of fit and demonstrate the additional explanatory power provided by taking a dynamic perspective on fit. In applying this dynamic view of fit, it will be made evident that users can readily misperceive fit, resulting in productivity losses, inhibition of learning (generativity) and even catastrophic decision making (Weick 1990). Thus, while an objectively good fit would seem to lead to better performance, user perceptions that fit is good may be negatively associated with productivity and performance. The basis for these arguments draws on work in ecological psychology, cognitive science, and organizational theory to identify four types of fit, and focuses particularly on the process dynamics of how fit emerges from user-technology interactions.

2. THE CONCEPT OF FIT

2.1 Toward a Dynamic View of Fit

Research examining user evaluations typically attempts to predict system use (and ultimately performance) on the basis of user evaluations of various characteristics of the system, task, user, organization and the like (Goodhue and Thompson 1995; Goodhue 1992; Davis 1989, 1993; Davis, Bagozzi and Warshaw 1989). Somewhat tautologically, these evaluations are usually based on users' experiences in using the system: a feedback loop exists. Although prior IS research on fit has recognized in theory that feedback is important (e.g., Goodhue and Thompson 1995), it has not been the main focus of study, either theoretically or empirically.

Instead, the prior IS research has taken a snapshot view of fit. The focus has been on the "goodness" of fit at a particular point in time or setting, rather than how fit evolves and emerges over time from user interactions with the technology. Yet it can be shown that the real explanatory power and richness of the concept of fit lies in understanding the dynamics of the process of "fitting." Under a dynamic view, fit is an emergent property of a process of fitting or adaptation to a task environment. To understand fit as an emergent property requires analysis of the feedback system from which it emerges. Fit as a scientific explanation is far more powerful when research considers the dynamics of how fit develops and influences user behavior over time, as opposed to simply considering the state of fit at a given point in time.

The additional explanatory power obtained from taking a dynamic view of fit and technology usage is well evidenced in the IS literature itself. For example, DeSanctis and Poole's (1994) Adaptive Structuration Theory (AST) takes a dynamic process view of technology usage. AST suggests that the way in which a technology may be used is not deterministic but rather adaptive. AST views behaviors in using technology as emerging from the interactions between users and the properties or features of the technology. Thus technology can be employed in a quite different manner than intended by the systems designers — what DeSanctis and Poole call unfaithful appropriations of the technology. Importantly, "unfaithful appropriations are not 'bad' or 'improper' but simply out of line with the spirit of the technology" (DeSanctis and Poole 1994, p. 130). In terms of the present research, the notion of unfaithful appropriations suggests that achieving a good fit is not simply a matter of engineering; rather, it emerges from user interactions with the system. Such an emergent notion of fit provides rich explanations of technology usage and impacts.

As a scientific concept, fit has its origins in the biological sciences, where the emphasis is clearly on understanding the process of fitting in order to understand the fit that emerges. Natural selection in evolution is viewed as a process of survival of the fittest. Fit emerges from an organism's adaptations to the environment in which an organism exists. In this evolutionary context, the power of the concept of fit is the explanation not of the outcome of the process of fitting (the selection of some biological feature of a species) but the process itself (how the biological feature came to be selected for in the evolutionary process) (e.g., see Dawkins 1982). In a behavioral as opposed to purely biological context, the field of ecological psychology also captures the dynamic adaptive/emergent nature of fit (Kochevar 1994). It is the ecological psychology concept of fit that forms the foundation for this research's analysis of fit with respect to technology usage and impacts.

In the ecological view, behavior is the product of the interaction between an agent and its environment. Gibson (1979) coined the term affordance to refer to the possible actions that may result from this interaction between an agent's knowledge and the properties of the task-environment. A situation can afford a particular action for an agent who has appropriate knowledge and abilities, and an agent can have the knowledge and abilities to carry out a particular action in an environment with the appropriate affordances (Greeno, Moore and Smith 1993). As Kochevar (1994, p. 6) puts it, "Environments provide information structured to support specific behaviors, and adapted individuals are sensitive to such information patterns." Importantly, the possible actions (affordances) an agent perceives in a given environment are also determined by the intentions or goals of a given agent (Heft 1989). For example, if an agent wishes to sit down, a chair may be seen as affording sitting; however, if the agent wishes to reach a book on the top shelf of a bookcase it may afford standing.

In the ecological view, the agent seeks to maintain fit between its knowledge and the properties of the environment that specify actions, in the context of a specific task. In essence, maintaining fit is a process of becoming sensitized to the affordances in a given task environment, and the fine tuning of this sensitivity. Problem solving behavior in this context may be characterized as gap closing (Lave 1988) between the agent's knowledge and the demands and properties of the task-environment. Gap closing involves taking the processes used in the past to handle similar classes of problems/tasks and iteratively manipulating them slightly until the present task/problem can be accomplished/resolved. Neisser's (1976) Perceptual Cycle characterizes this gap-closing process by which an agent becomes attuned to the affordances of the task-environment (see Figure 1). The agent has some knowledge of the environment based on past experiences. This knowledge drives exploratory action in the actual environment (e.g., behavior driven by a crude notion such as "my experience suggests that this [action] usually fixes problems like this" (Orr 1990)). The feedback as to the success of the action results in modifications to the agent's knowledge (the agent's sensitivity to the affordances of the environment is fine tuned) which then drives further action. This process iterates until the agent is satisfied that its knowledge of the environment and the actions that derive from it adequately address the problem (i.e., the task can completed) — satisfactory fit is achieved. Importantly, this conception of fit allows for new and unique combinations of actions to emerge. It allows for generativity as knowledge of the affordances supported by the environment and the resulting actions are continually modified and manipulated until a satisfactory (but not necessarily optimal) fit is achieved (Kochevar 1994).

The ecological view of fit can be seen to be a more general form of Goodhue's task-technology fit: the dimensions of task technology fit appear to map well into the ecological view of fit. The knowledge and abilities of users is clearly considered, as is the technology characteristics (the properties of the environment which specify and support the possible actions, the affordances) and it is the task that defines the agent's goals or intentions (and therefore, in part, the affordances they perceive). However, the ecological view also captures the dynamic and systemic nature of fit and provides a language and theoretical framework for discussing fit as an emergent property of the interaction between users and the technology. This ecological framework readily allows for adaptation: there is no uniquely correct fit (no engineered match) and the degree of fit fluctuates as the agent interacts with their task-environment (i.e., as the user interacts with the technology to carry out a task).

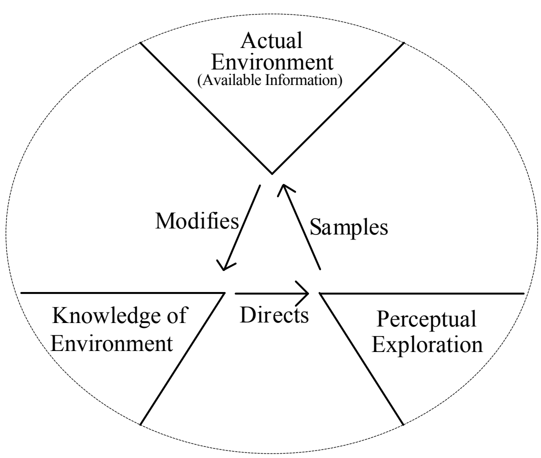

Figure 1. Neisser's Perceptual Cycle
(Adapted from Neisser 1976, p. 112)

In essence, Neisser's perceptual cycle is a model of learning. Learning is thus an integral component of a dynamic, ecological view of fit. It is perceptions of poor fit (between an agent's goals, knowledge and the environment) that drives adaptive behavior: learning. Conversely, if fit is perceived to be good there is no adaptation — the agent ceases learning. It is this relationship between perceived fit and learning that leads to situations in which perceptions of good fit can be bad, particularly if fit is misperceived.

2.2 Disentangling Fit

Before exploring the implications for technology usage of this dynamic view of fit, it is necessary to further disentangle the concept of fit. Gibson's affordance concept comprises goals/task, individual knowledge/abilities, and the characteristics of the environment, and so it would seem that there are three dimensions of fit corresponding to the relationships between each of these three components (as there is in Goodhue's Task-Technology Fit model). However when this general framework is applied to behavior in technology supported environments, it is apparent that there are two environments: the business problem environment (reality) and the technology (virtual) environment. Furthermore, the technology environment comprises a virtual representation of the business problem environment (Wand and Weber 1990) and means for manipulating that representation. Thus, the dynamics of Neisser's perceptual cycle become somewhat more complicated in technology supported environments as in addition to adaptation to achieve satisfactory fit with the business problem environment (Reality Fit), there is also adaptation to the virtual representation of the business environment (Cognitive Fit) and to the technology as a tool for manipulating the virtual representation (Tool-Fit). While IT is intended to support users in dealing with the complexity of the business reality (i.e., in achieving satisfactory Reality Fit), it is a double edged sword as the virtual representation embedded in the technology is an abstraction and so is by definition an imperfect representation. Consequently, there is the issue of fit between the virtual representation and the reality of the business environment (Representational Fit). Figure 2 depicts the four types of fit that must be considered in technology supported environments.

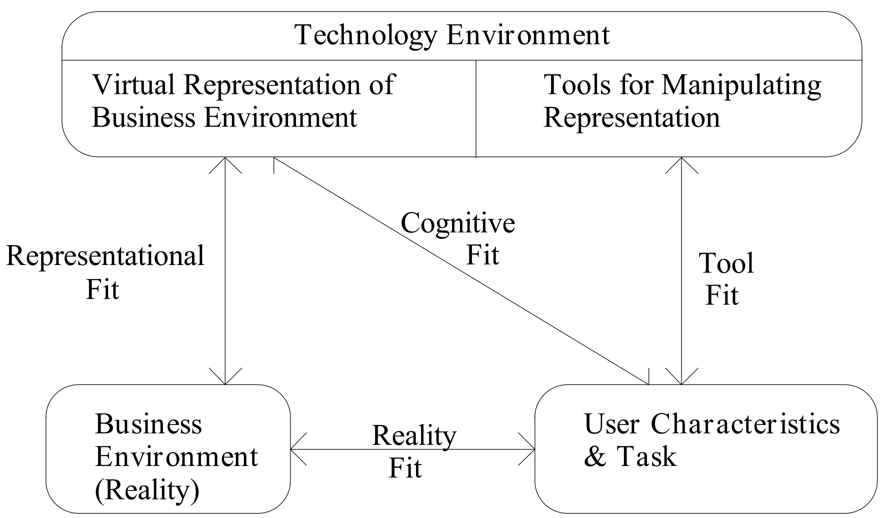

Figure 2. Four Types of Fit

The distinctions among the types of fit are more than simply theoretical, they have practical significance. If the goal of using information technology is to improve individual performance, then it is important to understand what aspect of fit is underlying any performance gains (or the lack thereof). Is it an issue of adaptation and fit to the representation presented by the information (Cognitive Fit)? Or, is it an issue of adaptation and fit to the technology as a tool for manipulating the representation (Tool Fit)? Or could it be an issue of the fit between the abstraction presented by the technology and the reality it represents (Representational Fit)?

From a cognitive science perspective, a task is a specification of what has to be achieved — of goals — not how it is to be achieved (McClamrock 1995). Task as goals is thus a characteristic of the user. The goals of a user determine what type of fit should be the focus in interactions with the technology. If the user's goal is to present some data in a particular manner (e.g., sorted), then tool fit should be the focus. If the user's goal is to analyze and interpret some data, then cognitive fit should be the focus. Additionally, subgoals may require presentation of data in a manner appropriate for analysis/interpretation and hence tool fit would also be important. If the user's goal is to solve some business problem, then reality, representational and cognitive fit should all be critical to success.

Since the goals of the user determine the types of fit that are critical, they also determine how performance is defined, since performance feedback provides an indication of the quality of fit (it is part of the basis for iteration around Neisser's perceptual cycle). For example, a clerk whose task is simply to present data in a particular format would likely focus on tool fit and the appropriate measures of performance would be time and efficiency (e.g., number of keystrokes) (Card, Moran, Newell 1983). In contrast the executive decision maker should be focused more on cognitive and representational fit — what the system can tell them about the business problem that confronts them — and hence the most appropriate measure is how the technology supported executive performs in tackling the business problem. Of course for the executive, real performance feedback is often delayed, as a result decision makers can be trapped into relying solely on the more immediate (but incomplete) feedback from the system. In fit terms, this trap involves focusing only on cognitive fit without regard to representational fit. In other words, adopting as truth the worldview provided by the technology and failing to recognize that the whole purpose of the technology is to aid the user in achieving fit with the business reality. Neisser's perceptual cycle, the manner in which an agent adapts to their environment, is thus complicated as well as aided by the introduction of technology, and hence the possibility for errors — for misperceptions of fit — arises.

3. WHEN GOOD FIT IS BAD

Objectively good fit with the technological environment at all three levels (tool fit, cognitive fit and representational fit) is intuitively desirable as it implies that the technology will be relatively easy to use, useful, and accurate in supporting the user's decision making and business task accomplishment. However, from an ecological perspective, recall that a good fit implies that there is no need for further exploration and learning (no more iterations around the perceptual cycle). While continuous learning certainly has a cost, in the rapidly changing technological and business environments of today it can be a necessary cost.

In any event, obtaining objective measures of fit is as at least as difficult as obtaining objective measures of IS success, which is what led to the interest in fit in the first place. Thus, researchers either have not formally measured fit (e.g., Vessey and Galletta 1991) or have relied on user evaluations of fit as surrogates for objective fit (Goodhue 1995; Goodhue and Thompson 1995). Initially, reliance on user perceptions of fit may appear quite reasonable. Indeed, from an ecological and dynamic perspective, it is their perceptions of fit that drive users' iterations through the perceptual cycle (i.e., their learning), not any objective measures. However, people's perceptions are not always commensurate with the true state of affairs, particularly in the presence of dynamic feedback systems (Sterman 1989a, 1989b).

The possibility that fit may be misperceived is problematic not only from the perspective of the researcher or practitioner trying to evaluate a system, but it also could be detrimental to users' performance with the system. Specifically, a belief that fit is good when in fact it is poor could lead to a cessation of learning well before the short term costs outweigh the long term benefits. Similarly, it can be seen that a misperception that fit is poor when in fact it is good could have detrimental performance impacts as learning continues well beyond the point at which the costs outweigh the benefits. That poor fit is bad makes intuitive sense; however, that good fit is bad seems somewhat counterintuitive and in conflict with the implicit assumptions of the existing IS research on fit. Thus, the focus of the remainder of this paper is on illustrating how, from a dynamic perspective, good fit can be bad. Drawing on anecdotal evidence and existing research, it is possible to demonstrate that perceiving fit with the technology environment (i.e., tool fit, cognitive fit, representational fit) to be good can be dangerous, particularly given that fit may be misperceived.

Consider first the (mis)perception of tool fit (i.e., fit in relation to a user's adaptation to the technology as a tool for manipulating a representation of reality), as exemplified in the case of Arthur (not his real name), the university administrative assistant and spreadsheet user. Arthur's introduction to spreadsheets was through the old DOS versions of Lotus 1-2-3. Over time, Arthur became very familiar with how to carry out certain tasks using the Lotus menu structure. In ecological terms, Arthur had adapted to achieve an acceptable fit with Lotus for his data manipulation tasks. Then, Arthur had a new work environment imposed upon him in which DOS Lotus 1-2-3 was replaced by the windows based spreadsheet Excel. Now Microsoft, the developer of Excel, kindly included a feature in the software to allow Arthur to continue using the Lotus 1-2-3 menu structure, thereby making the transition to the new environment easier.

Arthur prefers to use the Lotus 1-2-3 menu structure in Excel because he is well adapted to it: he perceives it as providing a better fit than Excel's standard interface. However, consider the task of sorting data on two keys, a routine task for Arthur. Comparing the operations required to carry out this data sorting task using the Lotus 1-2-3 menu structure (as Arthur does) with the standard Excel approach reveals that Arthur's adaptation and fit to Excel is relatively poor, both for the data sorting task (see Table 1) and in general.

Table 1. Comparison of Operations for Data Sorting Lotus Menu versus Excel Menu

	Lotus 1-2-3 in Excel		Standard Excel
1	/	invoke menu	<select data range>
2	D	select Data menu	Pull-Down Data Menu
3	S	select Sort	Select Sort
4	D	select Data-Range entry	Select Primary Key column
5	<select/enter cells for data range>		Click on Descending Bullet
6	P	select Primary Key entry	Select Secondary Key column (default Ascending)
7	<select cell in primary key column>		Click OK
8	D	select descending order	
9	S	select Secondary Key entry	
10	<select cell in secondary key column>		
11	A	select ascending order	
12	G	Go - execute sort.	

While Arthur's approach saves on short term learning costs, it is more costly in other ways. First, using the Lotus menu structure is clearly more inefficient and cumbersome as it requires more keystrokes/operations to execute a data sort than the Excel commands (Card, Moran and Newell 1983). Furthermore, since Arthur is not exploring Excel's menu structure, he misses out on the opportunity to learn the new types of operations possible under Excel (in ecological terms, generativity is lost). For example, Arthur is less likely to find out that three key data sorts are also possible under Excel (as would be evident from the Data Sort Dialog Box), or that is possible to get Excel to automatically generate subtotals in a table of data (an option under the Data Menu), features not available under DOS Lotus 1-2-3. Importantly, Arthur still perceives the fit with Excel to be relatively good because he is well adapted to the Lotus menu structure it provides. Yet Arthur's abilities and knowledge are not well adapted to the more efficient and powerful features of Excel. Objectively there is scope for Arthur to improve his fit. Arthur's case is not unique; for example there is the case of the Big Six accounting firm partner (in charge of in-house technology developments for the firm's national audit practice) who used DOS Lotus 1-2-3 as a word processor, despite the availability of a popular DOS-based dedicated word processing package (Owens 1990) — clearly an example of misperceived tool fit.

Perceptions of fit regarding the representation of the world provided by the technology (Cognitive Fit) can also be problematic. For example, Hedberg (1970; Hedberg and Jönsson 1978) describe a group of bank executives engaged in making policy and debt portfolio decisions, who, when presented with a new information system capable of providing new and different views of the world, simply used the new system to extract the same reports they had obtained from the old system. Hedberg and Jönsson's (1978, p. 49) description of the executives behavior is particularly striking:

> They requested the same reports, looked for the same information, and show little interest in discovering new things in the new information environments. . . . Their experience and their thought procedures appeared to act as blinkers which constrained their vision and curiosity.

In terms of the present work, the bank executives perceived a good fit with the representation of reality provided by the old reports, and hence failed to explore the different perspective of reality provided by the new reports that were available. Again, while this avoids the short term costs of learning how to use the new reports, it is a costly strategy in a constantly changing environment, particularly at the level of executive decision making. Indeed, it was with the objective of stimulating adaptation (learning) and preventing fit from stabilizing that Hedberg and Jönsson argued for the value of "semi-confusing information systems."

The difficulties in achieving satisfactory fit with the business problem environment (reality fit) that technology was intended to help solve also make it difficult to accurately perceive the fit between technology and the problem environment (representational fit). As an abstraction, the representation of the world provided by the technology is open to some interpretation (Weick 1990). Weick argues that complex technology decouples decision makers from the environment, hence engendering errors as sensemaking processes are interrupted. In ecological terms, the flow of the perceptual cycle is somewhat distorted as the decision maker takes actions in the business environment and views the results of those actions through the "equivocal" (Weick 1990) representation of that environment provided by the technology. The problem is exacerbated by our ability to make sense of our environment; we often impose structure where there is none (Weick 1990). As a result, a user may perceive that s/he has a good fit with the representation of the world provided by the technology (cognitive fit), and assume that reality fit is good, when the fit between the technology and reality (representational fit) is poor, making it virtually impossible to achieve good reality fit via the technology alone. This is particularly problematic as society moves to virtual organizations and communities and decision makers are further distanced from the reality of the business environment in which they participate.

In decoupling or separating the users from the environment in which they are acting, technology can create a false sense of security as cognitive fit can be high when representational fit may be quite poor. It is this decoupling (ignorance or misperception of representational fit) that Weick argues explains such technological disasters as the Three Mile Island Nuclear Reactor catastrophe. Woods, O'Brien and Hanes' (1987, p. 1726) comments about Three Mile Island are very telling: "The crew interpreted the control board instruments as best they could " — in other words they had good cognitive fit with the technology — "but the state of the plant and process was not assessed correctly." The good cognitive fit did not lead to good reality fit, because the technology did not provide an adequate representation of the processes occurring in reality (i.e., representational fit was poor). The problem was compounded by the fact that the crew did not have direct access to reality: they were separated from it by the control technology and hence could become decoupled from reality. The perceptual cycle was not just mediated through the technology but was broken by the technology.

As society becomes increasingly technology dependent, decision makers will become increasingly separated and decoupled from their environment, resulting in increasing frequency and regularity of decision making mistakes, both minor and catastrophic. In this light, Perrow's (1984) label of "Normal Accidents" for situations like Three Mile Island would seem quite appropriate. As Weick and others note, correcting such mistakes usually requires that "a fresh viewpoint enters the situation" (Woods, O'Brien, and Hanes, 1987, p. 1745). Yet, if representational fit (and consequently reality fit) is misperceived as good, learning and adaptation will cease and it is less likely that alternative viewpoints will be considered.

4. IMPLICATIONS AND CONCLUSIONS

This research has made arguments in support of four assertions associated with the concept of fit:

1. *Fit is dynamic.*

   It was shown that the explanatory power of the fit concept lies in considering it as an emergent property of user-technology (agent-environment) interactions, and in understanding the dynamics of the process of "fitting." This dynamic perspective on fit captures the important role of adaptation and generativity — learning. It recognizes that technology can be used in new and novel ways, beyond what is envisioned by systems designers or originally perceived by users.

2. *There are four types of fit (Tool Fit, Cognitive Fit, Representational Fit and Reality Fit) that must be considered in explaining technology usage and its impacts.*

   Adopting the dynamic view of fit provided by ecological psychology led to the identification of four distinct types of fit in technology supported environments. Depending on the task of the user, different types of fit were argued to be more critical to the success or failure of a system, and consequently different performance measures are indicated. Furthermore, for a failing system, different sorts of remedial action may be required depending on which type of fit is problematic.

3. *Users can misperceive fit*.

   Anecdotal evidence about Arthur, the spreadsheet user, demonstrated how users can misperceive their fit with the technology as a tool for manipulating representations of reality. Evidence from Hedberg and Hedberg and Jönsson revealed how users can misperceive their fit with the representation of the world provided by the technology. Finally, and perhaps most notably Weick's analysis of the equivocality of technology reveals how users can misperceive their fit with the reality of the environment in which they are making decisions in and the fit between that reality and the representation of it provided by the technology (they become decoupled from the environment).

4. *Good fit can be bad.*

   Perceptions that fit is good imply that learning has ceased, a potentially dangerous outcome, particularly as perceptions of fit can be erroneous. The impact of stopping learning before the costs outweigh the benefits include inefficient use of the technology (and possibly failure to recognize that a task could be performed with the technology), missing important information in decision making (e.g., Hedberg's bank executives), and even catastrophe (Weick 1990; Perrow 1984).

While further empirical validation of these assertions is required, it is clear that reliance on user evaluations of fit as a surrogate or predictor for IS success can be problematic. To fully appreciate the explanatory power of the concept of fit it must be recognized as both multi-dimensional and dynamic. The realization of the dynamic and multi-dimensional nature of fit has implications for understanding both the success and failure of systems and how successful systems can be achieved. It also serves to highlight that a move to greater reliance on technology, to the extent that virtual organizations and communities are created, has some dangerous, some would say even catastrophic, hidden consequences.

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