Motivational Framework: Insights into Decision Support System Use and Decision Performance

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1. Introduction

The purpose of this chapter is to discuss how characteristics of a decision support system (DSS) interact with characteristics of a task to affect DSS use and decision performance. This discussion is based on the motivational framework developed by Chan (2005) and the studies conducted by Chan (2009) and Chan et al. (2009). The key constructs in the motivational framework include task motivation, user perception of DSS, motivation to use a DSS, DSS use, and decision performance. This framework highlights the significant role of the motivation factor, an important psychological construct, in explaining DSS use and decision performance. While DSS use is an event where users place a high value on decision performance, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) do not explicitly establish a connection between system use and decision performance. Thus, Chan (2005) includes decision performance as a construct in the motivational framework rather than rely on the assumption that DSS use will necessarily result in positive outcomes (Lucas & Spitler, 1999; Venkatesh et al., 2003). This is an important facet of the framework because the ultimate purpose of DSS use is enhanced decision performance.

Chan (2009) tests some of the constructs in the motivational framework. Specifically, the author examines how task motivation interacts with DSS effectiveness and efficiency to affect DSS use. As predicted, the findings indicate that individuals using a more effective DSS to work on a high motivation task increase usage of the DSS, while DSS use does not differ between individuals using either a more or less effective DSS to complete a low motivation task. The results also show significant differences for individuals using either a more or less efficient DSS to complete a low motivation task, but no significant differences between individuals using either a more or less efficient DSS to perform a high motivation task only when the extent of DSS use is measured dichotomously (i.e., use versus non-use). These findings suggest the importance of task motivation and corroborate the findings of prior research in the context of objective (i.e., computer recorded) rather than subjective (self-reported) DSS use. A contribution of Chan's (2009) study is use of a rich measure of DSS use based on Burton-Jones and Straub's (2006) definition of DSS use as an activity that includes a user, a DSS, and a task.

Chan et al. (2009) extends the motivational framework by investigating the alternative paths among the constructs proposed in the framework. Specifically, the authors test the direct

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effects of feedback (a DSS characteristic) and reward (a decision environment factor), and examine these effects on decision performance. The results indicate that individuals using a DSS with the feedback characteristic perform better than those using a DSS without the feedback characteristic. The findings also show that individuals receiving positive feedback, regardless of the nature (i.e., informational or controlling) of its administration perform better than the no-feedback group. These results provide some evidence supporting the call by Johnson et al. (2004) for designers to incorporate positive feedback in their design of DSS. Positive feedback is posited to lead to favorable user perception of a DSS which in turn leads to improved decision performance. The findings also suggest that task-contingent reward undermine decision performance compared to the no reward condition, and performance-contingent reward enhance decision performance relative to the task-contingent reward group. The study by Chan et al. (2009) demonstrates the need for designers to be cognizant of the types of feedback and reward structures that exist in a DSS environment and their impact on decision performance.
The next section presents Chan's (2005) motivational framework. Sections 3 and 4 discuss the studies by Chan (2009) and Chan et al. (2009) respectively. The concluding section proposes potential research opportunities for enhancing understanding of DSS use and decision performance.

2. Motivational framework

The motivational framework (Chan, 2005) provides a foundation for facilitating understanding of DSS use and decision performance. A stream of research is presented based on a review of the literature on motivation, information processing, systems, and decision performance. The framework illustrates the factors that affect task motivation, and the DSS characteristics that influence user perception of a DSS which in turn impacts motivation to use the DSS. Task motivation and motivation to use the DSS are posited to influence DSS use. The framework also depicts a link between DSS use and decision performance. Figure 1 shows the adapted motivational framework developed by Chan (2005). The constructs in the framework are discussed below.

2.1 DSS characteristics

The characteristics of a DSS include ease of use (Davis, 1989), presentation format (Amer, 1991; Hard & Vanecek, 1991; Umanath et al., 1990), system restrictiveness (Silver, 1990), decisional guidance (Silver, 1990), feedback (Eining & Dorr, 1991; Gibson, 1994; Stone, 1995), and interaction support (Butler, 1985; Eining et al., 1997).

2.1.1 Ease of use

DSS use is expected to occur if users perceive a DSS to be easy to use and that using it enhances their performance and productivity (Igbaria et al., 1997). Less cognitive effort is needed to use a DSS that is easy to use, operate, or interact with. The extent of ease of use of a DSS is dependent on features in the DSS that support the dimensions of speed, memory, effort, and comfort (Thomas, 1996). A DSS is easy to use if it reduces user performance time (i.e., the DSS is efficient), decreases memory load with the nature of assistance provided (memory), reduces mental effort with simple operations (effort), and promotes user comfort (comfort). An objective of developers is to reduce the effort that users need to expend on a

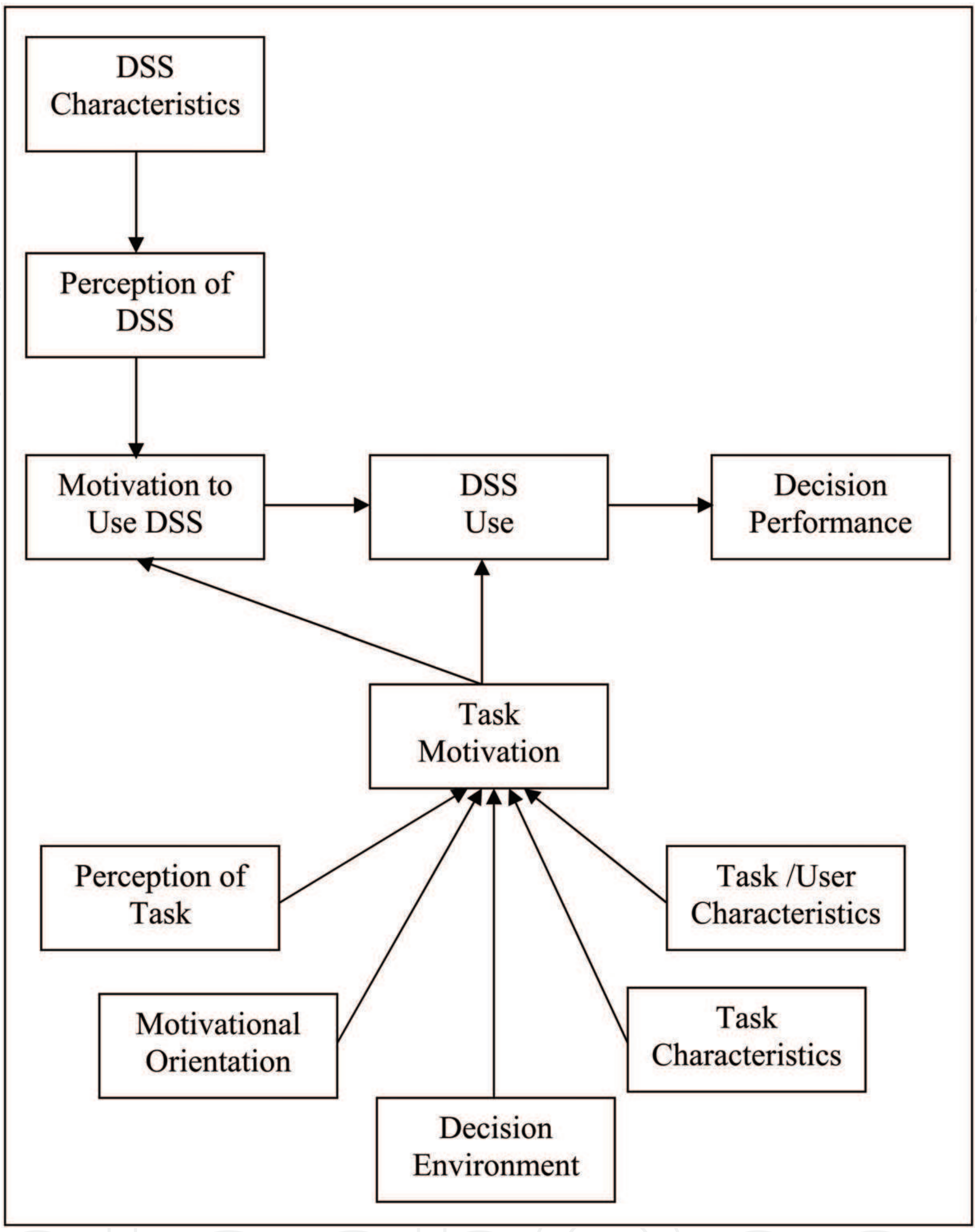

Fig. 1. A Motivational Framework for Understanding DSS Use and Decision Performance (Adapted from Chan (2005))

task by incorporating the ease of use characteristic into a DSS so that more effort can be allocated to other activities to improve decision performance. DSS use may decline if increased cognitive effort is needed to use a DSS because of lack of ease of use.

2.1.2 Presentation format

Presentation of a problem can be modified based on the assumption that information is correctly processed when it is presented in a form that evokes appropriate mental procedures (Roy & Lerch, 1996). The prospect theory (Kahneman & Tversky, 1979) suggests that presentation (framing) of alternatives can affect the riskiness of decision outcomes. This theory suggests that the way information is presented may influence a user's judgment or decision. In addition, the cognitive fit theory (Vessey, 1991; Vessey & Galletta, 1991) indicates that the level of complexity in a given task is reduced effectively when the problem-solving tools or techniques support the methods or processes required for doing the task. Thus, problem solving with cognitive fit results in effectiveness and efficiency gains.

2.1.3 System restrictiveness and decisional guidance

Two DSS attributes, system restrictiveness and decisional guidance, have been examined to show what users can and will do with a DSS (Silver, 1990). System restrictiveness refers to the degree to which a DSS limits the options available to the users, and decisional guidance refers to a DSS assisting the users to select and use its features during the decision-making process. If a decision-making process encompasses the execution of a sequence of information processing activities to reach a decision, then both the structure and execution of the process can be restricted by a DSS. The structure of the process can be restricted in two ways: limit the set of information processing activities by providing only a particular subset of all possible capabilities, and restrict the order of activities by imposing constraints on the sequence in which the permitted information processing activities can be carried out. User involvement is often essential during the execution of information processing activities after the structure of the process has been determined. The structure in the decision-making process is also promoted with the use of a restrictive DSS; in this respect, users are not overwhelmed with choices among many competing DSS. In certain cases, additional structure may actually enhance DSS use when ease of use is facilitated. However, lesser system restrictiveness may be preferred to enhance learning and creativity. Users may not use a DSS that is too restrictive because they may consider DSS use to be discretionary (Silver, 1988).

2.1.4 Feedback

Several researchers have undertaken exploration of the impact of various types of message presentation on users' behavior (Fogg & Nass, 1997; Johnson et al., 2004; Johnson et al., 2006; Tzeng, 2004). Fogg and Nass (1997) focus on the use of "sincere" praise, "flattery" (i.e., insincere praise) and generic feedback, and report that the sincere and flattery forms are perceived to be more positive. The authors suggest that incorporating positive feedback into training and tutorial software increases user enjoyment, task persistence, and self-efficacy. The positive feelings provided by the positive feedback engage the users and lead to greater success in system use (Fogg & Nass, 1997).

Tzeng (2004) uses a similar type of strategy to alleviate the negative reactions to system use arising from debilitated use of the system. The feedback from the system is examined in the context of "apologetic" versus "non-apologetic" presentation. As anticipated, the apologetic feedback provided by the system creates a favorable experience for the users (Tzeng, 2004). The results add to the body of research suggesting that system interface designers should be conscious of the need to create favorable user perception of systems to increase positive user experience to obtain increased system use and enhanced decision performance.

2.1.5 Interaction support

Interaction support is present when users are allowed a certain level of interactivity with a DSS. The design of a DSS has a determining effect on the degree of interaction between a user and a DSS (Silver, 1990). Individuals may perceive control over a DSS when some level of interaction support is provided by the DSS. Perceived control over the use of a DSS may have positive effects on motivation to use the DSS. Indeed, motivation is enhanced by the provision of information choice (Becker, 1997). Individuals using a DSS that allows user input (choice) in determining the DSS contents are more motivated than those using a DSS that does not allow this input (Roth et al., 1987). The effectiveness and acceptance of a DSS increase when users are provided with some control over the DSS (Roth et al., 1987). In a study where DSS with different levels of interaction support are designed, expert system users are reported to be in more frequent agreement with the DSS than the statistical model and checklist users (Eining et al., 1997). Specifically, individuals using a DSS with increased interaction support place more reliance on the DSS than those using the DSS with limited interaction support. Hence, the interaction support provided by the DSS has a positive impact on DSS use (Brown & Eining, 1996).

2.2 User perception of a DSS

User perception of a DSS (i.e., effectiveness, efficiency, and effort) is one of the two significant constructs that affects motivation to use a DSS. The relationship between user perception of a DSS and motivation to use the DSS is expected to be positive. That is, motivation to use a DSS is expected to increase when the DSS is perceived to be more effective or efficient, or less effortful to use.

2.2.1 Effectiveness

Prior research (e.g., Amer 1991; Eining & Dorr, 1991; Hard & Vanecek, 1991) has measured effectiveness in the context of DSS use. However, limited research has examined how the characteristics of a DSS influence DSS use. Factors, including the importance of a decision, may cause individuals to place more emphasis on effectiveness (Payne et al., 1993). Users may also place more weight on effectiveness and exert more effort to attain their goals when they realize the benefits of improved decisions; consequently, user considerations of decision performance lead to increased DSS use (Chenoweth et al., 2003). As individuals increase their focus on decision performance, DSS effectiveness becomes a positive factor affecting DSS use.

2.2.2 Efficiency

A DSS is efficient if it assists users in their decision-making in a timely manner. Rapid advances in computing technology, especially processing speed, result in less user tolerance for any delay in Internet applications (Piramuthu, 2003). Slow speed and time delays debilitate ease of use and have a negative impact on system use (Lederer et al., 2000; Lightner et al., 1996; Pitkow & Kehoe, 1996). Previous research has shown that system response time has an impact on the extent of system use. For example, download speed has been identified as one of the technology attributes that significantly influences intention to shop and actual purchase behavior in online consumer behavior research (Limayem et al., 2000). Download speed is also one of the key factors underlying user perception about the quality of a system (Saeed et al., 2003). Users may become anxious and less satisfied with a website or DSS when they experience delay in their processing requests (Tarafdar & Zhang, 2005). A delay that exceeds 10 seconds can cause users to lose concentration on the contents of a website (Nielsen, 2000). Novak et al. (2000) develop a speed of interaction scale and find that higher interaction speed has a positive impact on users' experience in system use.

2.2.3 Effort

Individuals experience a certain degree of effort in doing a task (Eisenberger & Cameron, 1996) and they tend to minimize effort when they engage in the task (Todd & Benbasat, 1992). The extent of effort-sensitive cognitive processes required by a specific activity must be taken into consideration when establishing a relationship between increases in effort and changes in performance. The decision strategies that individuals employ to process information vary in terms of the amount of effort involved in using these strategies. For example, the additive compensatory strategy is considered to be an effortful decision strategy (Payne et al., 1993) because individuals are required to examine all the attributes for two alternatives at a given time. In contrast, the elimination-by-aspects strategy is viewed to be a less effortful decision strategy (Payne et al., 1993) because the size of the alternative set is reduced each time an attribute is selected. The reduced alternative set decreases the amount of information processing.

Previous research demonstrates that DSS use increases when a DSS decreases the effort required for implementing an effortful strategy (Todd & Benbasat, 1992), and when use of the DSS leads to increased decision quality or accuracy (Todd & Benbasat, 1996). Todd and Benbasat (1994) extend and complement previous studies on the role of effort and accuracy in choice tasks by examining the role of DSS in reducing cognitive effort and, therefore, influencing strategy selection. They stress the importance of understanding the role of cognitive effort because it provides valuable insight into how a DSS influences the selection of problem-solving strategies by changing the effort relationships among the component processes that make up these strategies. Specific features can be incorporated into a DSS to change the relative effort required to implement different choice strategies; this can in turn affect strategy selection by a decision maker. Therefore, choice processes can be engineered to influence users to adopt strategies that maximize their value or utility (Todd & Benbasat, 1994).

2.3 Task motivation

Task (intrinsic) motivation is an important psychological construct in the motivational framework. Task motivation arises from one’s propensity to engage in activities of interest and the resultant promotion in learning and development and expansion of the individual’s capacities (Ryan & Deci, 2000). Task motivation entails “positively valued experiences that individuals derive directly from a task” and conditions specific to the task that produce motivation and satisfaction (Thomas & Velthouse, 1990, p. 668). People are motivated to perform a task when they engage in an activity simply for the satisfaction inherent in the behavior. This satisfaction can arise from positive feelings of being effective (White, 1959) or being the origin of behavior (deCharms, 1968). Task motivation is critical for high quality performance (Utman, 1997). The literature on the impact of task characteristics on work performance (e.g., Aldag & Brief, 1979; Hackman & Oldham, 1980; Lawler, 1973; Thomas & Velthouse, 1990) indicates a need for identifying factors that affect task motivation.

Task motivation (Amabile, 1983, 1988) is influenced by the following five factors: user perception of a task, users’ motivational orientation, decision environment, task characteristics, and task/user characteristics (ability, knowledge, and experience).

2.3.1 Perception of task

The four components of the Perception of Task Value scale (Eccles et al., 1983) are interest, importance, utility, and cost. The motivation theory suggests that task motivation is high when a task is perceived to be high in interest, importance or utility, or the cost of engaging in the task is low, and vice versa.

Individuals experience interest when their needs and desires are integrated with the activity. From this perspective, interest is the driving mechanism for all actions, including cognitive activity (Piaget, 1981). A person is said to be experientially interested when a certain quality of attention and sense of delight is present. Interest leads to the performance of intrinsically motivated behaviors (Deci, 1998). In this respect, interest and intrinsic motivation are considered to be synonymous (Tobias, 1994). Consistent with the definition offered by Sansone and Smith (2000), this chapter defines task (intrinsic) motivation as a person's experience of interest in an activity.

The importance component pertains to the importance of performing well in an activity (Eccles et al., 1983). Importance is also related to the relevance of engaging in an activity to either confirm or disconfirm salient features of a person's actual or ideal self-schema (Wigfield & Eccles, 1992). A task is deemed to be high in importance if it allows individuals to confirm salient attributes of their self-schemata (e.g., competence in the domains of sports or arts) (Wigfield & Eccles, 1992). When users perceive a task to be personally important, they become motivated by the task, leading to increased task motivation.

The utility component refers to the importance of a task for the pursuance of a variety of long-term or short-term goals without any regard for a person's interest in the task (Wigfield & Eccles, 1992). The utility factor relates to a person's extrinsic reasons for engaging in an activity; that is, a person may engage in a task not for its own sake but to obtain desired goals (Wigfield & Eccles, 1992). Utility can also be viewed as perceived usefulness of the task for goal attainment (e.g., individuals' belief about how the task can assist them to attain specific goals such as career prospects or outperforming others) (Pintrich & Schrauben, 1992).

The cost of engaging in a task is affected by the (1) amount of effort necessary for succeeding, (2) opportunity cost of engaging in the activity, and (2) anticipated emotional states such as performance anxiety, fear of failure, or fear of the negative consequences of success (Wigfield & Eccles, 1992). A negative relationship is proposed to exist between the value of a task and the cost/benefit ratio in terms of the amount of effort required for doing well in the task (Eccles et al., 1983). The opportunity cost of a task refers to the time lost for engaging in other valued alternatives (Eccles et al., 1983). Further, a person may experience anxiety, fear of failure, or fear of the negative consequences of success in the course of a task engagement (Eccles, 1987).

2.3.2 Motivational orientation

Individuals may be intrinsically motivated (i.e., perform a task for the sake of interest), extrinsically motivated (i.e., complete a task for the sake of extrinsic incentives) or have no motivation for doing a task (Amabile, 1988). Individuals have a desire to perform well either for internal (e.g., interest or enjoyment) or external (e.g., to impress others or to attain goals) reasons. A person's baseline attitude toward an activity can be considered as a trait (Amabile, 1983). Researchers (deCharms, 1968; Deci & Ryan, 1985; Harter, 1981) have treated the intrinsic-extrinsic motivational orientation as a stable individual difference variable. This means that an individual can walk into a situation with a specific motivational orientation. The type of motivational orientation (i.e., intrinsic, extrinsic, or both) determines a person's initial task motivation. Motivational orientation has an impact on the final and type of motivation in a specific task. The Work Preference Inventory (WPI) has been developed to assess the intrinsic and extrinsic motivation of individuals (Amabile et al., 1994). This scale directly assesses the intrinsic and extrinsic motivation of individuals, assumes the coexistence of intrinsic and extrinsic motivation, and incorporates a wide range of cognitions and emotions proposed to be part of intrinsic and extrinsic motivation. Chan's (2005) motivational framework suggests examination of the impact of motivational orientation (a trait variable) on task motivation (a state variable).

2.3.3 Decision environment

The decision-making process is frequently influenced by factors in the environment. These factors have an impact on the behaviors of decision makers. Factors in the decision environment (i.e., reward, justification, accountability, and time constraint) have an effect on task motivation. Task motivation is expected to be high when individuals are (a) provided with rewards that do not undermine their interest in a task (b) required to justify their performance in the task, (c) held accountable for the outcome of their decision performance, or (d) required to complete the task in a specific time frame. Task motivation is predicted to be low when the above decision environmental factors are absent.

(a) Rewards

Factors affecting motivation, and thus effort and performance, are difficult to consider without also considering the reward structures that are in place for effort and performance. While rewards are primarily viewed as necessary to provide extrinsic motivation, a meta-analysis of 128 well-controlled experiments examining the relationship between rewards and intrinsic motivation reveals significant and consistent negative impact of rewards on intrinsic motivation for interesting activities (Deci et al., 1999). This effect may be due to reward-oriented individuals being more directed toward goal-relevant stimuli, and the rewards actually divert such individuals' attention away from the task and environmental stimuli that might promote more creative performance (Amabile, 1983). Indeed, rewarded individuals "work harder and produce more activity, but the activity is of a lower quality, contains more errors, and is more stereotyped and less creative than the work of comparable non-rewarded subjects working on the same problems" (Condry, 1977, p. 471-472). On the other hand, there are many positive effects on performance derived generally from the introduction of rewards. Rewards can be used to motivate individuals to spend more time on a task (Awasthi & Pratt, 1990) and influence their focus on the task (Klein et al., 1997).

(b) Justification

The impact of justification and accountability on the decision makers' behaviors has been studied extensively in the judgment and decision making literature (e.g., Cuccia et al., 1995; Hackenbrack & Nelson, 1996; Johnson & Kaplan, 1991; Lord, 1992). Existing studies have used justification and accountability interchangeably. One explanation for the lack of distinction between these two constructs is the expectation of similar effects of justification and accountability on behaviors. Justification is defined as the need to justify one's decisions (Arnold, 1997); this definition is very similar to the definition of accountability offered by Kennedy (1993). Thus, the distinction between justification and accountability is unclear (Johnson & Kaplan, 1991).

Decision makers are constantly faced with the need to justify their decisions or to account to their sources for their decisions. Justification refers to the process that individuals experience to provide support or reasons for their behavior. Since individuals only need to provide justification for their behavior, they are not held responsible for the outcome as long as they are able to provide reasonable justification for their behavior. In contrast, when individuals are held accountable for their behavior, they are responsible for the outcome; that is, they will either be rewarded for a positive outcome or punished for a negative outcome. In this respect, two definitions of justification offered in the literature can promote understanding of the distinction between justification and accountability; that is, justification is "the act of providing evidence to support one's judgments or decisions" (Peecher, 1996, p. 126), or "the actual physical and/or mental process of explaining a judgment" (Johnson & Kaplan, 1991, p. 98).

(c) Accountability

Accountability is a "pre-existing expectation that an individual may be called on to justify his/her judgments to a significant other" (Johnson & Kaplan, 1991, p. 98). This implies that an important element of accountability is a person's responsibility for an outcome. In most business contexts, individuals are frequently expected to account for their decisions both to themselves and to others (Arnold, 1997). Some research evidence suggests that accountability can have an effect on decisions (Arnold, 1997). For example, MBA students show significant recency effect (i.e., they place more weight on evidence received later in a sequence) while this behavior is not observed with the auditor participants; however, the recency effect is absent when accountability is imposed on the MBA students (Kennedy, 1993).

(d) Time constraint

Time has frequently been used as a surrogate measure for cognitive effort or decision performance (Brown & Eining, 1996). For example, individuals in the highest time constraint condition exhibit more consistent performance than other groups when information load and presentation format in the context of a simple audit task are examined (Davis, 1994). The more consistent results obtained in this study can be attributed to the use of relatively simple strategies by the participants to reduce the effects of time constraint in the decision environment (Brown & Eining, 1996). Time constraint has also been reported to exert a negative impact on a judgment task relative to a choice task (Smith et al., 1997). Research can promote understanding of the effect of time constraint on task motivation.

2.3.4 Task characteristics

Task motivation is affected by characteristics of a task such as complexity, difficulty, structure, ambiguity, and novelty. Task motivation is expected to be high when a task is less complex, difficult, or ambiguous or has more structure or novelty, and vice versa.

(a) Complexity

Task complexity can occur at the stages of input, processing, or output and may relate to either the amount or clarity of information (Bonner, 1994). At the input stage, the amount of information can vary in terms of the number of alternatives, the number of attributes on which each alternative is compared, and attribute redundancy. Clarity of input may be reduced by relevant cues that are not specified or measured well, inconsistency between presented and stored cues, and presentation format. Processing can be complex when the amount of input increases, the number of procedures increases, procedures are not well specified, and the procedures are dependent on one another. Internally inconsistent cues or low or negative cue validities in nonlinear functions may reduce clarity and increase processing complexity. Complexity may also increase with the number of goals or solutions per alternative (i.e., the amount of output), and indefinite or unspecified goals (i.e., lack of clarity in output) created by the environment or by a person's lack of familiarity with the goals (Bonner, 1994).

(b) Difficulty
Difficulty can be defined as the amount of attentional capacity or mental processing required for doing a task (Kahneman, 1973). Task difficulty increases with increased similarity of the alternatives and this hampers a person's ability in discriminating the alternatives from one another (Stone & Kadous, 1997). A task is high in difficulty when a person perceives a tremendous amount of cognitive effort in information processing. The level of difficulty of a specific task has an effect on task motivation. Individuals are unlikely to be motivated by a task when they perceive the task to be difficult and vice versa. It is important to distinguish task complexity from task difficulty because these two constructs are not synonymous. That is, a complex task may involve an increased number of steps but it may not require increased cognitive effort to process the information (i.e., the task can be low in difficulty).
(c) Structure
Structure refers to the specification level of what is to be accomplished in a given task (Simon, 1973). A task can be classified on a continuum that indicates the degree of structure. A highly structured task requires a person to follow a predefined procedure for completing an activity. A task is highly unstructured when a predefined procedure for performing an activity is absent.
(d) Ambiguity
DSS use is reported to be influenced by task ambiguity (Brown & Jones, 1998). Although no significant difference in decision performance is found for both the DSS and non-DSS groups in relatively unambiguous decision situations, the DSS group outperforms the no-DSS group in relatively ambiguous decision contexts (Brown & Eining, 1996). Research is needed to provide insight into the impact of task ambiguity on task motivation and the resultant effect on motivation to use a DSS and DSS use.
(e) Novelty
Most conceptual definitions of creativity include the novelty characteristic (Hennessey & Amabile, 1988). Creativity is enhanced when novelty is present in a task. Individuals are most creative when they are motivated by a task and task motivation is further increased when the task entails a certain degree of novelty. Future work can facilitate understanding of the long- or short-term effects of the novelty characteristic on task motivation.

2.3.5 Task/User characteristics
Task/user characteristics refer to the users' ability, knowledge, and experience in a given task. These characteristics are discussed in the context of Libby's model. Ability relates to the users' capacity to engage in information processing activities that lead to problem solving; knowledge pertains to the information stored in memory; and experiences refer broadly to the task-related encounters that provide users with an opportunity to learn (Libby, 1992). Chan's (2005) motivational framework suggests that the users' ability, knowledge, and experience in a task have a positive effect on task motivation. That is, users with high ability are expected to be high in task motivation because their increased capacity in information processing results in effective and efficient problem solving. Users with low ability are predicted to be low in task motivation because of their limited capacity in information processing which in turn impairs their ability to solve problems. Users who are knowledgeable may possess essential information in memory that allows them to do a task effectively and efficiently; consequently, their task motivation is expected to be high. Less knowledgeable users may be low in task motivation because they do not have the necessary

information stored in memory that permits them to carry out the task effectively and efficiently. Experienced users with task-related encounters are stimulated by the opportunities to learn and this increases their task motivation. Since less experienced users tend to have fewer task-related encounters and fewer opportunities to learn, their task motivation may be low.

2.4 Motivation to use a DSS

Researchers have conducted studies to enhance understanding of why and when users may become motivated to use a DSS. Use of an expert system is found to enhance the engagement of users and increase DSS use (Eining et al., 1997). In contrast, passive DSS use leads to deficient user behavior (Glover et al., 1997). This effect can be attributed to lack of motivation to use a DSS. The Perceptions of Task Value scale (Eccles et al., 1983) can be modified to obtain the Perception of DSS scale to measure a user's motivation to use a DSS. The four components in the scale include interest, importance, utility, and cost. Although these components can be differentiated, it is not easy to distinguish their relations (Jacobs & Eccles, 2000). Motivation to use a DSS is predicted to be high when the DSS is perceived to be high in interest, importance or utility, or the opportunity cost of using the DSS is low, and vice versa.

2.5 DSS use

A review of 22 articles published in MIS Quarterly, Decision Sciences, Management Science, Journal of Management Information Systems, Information Systems Research, and Information and Management indicates that self-reported system use is measured in 11 of the 22 studies (Legris et al., 2003). The method frequently comprised two or three questions pertaining to the frequency of use and the amount of time spent using the system. Ten studies do not measure use; that is, use is either mandatory or ignored. Many studies using TAM do not measure system use directly. Instead, these studies measure the variance in self-reported use (Legris et al., 2003). It is important to recognize that self-reported use is not a precise measure of system use (Davis, 1993; Legris et al., 2003; Subramanian, 1994). Use of omnibus measures such as perceived use/nonuse, duration of use or extent of use to measure the content of an activity may not be effective if a respondent is unclear about the specific part of the usage activity actually being measured. Thus, these perception measures may not be appropriate for measuring system use when the content of the activity is absent. In contrast, rich measures incorporate the nature of the usage activity that involves the three elements of system use -- a user, a system, and use of the system to do a task (Burton-Jones & Straub, 2006).

2.6 Decision performance

In general, a DSS is used to make better decisions or to make a decision with less effort. DSS use increases when the DSS decreases the effort required for implementing an effortful strategy (Todd & Benbasat, 1992), and when use of the DSS leads to increased decision quality or accuracy (Todd & Benbasat, 1996). Individual-level decision performance measures include objective outcomes, better understanding of the decision problem, or user perception of the system's usefulness (Lilien et al., 2004). Previous research on decision support has also used decision performance as a means of comparing systems (e.g., Lilien et al., 2004; Todd & Benbasat, 1994) and comparing other facets of decision support, such as data representations (e.g., Vessey, 1991). When a DSS extends the capabilities of users, it enables them to overcome limited resources and assists them in making better decisions (Todd & Benbasat, 1999). Empirical research indicates that improved decision performance results if a DSS is a good fit for a task and supports the user through reduced effort (Todd & Benbasat, 1999).

Additionally, a meta-analysis conducted by Fried and Ferris (1987) supports the relationship between task motivation and decision performance. Task motivation has been reported to be a strong predictor of performance (Kuvaas, 2006). The impact of task motivation on performance has been supported in the context of sports (e.g., Callahan et al., 2003; Catley & Duda, 1997) and education (Lin et al., 2001; Vansteenkiste et al., 2004; Wang & Guthrie, 2004). Research on the job characteristics model (Hackman & Oldham 1976) also reports that variables with job motivating features have a positive impact on performance (Fried & Ferris, 1987).

Chan's (2005) motivational framework provides a stream of research for investigating the impact of various variables on DSS use and decision performance. It is important to recognize the existence of alternative relationships among the constructs in the framework. For example, Chan (2009) proposes and tests a model that examines how task motivation interacts with DSS effectiveness and efficiency to affect DSS use. Chan et al. (2009) also present a model that examines how feedback and rewards influence decision performance.

The next section discusses a study by Chan (2009) that tests some of the constructs in the motivational framework.

3. The effects of task motivation, and DSS effectiveness and efficiency on DSS use

Task motivation and DSS effectiveness and efficiency are constructs in the motivational framework for understanding DSS use and decision performance. Task motivation is an important variable that influences DSS use (e.g., Davis et al., 1992; Hackbarth et al., 2003; Venkatesh, 2000; Venkatesh & Speier, 1999). Since TAM does not model task (intrinsic) motivation explicitly, Venkatesh (1999, 2000) attempts to fill this gap by conceptualizing intrinsic motivation as computer playfulness. To augment these efforts, Chan (2009) proposes a research framework that links DSS effectiveness and efficiency with task motivation. In this framework, the effects of DSS effectiveness and efficiency are moderated by task motivation while task motivation has a direct effect on DSS use. In particular, the author examines whether task motivation affects use of a DSS to do a task and whether task motivation interacts with DSS effectiveness and efficiency to affect DSS use.

Chan (2009) conducts an experiment where the participants use a DSS to do one of two choice tasks that induces different levels of task motivation. The total number of iterations of the participants' use of the DSS and the total time taken on each choice task are captured and used as dependent variables. The results show that participants in the high task motivation condition use the DSS more (i.e., they have more iterations and spend more time on the task) than those in the low task motivation condition. Individuals performing a high motivation task also use a DSS more when it is more effective while DSS effectiveness does not affect the level of usage for individuals doing a low motivation task. In addition, the findings indicate that DSS efficiency has a significant impact on DSS use for individuals working on a high or low motivation task when DSS use is measured as the extent of use (i.e, the number of iterations or total time spent on a task). However, DSS efficiency does not have a significant impact on DSS use in the high task motivation condition when the DSS use construct is dichotomized as use or non-use rather than the extent of use. This result is consistent with the author's expectation that individuals performing a high motivation task are less concerned with the efficiency of a DSS.

In summary, DSS use increases (decreases) for individuals using a more (less) effective DSS to work on a high motivation task. As expected, DSS effectiveness is not a concern when individuals perform a low motivation task. The findings suggest that the strong negative impact of lack of task motivation undermines DSS use, regardless of the level of its effectiveness. The efficiency of a DSS is found to interact with task motivation to affect DSS use. That is, individuals completing a high motivation task exhibit higher tolerance for a DSS that is low in efficiency. In contrast, lack of task motivation exacerbates the users' low tolerance for a DSS that is low in efficiency.

An interesting design of the DSS in Chan's (2009) study is the built-in feature of an effortful but accurate decision strategy -- additive difference (AD). AD processing compares two alternatives simultaneously by comparing each attribute, finding the difference, and summing the differences. It requires some method for weighting each attribute, some transformation to put all the attributes into compensatory units, and a way to sum the weighted values of the attributes. After a series of alternative comparisons, the alternative with the greatest sum is chosen. AD processing is compensatory in that values on one attribute necessarily offset the values on another attribute. It makes more complete use of the available information and is normatively more accurate than non-compensatory strategies such as elimination-by-aspects (Tversky, 1972). Use of the more accurate and more effortful AD strategy relative to other less accurate and less effortful strategies (e.g., elimination by aspects) may be encouraged if users are provided with a DSS that reduces the cognitive effort for using the AD strategy to complete a task. The effort required for completing a task is minimal when the DSS provides high support for the AD strategy (Todd & Benbasat, 2000). In the study by Chan (2009), individuals use a DSS to select two alternatives for comparison and the DSS provides the results of how the selected alternatives differed on the attributes. Thus, the DSS in the study provides enhanced automation that reduces the effort that a user may otherwise have to expend to process information manually.

The next section describes a study by Chan et al. (2009) that examines the effects of feedback and reward on decision performance.

4. The effects of feedback and reward on decision performance

Chan et al. (2009) extend the findings of Ryan et al. (1983) on the use of informational versus controlling feedback and rewards in the context of a DSS and the interface design. While Ryan et al. examine the effects of verbal feedback on intrinsic motivation, Chan et al. focus on the impact of text-based feedback from a DSS on decision performance. The authors also explore the effect of task-contingent versus performance-contingent rewards on decision performance. The results reveal a differential effect from that of Ryan et al. (1983) when feedback is provided through a DSS and the focus is on decision performance rather than the precursor condition of intrinsic motivation.

4.1 Informational feedback versus controlling feedback

Chan et al. (2009) use cognitive evaluation theory to examine feedback as a DSS characteristic. Cognitive evaluation theory suggests that events can be categorized as either informational or controlling. Informational feedback occurs when individuals receive information about their competency at a task in a self-determined performance context. When controlling feedback is administered, individuals experience pressure toward the achievement of specific outcomes such as attaining a specified level of performance (Ryan et al., 1983). Informational feedback facilitates an autonomy-supportive context that promotes autonomy, making individuals more inwardly focused and thus increasing task (intrinsic) motivation (Deci & Ryan, 1987). Controlling feedback debilitates autonomy, creativity (Amabile, 1983) and cognitive flexibility (McGraw & McCullers, 1979), leading individuals to perform in a specific manner in which they believe they "should" (Deci & Ryan, 1987). While individuals are more intrinsically motivated when they expect an informational rather than a controlling evaluation (Shalley & Perry-Smith, 2001), task (intrinsic) motivation is undermined by controlling feedback (Rigby et al., 1992). Previous studies (e.g. Ryan, 1982; Ryan et al., 1983) examine feedback in an informational or controlling manner and report that individuals exhibit higher task motivation in the informational feedback than controlling feedback condition.

While getting a user to accept and use a DSS is critical and the nature of the supportiveness of the feedback is important, some form of positive feedback assists individuals in performance improvement. In a DSS environment, the focus is on providing useful feedback for improving decision performance. Greater task motivation generated by informational feedback as opposed to controlling feedback leads to enhanced decision performance (Chan et.al, 2009). Individuals' level of interest in an activity increases when they receive feedback on their competence in the activity; consequently, they exert more effort to improve performance (Harackiewicz & Sansone, 2000).

4.2 Task-contingent versus performance-contingent reward

Cognitive evaluation theory also provides insight into the effect of rewards on individuals' behavior. In essence, rewards can be viewed as one type of feedback mechanism and classified as task noncontingent, task-contingent or performance-contingent rewards (Ryan et al., 1983).

Task noncontingent rewards occur when individuals receive rewards for doing a task, without requirement of engagement in the task (Deci et al., 1999). For example, providing a gift for participation without regard for how the participants perform during the experiment is a task noncontingent reward (Deci, 1972). Task noncontingent rewards are unlikely to affect task motivation because individuals are not required to perform well in the task, complete the task, or even engage in the task (Deci et al., 1999). Three meta-analyses performed by Deci et al. (1999), Tang and Hall (1995), and Cameron and Pierce (1994) do not suggest any significant impact of task noncontingent rewards on task motivation.

Task-contingent rewards require individuals to actually perform a task and can be classified as completion-contingent or engagement-contingent rewards (Deci et al., 1999). Completion-contingent rewards are provided only upon explicit completion of the target activity. For example, individuals work on four variations of a three-dimensional puzzle and receive $1 for each puzzle completed in the required time (Deci, 1971). Engagement-contingent rewards are offered simply for engagement in the task, without consideration of completion of the task. For instance, participants receive a reward for engaging in a series of hidden-figures puzzles (Ryan et al., 1983). These individuals are not aware of their performance in the task or the extent of their completion of the activity because they do not know the number of hidden figures in each drawing (Deci et al., 1999). Both completion-contingent and engagement-contingent rewards have about the same level of undermining effect (i.e. negative effect) on free-choice behavior and self-reported interest (Deci et al., 1999).

Performance-contingent rewards are administered for superior performance in an activity. Such rewards are either a direct function of actual performance success (e.g. an 80% accuracy rate on a task that leads to 80% of the maximum possible reward) or achievement of a specific standard (e.g., perform better than 80% of the other participants or achieve at least an 80% accuracy rate on a task). Performance-contingent rewards can have a facilitating or debilitating effect on task motivation, depending on the saliency of the informational or controlling aspect of the reward (Ryan et al., 1983). In particular, informational (controlling) administration of performance-contingent rewards leads to increased (decreased) task motivation (Harackiewicz, 1979; Ryan et al., 1983). Task motivation is maintained or increased if the performance-contingent reward is perceived to provide competence information; in contrast, task motivation is impaired if the reward is used to control how well a person does in a task (Ryan & Deci, 2000). The context in which performance-contingent rewards are administered can convey either competency or pressure to do well in an activity (Ryan et al., 1983).

Individuals using a DSS based on different reward structures are expected to exhibit different performance effects. Relative to the no reward condition, task-contingent rewards may be perceived as overjustification which undermines task motivation (e.g., Deci, 1972; Lepper et al., 1973; Ryan & Deci, 1996; Sansone & Harackiewicz, 1998). This undermining effect occurs when individuals are rewarded for doing an interesting task. The response to the reward is generally for individuals to exhibit less interest in, and willingness to, work on a task (Deci & Ryan, 1987). Performance-contingent rewards have also been shown to debilitate task motivation and decision performance (e.g., Boggiano & Ruble, 1979; Daniel & Esser, 1980; Ryan et al., 1983). Additionally, performance-contingent rewards can be more controlling, demanding, and constraining than task-contingent rewards because a specific standard of performance is expected. This leads to greater pressure and subsequent larger decrements in task motivation than in conditions where task-contingent rewards are administered (Harackiewicz & Sansone, 2000). In contrast, performance-contingent rewards may lead to better performance when individuals are motivated to work harder and put in more effort than they otherwise would (Harackiewicz & Sansone, 2000); therefore, performance-contingent rewards may be effective for improving decision performance (Lepper, 1981).

4.3 Interactive effect of feedback and reward on decision performance

It is imperative for researchers to consider the combined effects of feedback and reward on individuals' behavior (Ryan et al., 1983). Reward structures have informational and controlling attributes perceived by the individuals subject to the reward, and these informational and controlling attributes commingle with the informational and controlling nature of the feedback characteristic of a DSS. Perception of reward structures can be significantly influenced by the nature of feedback, with informational (controlling) feedback highlighting the informational (controlling) aspect of a reward structure.

Reward is an example of a controlling event that in itself may work against the positive effect of the information contained in the performance-contingent reward (Ryan & Deci, 2000). Although task motivation may be undermined by the prospect of reward during task performance, this effect may be offset by enhanced performance motivated by the expectation of reward (Deci & Ryan, 1985). Decision performance may not be undermined in the presence of informational feedback and performance-contingent rewards because cue values (Harackiewicz et al., 1984) may highlight the informational aspect of performance-contingent rewards and offset their controlling aspect. This sheds light on Chan et al.'s (2009) findings on insignificant decision performance effects for individuals provided with either an informational or controlling feedback when performance-contingent reward is administered. Consistent with Ryan et al.'s (1983) findings for their intrinsic motivation variable, Chan et al. (2009) report that the informational feedback/performance-contingent reward group marginally outperforms the no-feedback/task-contingent reward group. However, contrary to Ryan et al.'s (1983) finding of no significant difference for their intrinsic motivation measure, Chan et al. (2009) demonstrate that the controlling feedback/performance-contingent reward group performs better than the no-feedback/task-contingent reward group. This alternative finding is not surprising considering the combined effects of the participants' positive response to the controlling feedback in a DSS environment and the positive effect theorized for performance-contingent rewards on decision performance (as opposed to the negative effect on intrinsic motivation in Ryan et al.'s study).

5. Conclusion

Chan's (2005) motivational framework provides a foundation for facilitating understanding of DSS use and decision performance. Instead of relying on the assumption that DSS use necessarily results in improved decision performance, the motivational framework proposes a link between DSS use and decision performance. Chan (2005) also identifies the significant role of the motivation factor in explaining DSS use and decision performance. The author proposes examination of motivation as two separate components; namely, task motivation and motivation to use a DSS. Separation of these two effects assists researchers in identifying the underlying reasons for lack of DSS use.

Additionally, the motivational framework developed by Chan (2005) presents abundant future research possibilities. Future work can examine factors that affect task motivation, a key construct in the motivational framework. Task-related factors such as interest, utility, importance or the opportunity cost of engaging in a task can be manipulated to obtain a measure of self-reported task motivation to provide additional insight into future research findings. It might be interesting to investigate factors (e.g., the users' motivational orientation, decision environmental factors and task characteristics) that influence task motivation.

The motivation theory may provide insight into the findings by Todd and Benbasat (1992) on why users do not translate the effort savings from use of a DSS to perform a task into increased information processing. An examination of task motivation also helps us consider ways for increasing DSS use. DSS use is posited to occur when the benefits (i.e., effectiveness and efficiency) outweigh the costs (i.e., cognitive effort) associated with usage (Todd & Benbasat, 1996). For example, features can be incorporated into a DSS to reduce the cognitive effort involved in the use of a strategy (Todd & Benbasat, 1994a, 1994b) and to encourage DSS use (Todd & Benbasat, 1996).

A rich measure of DSS use consistent with Burton-Jones and Straub's (2006) definition of a DSS (that includes a user, a DSS, and use of the DSS to complete a task) is a more relevant construct than behavioral intention (Chan, 2009). Caution should be exercised to avoid the misleading assumption that behavior would follow intention (Limayem et al., 2000). For example, one might intend to lose 20 pounds; however, the individual might not engage in actual behavior (i.e., exercise or cut down on calories) to lose the intended weight. TAM posits that behavioral intention leads to system use (Davis et al., 1989); however, prior research findings on the relationship between intention to use systems and system use are mixed. Lack of a strong correlation between self-reported and objective usage data (Szajna, 1996) and the low correlation between intention and system use (Kim & Malhotra, 2005) present a challenge to the use of intention as a proxy for system use. Further, many TAM studies have used the intention (i.e., self-reported) measure as a proxy for system use although the focus of these studies is on system use (Kim & Malhotra, 2005). Since most TAM studies measure the variance in self-reported use, future research should measure system use rather than usage intention (Davis, 1993; Legris et al., 2003; Lucas & Spitler, 1999; Subramanian, 1994).

Further, empirical evidence in the behavioral decision-making literature suggests that decision makers make tradeoff between accuracy and effort in their formulation and subsequent use of DSS (Bettman et al., 1990; Creyer et al., 1990; Jarvenpaa, 1989; Johnson & Payne, 1985; Johnson et al., 1988; Payne, 1982; Payne et al., 1988, 1993; Stone & Schkade, 1991). Although accurate decision strategies such as additive difference (AD) can lead to improved decision performance, the effort required for using these strategies may discourage use of such strategies. Use of the more accurate AD strategy is expected to increase when the effort required for using the strategy is reduced; that is, when a DSS provides high support for the strategy (Todd & Benbasat, 2000).

Insights can also be gained from future work on whether user perception of a DSS might affect motivation to use a DSS, and whether task motivation interacts with DSS characteristics (e.g., ease of use, presentation format, system restrictiveness, decisional guidance, feedback or interaction support) to affect DSS use. Research can assist system developers in understanding the types of characteristics that can be incorporated into a DSS to create favorable user perception of the DSS to increase motivation to use the DSS, DSS use, and decision performance.

Finally, alternative paths among the constructs are implicit in the motivational framework developed by Chan (2005). Chan (2009) conducts a study to examine how task motivation interacts with DSS effectiveness and efficiency to affect DSS use. Chan et al. (2009) also examine the effects of feedback (a characteristic of a DSS) and reward (a characteristic of the decision environment) on decision performance. These studies demonstrate the existence of alternative paths in the motivational framework. Future work can explore other possible alternative models from the framework.

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