

## **The Perception of Difficulty in Project-Work Planning and its Impact on Resource Sharing**

### **1. Introduction**

As global competition and technology have continued to accelerate the pace of change in business, researchers and practitioners alike have noted that the nature of work across all industries has become increasingly project-oriented and less routinized (Leybourne 2007; Wang and Salunga, 2008). This shift derives principally from organizational challenges that must be confronted idiosyncratically in resource-constrained environments. In fact, businesses are increasingly challenged by not simply isolated projects, but rather multiple interrelated projects simultaneously orchestrated by numerous project managers (PMs) (Leybourne, 2007; Thiry and Deguire, 2007).

Flatter organizational structures have emerged concurrently with such challenges, as has the increasing need to facilitate the flow of resources throughout firms. At the same time, the nature of projects and their management has become more variable, requiring the need to continuously adjust to a variety of emerging and not easily anticipated resource constraints (Thiry and Deguire 2007). For example, project managers are tasked with the assignment of workers to projects. In this area PMs must establish an appropriate sequence and configuration of work so as to balance a host of constraints including employee skills and abilities, transfer costs between employees, and multiple projects requiring the same workers (Yang and Sum, 1993; Icmeli and Erenguc, 1996; Smith-Daniels, et al. 1996; Kolisch, 1996; Ozdamar and Ulusoy, 1996). In these variable settings it has become increasingly evident that PMs must be able to adapt not only to their own evolving project needs but also those of the concurrent projects that they themselves do not personally manage. To date, however, there has been limited research as to the effects that such requirements have on project manager behavior and the performance implications of such behavior for organizations (Bendoly and Swink, 2007).

In multi-project contexts, it is likely that the degree of difficulty individual PMs associate with their work has an impact on their willingness to conduct themselves in ways that may benefit the organization, and yet this difficulty may represent an additional burden with regards to managing their own projects. This is a common description of the concept of resource sharing among project managers (Payne and Turner, 1998). Although a willingness to consider resource-sharing activities in multi-project contexts is often assumed to provide positive organizational consequences, the psychological ownership framework (i.e., Pierce et al., 2003) we develop suggests that perceptions of the difficulty PMs associate with their work may negatively impact this dynamic. In this study, we extend research in the area of psychological ownership in developing our arguments that, when project-work planning activities are increasingly difficult, PMs become attached to their resource solutions and may be unwilling to alter them to coincide with the demands of interrelated projects (to the detriment of organizational goals). Specifically the resource ‘solutions’ we focus on here pertain to worker assignments to specific jobs within projects.

It is worth re-emphasizing the practical relevance of the challenging work-planning context associated with managing projects. Managers capable of deploying flexible approaches toward resource allocation, and who are willing to adapt their work plans, are critical in this context (Tatikonda and Rosenthal, 2000; Tukul and Rom, 1998). While it is obvious that, in certain scenarios, “sharing” may be more mandatory than voluntary, we are particularly interested in the latter since requests for voluntary sharing are thought to be encountered much more frequently in real work settings (Blindenbach-Driessen et al., 2008). We view such voluntary sharing of scarce resources in the way that Organ (1997) describes organizational citizenship behavior (OCB), as discretionary “contributions to the maintenance and enhancement of the social and psychological context that supports task performance” (Organ, 1997, p. 91).

Numerous conceptions of OCB have been developed in the literature (e.g., Podsakoff et al.,

2000). The idea of sharing scarce resources (e.g., workers assigned to jobs) with coworkers in need is central to these conceptualizations (e.g., Bergeron, 2007). This kind of sharing is therefore separated from mandates of organization-wide performance that might otherwise confound decisions to share resources. The use of a controlled laboratory design has the potential for minimizing the risk and impact of such confounds in this context. It can do so by ostensibly eliminating the influence of organizational mandate, and ensuring that multiple project-work plans of equal merit can be developed regardless of the sharing of any individual resource. While our goal is to examine the effect of project-work planning *difficulty* on a PM's *willingness to share*, it is not our only research objective. Building on the implications of psychological ownership theory (e.g., Pierce et al., 2003), we also explore the moderating role played by PM *task self-efficacy*, which is an individual's judgment of his or her competency in successfully completing a given task (Bandura, 1977; Silver et al., 1995). We test the conceptual relationships presented in Figure 1 in a laboratory experiment in which we manipulate the difficulty of work planning (worker assignment) tasks across a series of projects, and, once an assignment of project work to these subordinates has been finalized, we then measure professional project managers' willingness to share assigned workers.

-----Insert Figure 1 about here-----

It is worth noting that the model depicted in Figure 1 is deceptive in its conceptual simplicity. There are multiple reasons why project work-planning difficulty, regardless of how it is measured, should be expected to negatively impact sharing behavior—not the least of which is the possibility that preferred solutions to more difficult tasks may be compromised with the addition of further constraints (i.e., when a resource is shared and hence becomes unavailable for certain uses). Hence another aim of our controlled experimental design is to eliminate the potential complication of such subsequent performance risk, in order to focus on a much more nuanced impact that task difficulty may have on willingness to share. Although the effect of planning difficulty has been viewed as

relevant, empirical exploration of this factor remains fairly limited (Chen and Chen 2007; Payne and Turner 1998) and no study to our knowledge has yet to investigate the relationships we are concerned with in Figure 1.

In order to focus on the dynamics associated with these specific relationships, several design precautions were taken. For example, our laboratory task was designed so that subjects were aware that identical performance levels could be obtained regardless of an incident of sharing. Further, our experiment made clear that sharing had no added impact on the work loads of the subjects involved and would not penalize others, so as not to manifest concerns over these issues that might also impact sharing tendencies. Controlling for such an issue, among other possible confounds, is critical in clearly identifying the specific theoretical phenomena of interest and thus requires a high level of model focus. Additional precautions, such as attempting to account for individual non-task specific predispositions towards sharing, are outlined in the discussion of methods presented in this work.

Overall, the present study contributes to the literature in a number of ways. First, despite calls for it (e.g., Gerwin and Moffat, 1997; Smith-Daniels, 1997), very little research has examined the potential externalities associated with managerial challenges in multi-project settings. Our controlled examination of project-work planning difficulty provides one of the few glimpses into this dynamic, behaviorally influenced, and often misunderstood context. Furthermore, in the current study we attempt to broaden our theoretical understanding of the dynamics in this context by incorporating relevant literature from organizational behavior – specifically, the literature on psychological ownership and organizational citizenship behavior. Most notably, this study provides a contribution to the emerging literature on behavioral operations management (cf. Bendoly, Croson, Goncalves, Schultz, 2009; Cantor and Macdonald, 2009; Gino and Pisano, 2008; Bendoly, Donohue and Schultz 2006; Boudreau, Hopp, McClain and Thomas, 2003; Croson and Donohue, 2002). Finally, our empirical findings help reinforce the importance of managerial task self-efficacy. The moderating

role we propose for task self-efficacy is particularly relevant in that it seems to help overcome somewhat irrational barriers to what might otherwise be critically essential resource-sharing activities.

To motivate our study, the remainder of this paper will begin with a more in-depth consideration of the relevant literature and how it helps position our hypotheses and research design. After a discussion of our laboratory methods and the general nature of the data collected, we present our analysis of the data and our formal analytical findings. We conclude with a discussion of our findings' implications for both future research and practice.

## **2. Background and Hypotheses**

Central activities of project managers include (1) the subdivision of projects into a series of steps, in which the sequence of completion and the implied possibilities for parallel work processing are both specified, and (2) the development of schedules along which work can best be processed, given resource constraints (e.g., workers, machines, time, quality parameters, etc.) (e.g., Meredith and Mantel, 2006; Gray and Larson, 2000). Factors such as re-assignment availability, cognitive switching costs, and organizational prioritizations of concurrent and resource-*competing* projects make traditional scheduling techniques somewhat outmoded (Kerzner, 2006). Such techniques assume that steps within projects are staffed by predictable automatons and occur in isolation from other organizational activities.

More contemporary scheduling techniques assume less consistency and thus require greater heterogeneity in strategies for allocating workers across projects. For example, strategies may involve (a) assigning an employee across concurrent, interdependent steps of a project, or (b) assigning a greater number of employees across several discrete project steps. Heterogeneity in problem-solving strategies represents a more difficult planning task that requires creatively changing approaches to worker allocations across projects (e.g., Bendoly and Swink, 2007). Generally

speaking, flexibility (or “relative flexibility”, e.g., Tatikonda and Rosethal, 2000) plays a central role in successful project management (Verma and Sinha, 2002; Turner, 2004), particularly when multiple, concurrent project time-lines require as-needed worker allocation strategies (Turner, 2008, pp 71-88, 279-285; Leybourne and Sadler-Smith, 2006).

The role of interdependence in multi-project settings has also received a great deal of attention in the organizational behavior (OB) literature. In the OB area, some researchers (e.g., Johnson and Johnson, 1989) distinguish task interdependence from resource interdependence, while others (Thompson, 1967) focus on the processes by which inputs are combined to create outcomes. Thompson (1967) maintains interdependence as a characteristic of work, inherent in task technologies, whereas Guzzo and Shea (1992) holds that interdependence represents an attribute of employee behavior. Relative to the current discussion, interdependence tends to increase communication (Johnson, 1973), helping, and information sharing (Crawford and Haaland, 1972). Interdependence may also increase expectations of help (Spilemann, 1971; Thomas, 1957) and norms of cooperation (Kiesler and Kiesler, 1979; Shaw, 1981), making resource-sharing more likely to be demonstrated (Krebs, 1970), expected (Lam et al., 1999), and valued (Miller and Hamblin, 1963). However, it also is important to note that inherent interdependencies may have negative effects on feelings of personal achievement in one’s own work (Manz and Angle, 1986). As argued by transactions-cost economics, incentives to withhold contributions (e.g., share) that facilitate others’ performance are heightened when work conditions are difficult (Jones, 1984; Williamson, 1975). These ideas are consistent with a great deal of laboratory research that points toward negative relationships between identifiability and social loafing (i.e., Harkins and Petty, 1982; Weldon and Gargano, 1988; Williams, et al., 1981). Thus, interdependence may have a range of consequences on scarce resource allocations. At their core, we expect project management contexts in which both explicit and implied interdependencies are present (both within and, ostensibly, between projects for

example) to be particularly salient as we attempt to observe the effects of specific task attributes on the behavior of the managers overseeing them.

### *2.1 Willingness to Share*

Because in-progress projects encounter both unforeseen opportunities and threats, successful PMs must be able to reconsider resource allocation decisions so as to leverage or compensate for these events (Richmond and Skitmore, 2006; Turner, 2004). Huchzermeier and Loch (2001) refer to such *mid-course* actions in their discussion of “improvement” options as an extension of Trigeorgis’s (1997) option-oriented framework for valuing projects. Sharing previously allocated workers represents one such mid-course action. For example, for the good of a particular project, a PM may be asked to share workers so that the project may be completed on time. Doing so would require the PM to adjust worker assignments to make workers available for sharing without jeopardizing her own project. Bendoly and Swink (2007) argue that such sharing behaviors in multi-project settings are affected both by tangible resource interdependencies as well as psychological reactions to work environments and experiences (Thompson, 1967; Pfeffer and Salancik, 1978).

While sharing may benefit other projects, as well as the organization as a whole, the direct benefits to the PM for sharing may be somewhat less clear. As noted above, such behaviors are akin to the demonstration of citizenship behaviors (Bergeron, 2007) that may benefit the organization and those provided with help (i.e., Organ, 1988), but in fact detract significantly from the performance and career trajectories of those who provide it. Sharing scarce resources is typically not required for PMs to optimize project performance, and it may have limited direct value. In fact, failing to share these resources may be the only option without direct, immediate negative consequences for the focal manager. As Bergeron (2007) argues, the consequences of allocating scarce resources may come at the expense of one’s own work. As she notes, the decision to provide these resources creates a social dilemma, in which the focal PM may benefit from not sharing, but the organization as a whole may

suffer (e.g., Orbell and Dawes, 1981). On the other hand, appropriately assigning a fixed pool of resources (e.g., workers) so that tasks can be coordinated and projects can be completed in the shortest period of time requires balancing multiple constraints. Thus, agreeing to share resources may make the job of the PM more difficult in some instances. More importantly, from our perspective, it implies the (at least partial) deconstruction a project plan that may have required a great deal of invested effort. Nevertheless, in cases where sharing benefits the organization, adapting prior assignments may have positive organizational consequences (e.g., Orbell and Dawes, 1981; Bendoly and Swink, 2007).

Thus, sharing resources in such cases may be characterized as task-focused, altruistic behavior (Settoon and Mossholder, 2002), a specific type of citizenship. This dimension includes voluntary behavior that helps coworkers resolve work-oriented problems (Podsakoff et al., 2000; Smith, Organ and Near, 1983). Rather than a general characteristic of work contributions, we propose that the willingness to share scarce workers is a specific embodiment of altruism that is consistent with Le Pine and colleague's (2002) encouragement approach to citizenship. Encouragement encompasses both personal and task-related help, assistance with work and work-related guidance, and positive advocacy. Thus, we define *willingness to share* workers as the agreement to reassign employees in response to an emergent need to incorporate these resources into a peer's scheduling arrangements. We argue below that willingness to share is directly impacted by psychological ownership (e.g., Pearce et al., 2003).

## *2.2 Psychological Ownership*

The concept of psychological ownership is rooted in the phenomenon of possession and the experience of psychological connection (Dittmar, 1992). The theory of psychological ownership (e.g., Pierce et al., 2001) holds that ownership is “the state in which individuals feel as though the target of ownership (material or immaterial in nature), or a piece of it is ‘theirs,’ (i.e., ‘It is MINE!’)”

(p. 299). According to the theory, psychological ownership satisfies task self-efficacy and self-identity needs (e.g., Bandura, 1977; Dittmar, 1992). While several concepts explain the emergence of psychological ownership, self investment plays a central role in the resource-sharing context. It is without question that many tasks faced by managers require complex thinking, intense focus, and the investment of cognitive bandwidth. These individuals feel ownership over things they create, and feelings of ownership are strengthened to the extent that energy, effort, and attention have been invested (e.g., Pierce, et al., 2003). Further, the more complex and difficult the process of creation, the more attached to the target a manager is likely to become.

Research on psychological ownership has typically focused on the organization or job as a target of ownership (e.g., Van Dyne and Pierce, 2004; Mayhew et al., 2007). For example, in the area of organizational citizenship, psychological ownership for the organization is argued to be positively related to organization-directed citizenship behaviors (O'Driscoll et al., 2006; Van Dyne and Pierce, 2004). However psychological processes associated with possession can also apply to a range of objects including intangibles such as ideas or plans (Brown et al, 2005; Pierce et al., 2001; Pratt and Dutton, 2000). Hence, we propose that psychological ownership may develop with respect to resource allocation plans. PMs faced with highly difficult tasks, such as those requiring a high degree of switching between disparate work allocation strategies in project planning settings, should be less willing to share resources because of greater feelings of ownership for the schedules they develop. The kind of creative thinking needed in these settings involves a cyclical process of experimentation, reflection, and action, (i.e., trying new ways to do things in contrast to just relying on habit or automatic routines). As PMs are tasked with developing resource allocation solutions under dynamic constraints, not only is their ability to devise creative solutions challenged, but so is their ability to adjust strategies to devise the 'good' solutions. Such variability represents a great deal of difficulty when PMs are unable to re-apply historic worker assignment strategies. Consistent with

psychological ownership theory, given the increased investments required to create plans using alternating strategies, project managers in these contexts are likely to feel stronger psychological ownership for their resource allocation solutions.

As a result of these feelings of ownership, PMs required to vary resource assignments are more likely to display territorial behaviors (e.g., Kerzner, 2006), become self-focused (e.g., Brown 2002), and potentially lose sight of broader organizational goals (Brown et al., 2005). These individuals may be more focused on protecting their *creations* than on sharing resources with coworkers (Bergeron, 2007; Brown, et al., 2005). Thus, although sharing resources may benefit the organization (e.g., Orbell and Dawes, 1981; Bendoly and Swink, 2007), psychological ownership and feelings of territoriality may lead to defection behavior (e.g., not sharing resources). Similarly, the threat-rigidity thesis provides additional support for this idea, suggesting that individuals respond to external events that may threaten their individual interests by adhering to the status quo (Staw et al., 1981). As a result, PMs tasked with more demanding planning assignments will be less likely to alter plans by sharing resources with other PMs.

An alternate possibility is that requests to share resources enhance external demands so that, in the future, individuals are more willing to respond in flexible ways (e.g., sharing resources given subsequent request to do so). As Fay and Sonnentag (2002) argue, individuals may respond proactively to external demands by taking the personal initiative to ensure that such demands are reduced in the future. PMs may anticipate requests to share resources based on prior requests. In this case, they may consider the possibility of additional requests as they develop subsequent assignment plans, potentially minimizing the impact of sharing on their plans. As a result, they may be more willing to share in this case. We expect that the potential positive effects of difficult project work-planning on sharing may offset the expected negative effects associated with psychological ownership processes. However, due to the pervasive influences of both territoriality and possession,

we expect the overall effect of project work-planning difficulty to be negative. Thus, building on the implications of psychological ownership theory in this context, coupled with evidence from the territoriality literature, we expect that project work-planning difficulty negatively impacts resource-sharing behaviors. Stated formally, we expect the following.

*Hypothesis 1: Difficulty in project-work planning has negative effects on the willingness to share resources.*

However, while we expect the main effects of such difficulty on resource sharing behavior to be negative, task self-efficacy (e.g., Bandura, 1977; Tierney and Farmer, 2002) should moderate this relationship positively. As stated in the introduction, we are particularly interested in the role of *task self-efficacy*, which reflects an individual's belief in his or her capacity to successfully conduct a particular task (Bandura, 1977; Silver et al., 1995). A long line of research articulates task self-efficacy as a cognitive approach to understanding persistence and effort (see Stajkovic and Luthans, 1998 for a review). In the present context, we view PM task self-efficacy as an individual's perceived competency regarding the project management task in question. Psychological ownership theory once again provides a useful foundation for this exploration, since the concept of psychological ownership is thought to satisfy several needs, including competency needs (Pierce et al., 2001). Individuals tend to become psychologically attached to a target, and, as a consequence, they display territorial behaviors toward the target to the extent that control over the target provides them with a greater sense of task self-efficacy. Individuals protect targets, and display territorial behaviors, as a way of conveying and protecting beliefs about their own competency (Pierce et al., 2001). To the extent that ownership of project resources fulfills these needs, PMs tend to attach greater subjective value to the target (e.g., workers or other resources), and thus they should be less willing to share them. Because competency needs are established through ownership, individuals should have greater psychological attachment to the target, and display greater territorial behaviors

(e.g., not sharing resources) when they are *less* confident in their abilities to successfully allocate resources (i.e., PM task self-efficacy). In this case, given otherwise lower levels of task self-efficacy, attachment to the target is a particularly important means of fulfilling competency needs.

Casting this in an alternative light we propose that, given high task self-efficacy (i.e., when PMs report a high degree of confidence in their competency in worker assignment tasks), individuals should be less reliant on protecting their creations to meet these same needs. Therefore, task self-efficacy should moderate the relationship between project work-planning difficulty and the willingness to share resources. Given the implications of psychological ownership theory in this context, we expect that the negative relationship between the difficulty of project work-planning and the willingness to share resources is strong under conditions of low task self-efficacy but is significantly mitigated under high task self-efficacy. Stated formally, we expect the following.

*Hypothesis 2: Task self-efficacy moderates the relationship between project work-planning difficulty and willingness to share resources, such that the relationship between these variables is negative under conditions of low task self-efficacy.*

### **3. Methodology**

We followed a multi-phased experimental approach similar to that employed by Bachrach, Bendoly, and Podsakoff (2001). Data collection for this lagged experimental study was conducted over a three-month period (Cook and Campbell, 1979). At the start of this timeline we collected data on perceptions of task self-efficacy and relevant demographic controls from participants. This was later followed at the tail end of the timeframe by the formal lab study, post-task questions and exit interviews. By collecting data for our conceptual moderator before exposing participants to the experimental manipulations, we are able to avoid the risk that the manipulations may have had an effect on the reports of task self-efficacy. Development and pilot-testing of the laboratory design,

instrument, and measurement scales was conducted four months prior to the main experimental period.

A total of 161 project managers associated with a Southeastern chapter of the Project Management Institute agreed to participate in the study. The subject-recruiting effort was facilitated through the valued assistance of local PMI chapter officers willing to serve as champions for the research effort. As recruitment incentives, subjects were offered summary reports in exchange for participation. This sample represented 43% of a total targeted participant pool stratified by industry type (e.g., construction (24%), information technology (21%), accounting (15%), etc.) and was screened based on professional project management experience in “multi-project” environments. No subjects in the sample opted to out of the experiment early. All targeted participants had a minimum of two years managerial work experience ( $x = 4.3$ ,  $sd = 1.5$ ). The average age was 39 ( $sd=8.8$ ), and 53% were male. There were no significant demographic distinctions between the participants and the remaining target population, nor was any such difference identified between this group and the overall chapter population ( $p > .05$  for all comparisons between sample age, gender, and experience as reported by either the PMI chapter constituency or at the U.S. national level). This non-significant difference held for all by-industry comparisons as well (F-stat non-significant at  $p>0.1$  level).

### *3.1 Procedural Structure*

Data collection for our full study proceeded in three phases, including a pre-task questionnaire, a controlled laboratory experiment, and a post-task questionnaire and structured exit-interview process. *Pre-task questions* were designed to elicit information on existing demographic data (e.g., work experience, gender, age, etc.) as well as information about self-reported on-the-job task self-efficacy in work-assignment tasks (our proposed moderator). This instrument also included a measure of predisposition to sharing, subsequently used as a control in our analyses, that was based

on Bendoly and Swink's (2007) measure of sharing disposition. *Post-task questions* were designed to elicit subjective perceptions of the task experience, in part to provide guidance when checking the effectiveness of our experimental manipulations. Self-reported task self-efficacy on the experimental task was collected following the experiment as well. Our exit interview process also provided an opportunity to further qualitatively gauge the extent to which individuals interpreted and responded to our experimental treatments as we had anticipated. A formal discussion of the findings from these exit questions is provided in our analysis.

The experimental interface was a project management task-simulation tool developed in Excel through the use of standard ActiveX controls (predominantly pull-down menus) and the Visual Basic programming script for data recording, timer count-down functionality, transitioning between new project assignment tasks and sharing responses, and overall project activity and performance tabulation. More basically, the interface provided the means through which subjects were exposed to project management decision-making scenarios. It served as the context within which participants devised worker allocation solutions and through which objective data relating to key concepts, such as responsiveness to the manipulations of difficulty and resource-sharing behavior, were collected (See Figure 2). The experimental task required study participants to assign one of five workers (A through E) to each of 10 sequential steps into which projects were divided with the explicitly stated objective of minimizing estimated project-completion time. Participants were asked to work on five sequential projects, each of which had a relatively large number of feasible assignment solutions (e.g.,  $5^{10}$  or almost 10 million possible combinations).

-----Insert Figure 2 here-----

Distinctions between solutions stemmed in part from defined worker skill-sets in which, when viewed in isolation, some workers were expected to be able to complete certain steps faster than others. Consequently, as in 'real world' projects, the potential exists for disadvantages if the

same workers are not assigned to a specific set of highly interdependent steps. Increased interdependency across steps favors more frequent use and reliance on certain workers, and it ultimately encourages an approach to resource allocation strategy very different than that appropriate to cases of low interdependency across steps (e.g., Kerzner, 2006). Regardless, as stated earlier and made clear to the subjects in pre-briefing, equally good solutions could be obtained for each project-work planning scenario, even in the absence of a single worker.

Via the laboratory interface, the following kinds of in-task data could be collected for any assignment solution devised, regardless of treatment: 1) the worker assignments for each of the ten steps or jobs in a project; 2) overall objective performance (anticipated project completion time) based on these assignments; 3) time spent on the decision-making process (e.g., how long it took each participant to come up with an assignment solution before submission); and 4) self-reported data, provided by participants, after each solution submission regarding their willingness to share the workers specifically assigned to each of the ten steps of a project. Time spent on the decision-making process, as collected in piloting, was primarily used to assist in developing a benchmark for limiting the time spent on these activities in the main experiment.

After entering the laboratory, participants were first given a set of instructions and guided through the general task information by a study administrator. They were then given the opportunity to interact with the interface on a *dummy* project for a total of five minutes. During this time participants were able to modify worker assignments until satisfied with the project-completion time results. Upon submission of their assignment decisions, they were instructed to specify, via the interface, their willingness to voluntarily (without threat of repercussion) share each of the resources assigned to each of the ten steps with other project managers. At this point, it was emphasized that any work-plan adjustment needed due to sharing would be assigned to a lower-level manager equally competent in this type of task and hired at a contracted rate. Hence, sharing in general should not

imply additional work for the participants nor penalties to others. It also was re-emphasized that the sharing of any one resource would not have adverse consequences for project effectiveness or on their overall performance.

Once this information was submitted, the study administrator randomly selected the scenario associated with the treatment of interest, and objective data collection then began. Scenario structures were reinforced both through numerical figures relating to anticipated worker times per job, a tabular presentation of work transfer costs and formal descriptive narratives (see Appendix B). The extent to which these varied again depended on the specific treatment to which each subject was exposed. For each of the five projects participants were asked to manage in turn, they were limited to a two-minute period for decision-making. At the end of that time period, if assignment decisions had not already been submitted, the system automatically recorded the most recent assignments, blocked any further modifications of the assignment solution, and transitioned participants into the resource-sharing feedback phase of inquiry. There was no time constraint for making the subsequent worker-sharing decisions. Following this phase, if all five projects had not yet been handled, a new project scenario for work-assignment was presented.

### *3.2 Manipulation Design*

We focus on the extent to which project work-planning difficulty impacts behaviors often associated with PM flexibility. However, difficulties are exacerbated in dynamic environments where project demands change from project to project (e.g., Kerzner 2006). In order to ensure that difficulty can be effectively controlled in our study, we capitalize on this point. Since it is quite likely that the prior experience of PMs may predispose them to view a particular kind of work planning scenario (task) as ‘run of the mill’, we specifically manipulate the extent to which PMs are forced to switch between work assignment strategies in designing a series of project solutions. Our operationalization of ‘difficulty’ specifically involves the extent to which PMs are faced with a

heterogeneous mix of project-planning tasks to complete. It hence captures the general difficulty associated with repeatedly switching approaches to project designs, regardless of individual familiarity with any one scenario or whatever potentially familiar tactics for resolution might be at hand.

With this operationalization of project work-planning difficulty in mind, our manipulations focused on exposing participants to alternate sets of project-work assignment problems. Participants were exposed to either a high or low treatment condition to mimic organizational conditions for which: 1) a great deal of switching-based difficulty is encountered in seeking good solutions to the complete set of five project tasks, or 2) where a repeated approach to planning is more than adequate across the set. Eighty subjects were exposed to the low-difficulty treatment, and another 81 were exposed to the high-difficulty treatment. Participants were encouraged by virtue of the numeric time-cost and -benefit structures presented either to adjust their solution approaches across the five projects, thus requiring switching (and greater difficulty), or, in the low treatment, to not alter their solution tactics. These two treatments were implemented through both case summaries embedded in the interface as well as changes in the numerical data used to illustrate interdependencies across steps (also clearly visible through the interface and clearly impacting directly the observable projected performance of work plans developed by study participants).

### *3.3 Measures*

#### *3.3.1 Key variables*

We use an aggregate measure of the willingness to share resources, captured from the reports provided by participants during the experimental task. After completing each of the five projects, participants were asked about their willingness to share (i.e., relinquish) each of the workers that they had just assigned to the various steps in their project with other project managers (i.e., for use in their projects instead) using a 7-point scale ranging from (1 = *not at all willing*) to (7 = *fully willing*).

Willingness to share was calculated as the average of the last four of these responses. We excluded the first response because it was not reflective of the required changes in resource assignment strategies as manipulated by our design.

We measured task self-efficacy via the self-reports collected prior to participation in the experiment as well as through the collection of post-hoc measures, consistent with approaches generally used within the self-efficacy literature (see Stajkovic and Luthans, 1998 for a review). Specifically, post-hoc measurement of task self-efficacy was strictly used as part of the manipulation checks conducted. In order to capture participants' task self-efficacy in both the pre-and post-task phases, we used a modified a three-item scale developed by Tierney and Farmer (2002, 2004) to cater specifically to the project management task context (e.g., Beghetto, 2006). Items included in the measure were, "I feel that I am good at generating effective worker assignments based on changing requirements," "I have confidence in my ability to perform well on these problems even when alternating approaches are needed," and "I have a knack for translating a range of varying project and worker conditions into good solutions." The reliability of the three-item task self-efficacy scale in the current study was quite high ( $\alpha = .88$ ). The total score for this measure was based on scale averaging.

In order to provide a conservative test of the moderating role of task self-efficacy in the relationship between difficulty and sharing behavior, we incorporated a second approach, which involved capturing participants' objective task performance following completion of the scheduling task. It is generally expected that individuals who experience success on a particular task also will experience enhanced task self-efficacy (Bandura, 1977). Task performance was captured as the average anticipated duration of each of the five projects managed by a subject. These averages were based on records of the objective calculations of project duration that were visible in real time to subjects while they designed worker assignments for a given project. Each project's estimated

duration was derived from the sum of assignment-based completion times (including transfer costs when applicable) for all ten sequential steps of each project. For analysis, total completion time was standardized and reverse-coded so that higher levels of objective performance were associated with faster completion (i.e., lower time totals). To ensure completeness in our analysis and to assist with interpretation, we evaluated the moderating role of both task self-efficacy and task performance (which were highly correlated in this study,  $\rho = .63, p < .01$ ) on the relationship between our manipulation of project work-planning difficulty and the willingness to share resources.

### *3.3.2 Control Variables.*

As noted above, in the pre-task survey we captured participants' predispositions to sharing using Bendoly and Swink's (2007) three-item scale. Items used to capture predisposition to sharing include "I was fully willing to allow those below me to work for other project managers whenever requests were made," "I encouraged the exchange of assigned workers with other project managers to promote effectiveness across projects," and "I focused my labor-resource decisions on the objectives of the firm rather than personal objectives." The reliability of the predisposition-to-sharing scale in the current study was  $\alpha = .84$ . As a general check for construct validity with regards to all scales used, we also conducted confirmatory factor analysis (CFA) procedures similar to those used in recent behavioral studies (cf. Siemsen, Roth, and Balasubramanian 2008). All factor loadings regarding the items employed were as anticipated and significant at the  $p < 0.01$  level. The measure for predisposition to sharing is the three-item scale average.

### *3.3.3 Manipulation Markers*

In order to ensure the effectiveness of controlled experimental manipulations, it is common to collect either in-task or post-hoc tests to determine whether participants were responsive to the manipulation conducted. Here we employ both in-task and post-hoc approaches. Post-hoc items used to capture perceptions of difficulty included "The preferred approach to project-work planning

tends to vary over time,” “The best approach to assigning workers to steps changes from project to project,” “The ideal tactics useful to me in these work-planning tasks were relatively stable” (reverse-coded), and “The tasks in general seemed to require only one approach to scheduling workers across steps” (reverse-coded). The reliability associated with this scale in the current study was  $\alpha = .91$ .

In order to proceed in the most conservative fashion with respect to drawing conclusions regarding the effectiveness of the ‘difficulty’ manipulation, in addition to capturing participants’ post-hoc perceptions we also calculated the extent to which participants’ solutions reflected the kind of effort required to tackle the work in the two experimental conditions. Specifically, in each of the five projects, participants were faced with essentially a constrained set of binary decisions (i.e., whether or not to assign specific workers to specific project steps or jobs). The applied constraint ensuring that exactly one worker would be assigned to each of the assignable steps makes the decision a nominal one, but it can nevertheless be represented mathematically as  $x_{kj} \in [0,1]$ , denoting worker  $k$ ’s assignment to step  $j$  of the project, constrained such that

$$\sum_{k=1}^5 x_{kj} = 1 \quad , \quad \forall j \in 10 \quad (1)$$

In the interest of the flow of discussion, we expand the remainder of the computational form of this decision-making context in Appendix A. However, for measurement-discussion purposes it is convenient to establish this basic notation at this point. As described earlier, effective solutions to worker assignments are highly dependent on the level of interdependency across the steps of a project. Hence, while one set of project conditions promotes the use of a wide variety of workers, others promote reliance on relatively small numbers of critical workers to shoulder the majority of the work. Our interest in ‘responsiveness to task difficulty’ can not be derived from the form of the solution for any one project task alone *per se*, but rather it must be based on changes in such form, as such changes relate closely to changes in fundamental approaches to solution development. Across

the full set of five projects for which participants were asked to provide solutions, we view heterogeneity in observed strategies to work assignment as a *direct measure* of responsiveness to the difficulty of the tasks set for each individual involved in the experiment. In order to leverage this objective measure to assess the utility of the manipulation, we borrow from the heterogeneity literature and adopt the use of Blau's (1977) index. Following the notation in Equation 1, we define Blau's index for each project's work assignment solution as:

$$1 - \frac{\sum_{k=1}^5 (\sum_{j=1}^{10} x_{kj})^2}{100} \quad (2)$$

To provide a general measure of responsiveness to project work-planning difficulty, again operationalized as the degree of heterogeneity in the resource-allocation strategies applied, for each subject we calculated both the variance and range in these indices across the five projects for which subjects provided solutions. Ultimately, while we find both approaches to measuring heterogeneity in solution strategies to be adequate in our analysis without significant or practical differences in associated effect sizes (maximal  $R^2$  differences observed less than .02, maximal changes in significant coefficients of  $p > 0.15$ , across all comparable models tested), we restrict all of the following numerical reports to those associated with the variance approach. It is worth noting that the same approach to measuring variance in implied work-assignment tactics was used in devising appropriate batteries of tasks for each treatment in our design. After constructing each numerical project scenario, we computationally determined the Blau's index values associated with the 20% solutions for each scenario. These were then used to construct five-project batteries that clearly fit either our low- or high-difficulty treatments for use in both our pilot and main studies.

#### 4. Analysis and Results

The means, standard deviations, and correlations among all key study variables are presented in Table 1. There was a significant, positive correlation between objective in-task performance on the

project-scheduling work and pre-task reports of task self-efficacy ( $\rho = .63, p < .01$ ). Further, as expected, there also was a significant, positive correlation between perceived heterogeneity and responsiveness to task difficulty ( $\rho = .17, p < .05$ ), thus providing preliminary support for the effectiveness of our ‘difficulty’ manipulation.

-----Insert Table 1 here-----

There was no significant distinction among the treatment sub-groups with regards to our control measures (age:  $p = .87, t(159)=0.16$ ; gender:  $p = .71, t(159)=0.37$ ; years experience:  $p = .80, t(159)=0.25$ ; predisposition to sharing:  $p = .84, t(159)=0.20$ ). However, we did observe some marginally significant correlations with these controls and the moderator variable, task self-efficacy ( $\rho = .15, p = .10$  for predisposition to sharing;  $\rho = .14, p = .11$  for gender;  $\rho = .13, p = .13$  for age). Hence we continued to consider the potential role of these demographic controls in later analysis.

#### *4.1 Manipulation Checks*

We conducted five checks to determine whether participants across the two laboratory conditions interpreted the nature of the conditioned settings as we intended. Given our focus on only a single treatment, we had little concern for the possible risk of treatment confounds discussed by Wetzel (1977). However, we were concerned that the nature of our treatment was direct enough to yield its targeted result without generating other extraneous consequences. A simple check comparing differences in in-task and post-task variables is sufficient to provide some level of assurance in this regard.

Using SPSS 16.0 following the estimation procedure described in section 3, we evaluated ‘responsiveness to difficulty’ in particular as a check of the effectiveness of our controlled laboratory manipulation. The results of planned comparisons of the ‘high difficulty’ and ‘low difficulty’ groups along this and other relevant measures is provided in Table 2.

-----Insert Table 2 about here-----

Post-hoc perceptions of respective treatment levels (heterogeneity in task) indicated that the high (3.93,  $sd = 1.11$ ) and low (3.54,  $sd = 1.29$ ) conditions were significantly different from each other ( $t(159) = 2.07, p < .05$ ) and in the expected direction.

Furthermore, our in-task measure of responsiveness-to-task difficulty matched our expectations of the controlled manipulation well. Specifically, the variance in participants' allocation strategies in the high (.017,  $sd = .0065$ ) and low (.014,  $sd = .011$ ) conditions were significantly different from each other at the  $p < .10$  level,  $t(159) = 1.68$ , and in the expected direction. We also considered whether the tendency for individuals to not fully complete their tasks in the time allotted might provide an indication of the difficulty presented. Since subjects were expected to formally submit their plans upon completion, we use the failure to do so as a proxy for incompleteness and thus general difficulty across the two experimental conditions. For the low difficulty (low heterogeneity) treatment, 96.3% of the subjects selected "submit" for every one of the five projects they were asked to manage. According to a z-test for equal proportions, the numbers were significantly different for the high difficulty (high heterogeneity) treatment (85.2% completed all projects within the time window allotted). At the same time, the manipulation had very limited impact on other measures of participant activity in our study (e.g., in-task performance, or post-hoc reports of task self-efficacy). Hence, concerns regarding potential Hawthorne effects are assuaged (Adair 1984).

As a further check to the translation of our treatments into recognizable differences in difficulty by our subjects, we looked to the structured exit interviews conducted in both the pilot and in the full study. Analyses of participants' responses within these interviews suggested that the load associated with our high-difficulty treatment was sufficient to push individuals beyond a comfortable challenge. Specifically, when subjects in the structured interview were asked if they found the task to be "non-challenging", "challenging", or "excessively challenging", 28.8% of those exposed to the

easy treatment suggested excessive challenges compared to 55.6% of those in the high difficulty treatment. Only three individuals in total regarded the task to be non-challenging. The exit interviews also suggested that individuals fully believed that the development of alternative equally good solutions could be obtained even if sharing took place. Based on a review of our transcripts, this observation seemed to be true regardless of whether individuals showed low or high levels of sharing in the task. Also, there was no statistical difference in the frequency of these reports across treatment conditions (i.e., high vs. low difficulty), nor were there any accounts of perceived differences in pressure towards (i.e., explicit encouragement of) sharing across the treatments. Taken together these results provide support as to the effectiveness of our manipulation (Cook and Campbell 1979; Perdue and Summers 1986).

#### *4.2 Hypothesis Tests*

We tested the study's hypotheses using ordinary least squares (OLS) regression. The results from these analyses are summarized in Table 3. All of the variables and interaction terms in these analyses were standardized separately so as to facilitate interpretation and discussion. In order to provide a test of our main-effects and moderation hypotheses, we conducted two sets of analyses, represented in Table 3 as Model 1 and Model 2. In the first set, we modeled task self-efficacy (the first of our two conceptual moderators) using subjective pre-task reports of self-reported task self-efficacy. In the second set of analyses, we incorporated non-self-reported, albeit indirect, estimator of task self-efficacy that was modeled using an objective measure of scheduling performance. There is little appreciable difference in the outcomes associated with the two models.

-----Insert Table 3 about here-----

In order to check against the prospect of excessive levels of collinearity, which might otherwise contaminate the interpretation of these results, standard VIF checks were performed for the

variables involved in each model. In no instance did these assessments reveal VIF levels for the factors to exceed 4 (well within the bounds suggested by Kutner, Nachtsheim and Neter (2004)).

Overall, the results reported in Table 3 provide support for the study hypotheses. According to Hypothesis 1, project work-planning difficulty negatively affects the willingness to share resources. As expected, the effect of difficulty was significant and negative in both models ( $\beta = -.73$ ,  $p < .01$ ;  $\beta = -.75$ ,  $p < .01$ , respectively), providing support for Hypothesis 1. Hypotheses 2 predicted that, at higher levels of task self-efficacy, these negative effects would be significantly mitigated. As the results presented in the table indicate, the interaction between work-planning difficulty and both self-reported task self-efficacy (Model 1:  $\beta = .31$ ,  $p < .01$ ; collected pre-task) and in-task performance (Model 2:  $\beta = .32$ ,  $p < .01$ ) were, respectively, significant and positive, providing support for Hypothesis 2.

The moderating role played by task self-efficacy is emphasized by the simple slope comparisons depicted in Figure 3 (e.g., Stone and Hollenbeck, 1989).

-----Insert Figure 3 here-----

The depiction here is similar to those used in recent behavioral effect studies (cf. Siemsen, Roth, and Balasubramanian 2008). The four points plotted on each graph represent subsets of the full sample split by (a) treatment level and (b) lower vs. upper percentiles in either of the task self-efficacy measures. The values of the dependent variable plotted are therefore cross-tab based sub-sample means.

## **5. Discussion**

In this study, we explore the effect of project work-planning difficulty on the willingness of project managers to share workers with other project managers. Further, building on the implications of psychological ownership theory in this context, we examine the moderating role played by project managers' task self-efficacy. As expected, consistent with the first hypothesis, the results from our

experimental test indicate that difficulty in scheduling tasks has a significant, negative effect on the managers' willingness to share assigned workers across multiple projects. Further, in support of Hypothesis 2 we also find that task self-efficacy significantly and positively moderates this relationship such that the effects of difficulty on resource-sharing decisions are significantly mitigated when task self-efficacy is high.

### *5.1 Contributions to Research*

These findings contribute to the literature in several important ways. First, in a test of psychological ownership theory, our results suggest that psychological attachment to resource-allocation solutions may impact project managers' decisions about worker sharing. The finding that difficulty in work-planning is negatively related to the willingness to share workers indicates that this tendency may be most pronounced precisely when effective cross-project solutions are most likely to require the unrestricted movement of such resources within an organization. This suggests that an unfortunate consequence of psychological ownership in this context may be that personal attachment to ideas, projects, or scheduling solutions within firms may undermine broader organizational objectives (Brown, et al., 2005). Managers' attachment to their solutions may prevent them from making judgments for the betterment of the firm. Importantly, however, the results from our analyses also suggest that task self-efficacy may alleviate otherwise negative consequences of this kind of psychological attachment.

This study also provides a conceptual bridge between the literatures on project management and citizenship behavior. Specifically, in her recent study, Bergeron (2007) argues that organizational citizenship behavior is a scarce resource. Employees make decisions whether to allocate these scarce resources at the potential expense of other important outcomes, such as individual in-role work performance and ultimate career trajectory. These decisions lead to a division of resources which may, in balance, have positive consequences for the organization but that

may come at the expense of individual performance outcomes. We argue that Bergeron's scarce resource-allocation decision framework captures decisions about worker allocation in the project management context as well. Although task difficulty and other issues related to individual challenge have not been identified as an antecedent of employees' organizational citizenship behavior (e.g., Organ, et al., 2006), the psychological ownership framework we develop in the current study suggests this possibility may be an important avenue for future research to explore more fully.

### *5.2 Practical Implications*

Specifically, the current results bring to light insights into potential anti-organizational behaviors (e.g., non-willingness to share scarce resources) as functions of what otherwise might be seen as very common operating conditions for project managers (i.e., challenging and widely varying work planning tasks). Also suggestive, however, are means to accommodate such policies while not encouraging anti-organizational behavior. The direct and practical implications of the observed task self-efficacy moderation should be an increased organizational focus on both effective selection processes coupled with training modules designed to improve task self-efficacy. In contexts in which organizational objectives unavoidably impose greater levels of difficulty, it is essential that members have both a greater capacity to be creative as well as the ability to balance attachment to their solutions with broader organizational goals.

Increased training to promote fluency in various approaches and ways of thinking about project work assignments may prove valuable in augmenting task self-efficacy. Incentives and increased documentation of sharing also may be useful tools in this regard. More centralized intervention and control of 'sharing' (i.e., imposing work reallocations centrally) also may have utility in certain cases and can be perhaps most appropriately and selectively applied to what are

foreseen to be either (a) particularly difficult project management scenarios or (b) unique scenarios involving PMs viewed as having little experience with the specific kinds of challenges involved. It may only be through these tactics that organizations are able to navigate the increasingly complex competitive landscape characterizing the contemporary business environment.

Furthermore, management might do well to encourage awareness of the extent to which non-sharing impedes cross-organizational multi-project work, perhaps through better accounts of resource sharing. While needless overindulgence in sharing should not be encouraged, particularly at the expense of focal projects (e.g., Bergeron, 2007), there are likely to be intelligent middle grounds available to project managers. Training programs for project managers that emphasize cross-project interdependencies, the value of project resource coordination, and the trade-offs associated with such activities also will play an important role in achieving enhanced organizational outcomes. Such programs are not currently standard practice, but they could increase awareness of such middle grounds while further reducing risks of the kind of negative carry-over effects observed in the current study.

### *5.3 Study Limitations*

Although our findings contribute to the literature and ostensibly to practice in several important ways, the results we report must be viewed within the context of the limitations of our study design. The principle limitation of the current study stems from an inherent lack of external validity or generalizability to contexts beyond the laboratory setting in which it was conducted (e.g., Cook and Campbell, 1979). In particular, our study was highly constrained to a fixed set of generalized projects from which subjects were significantly detached and for which a realistic sense of ownership and role in a greater organization were clearly only very generally approximated. Behavioral studies in the field involving project managers in real projects, although considerably more difficult to conduct and control, would likely incorporate many more issues than those

considered here, and they would hence permit for other mitigating factors to impact the relationships on which we focus. Furthermore, the dynamics observed in this study may be very different when such forms of flexibility are studied in contexts in which the key activity is something other than a project management task. Nevertheless, the results are suggestive, and additional research designed to further tap into the roles of other factors and contexts are to be encouraged.

#### *5.4 Future Research*

The negative effects of project-work planning difficulty we observe in the current study suggest a variety of directions for future research. The moderating effect of task self-efficacy in the relationship between difficulty and willingness to share resources begs the question - can this effect be reversed? Our findings suggest task self-efficacy may serve to moderate the negative consequences of planning difficulty on resource-sharing behavior. It will be important for future research in this area to continue to explore the role of task self-efficacy. Alternatively, it is possible that increased planning demands may enhance sharing behaviors when individuals act proactively to minimize future demands. In particular, Fay and Sonnentag (2002) suggest that individuals are more likely to display personal initiative when faced with stressors that induce the tendency to eliminate future occurrences of the stressor. In the current study, for example, a PM may share resources with another PM if he or she can broker an exchange minimizing the complexity associated with the need to change assignment strategies. Future research should allow for creative responses to difficult planning and requests to share resources.

A second direction regards the level of social contact or interdependence among project managers. For example, evidence from the citizenship area suggests that discretionary helping behaviors may both be recognized as more central for task accomplishment (Bachrach et al., 2006; Bachrach et al., 2007) and occur with greater frequency when employees work interdependently or have emotional attachments (Smith et al., 1983; Pearce and Gregerson, 1991; Kogut and Ritaov,

2007). In contrast, research within transactions cost-economics suggests that workers are given incentives to withhold making contributions when conditions fail to highlight individual accomplishments (Jones, 1984; Williamson, 1975). When project work is managed autonomously, as is the case in the current study, or if the consequences of sharing are not likely to reflect positively on the focal employee, managers may be less likely to share scarce resources, particularly when sharing may disrupt prior resource allocations (e.g., Bergeron, 2007). Thus, it will be important for future research to explore the moderating role of factors such as task interdependence (e.g., Wageman, 1995), autonomy (e.g., Liden et al., 1997), and transparency (e.g., Williams et al., 1981) in the relationship between project-work planning difficulty and decisions about resource-sharing.

Further, although our focus in the current study has been on managers' decisions about resource allocations, given the increasing use of work teams in organizations (e.g., McGrath, 1997) it will be important for future research to explore the dynamics within project teams that influence managers' perceptions of difficulty. In addition, building on the psychological ownership framework we employ, it will be important for future research in this area to explore the impact of the target of attachment on decisions about helping and resource-sharing (O'Driscoll, et al., 2006; Van Dyne and Pierce, 2004). We investigated a proximal target of attachment, individual resource sharing, but questions remain about the effects of attachment to more distal targets (e.g., the organization) and the interplay between proximal and distal outcomes. While our results provide an important first step in understanding the impact of difficulty in project-work planning and are consistent with psychological ownership theory, future researchers should incorporate measures of psychological ownership to provide evidence of the role of psychological ownership and attachment.

Finally, the methods we use provide a relatively unique approach to thinking about managerial responsiveness to changing task requirements in general. For example, in the creativity field, a primary approach to measuring such responsiveness to required creativity has been the use of

subjective measures, including supervisor or other expert ratings (e.g., George and Zhou, 2002; Oldham and Cummings, 1996; Perry-Smith, 2006; Shalley, 1995). The nature of the creative process makes it particularly difficult to quantify (Amabile, 1996). Thus, our measure, based on an objective evaluation of heterogeneity, represents a departure from previous work in the area. Although it clearly does not capture all factors and dynamics associated with adapting to dynamic operational tasks, we believe that future research should continue to explore objective approaches to the evaluation of these very real characteristics of work faced by operations managers.

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**Table 1: Means, Standard Deviations, and Correlations Among Study Variables**

Variables	Timing	Mean	SD	Range	1	2	3	4	5
1. Predisposition to Sharing	Pre-task	3.91	1.40	1.3 6.5					
2. Self-Reported Efficacy	Pre-task	3.49	1.46	1.5 5.9	.05				
3. In-Task Performance	In-task	57.9	21.3	29 83	.04	.63***			
4. Responsiveness to Difficulty	In-task	.43	.19	0.12 0.73	-.02	.01	.02		
5. Willingness to Share	In-task	3.74	1.24	1.2 6.2	.26**	.17*	.19**	-.39***	
6. Perceived Heterogeneity	Post-task	3.56	1.31	1.4 6.1	.21**	-.01	-.01	.17*	-.12

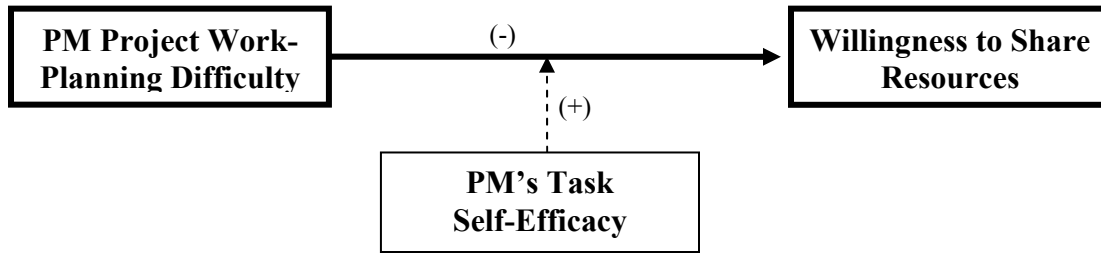
Note: \*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; With the exception of in-task performance (time) and responsiveness to difficulty (fractional), means and standard deviations are all derived from Likert-type scale values. Post-task self-reports of efficacy, although not used in our larger model, were significantly correlated to both Pre-task self-reports as well as In-Task Performance.

**Table 2: Summary Experimental Treatment Level Checks**

Variables used in treatment checks	Treatment : Level of structural and case-implied variation across 5 project management problems		p-level
	<i>Low Difficulty</i> : Worker-job dynamics are roughly constant across 5 projects (n=80)	<i>High Difficulty</i> : Work-job dynamics vary greatly across 5 projects (n=81)	
Perceived Heterogeneity in Task ( <i>Post-Task Manipulation Check</i> )	$\mu$ ( $\sigma$ ): 3.54 (1.29)	$\mu$ ( $\sigma$ ): 3.93 (1.11)	0.038 (t= 2.09)
Responsiveness to Task Difficulty ( <i>Observed In-Task Manipulation Check</i> )	$\mu$ ( $\sigma$ ): 0.0142 (0.0065)	$\mu$ ( $\sigma$ ): 0.0171 (0.0112)	0.097 (t= 1.67)
Full completion of Task in time given ( <i>Observed In-Task Manipulation Check</i> )	rate : 96.3%	rate : 85.2%	0.031 (z= 2.14)
Overall In-Task Performance {stdzd} ( <i>Observed In-Task Hawthorne Check</i> )	$\mu$ : -0.32	$\mu$ : -0.33	0.750 (t= 0.32)
Post-Task Self-Reported Efficacy {stdzd} ( <i>Post-Task Hawthorne Check</i> )	$\mu$ : -0.11	$\mu$ : 0.11	0.928 (t= 0.09)
Task seen as "excessively challenging" ( <i>Post-Task Manipulation Check</i> )	rate : 28.8%	rate : 55.6%	< 0.001 (z= 3.33)

**Table 3. Willingness to Share Resources as a Function of Difficulty and the Moderating Role of Task Efficacy**

	Pre-Task Self-Reported Efficacy as Moderator (Model 1)						In-Task Performance as Moderator (Model 2)					
	Main Effects			Main + Interaction Effects			Main Effects			Main + Interaction Effects		
	$\beta$	Error	Sig.	$\beta$	Error	Sig.	B	Error	Sig.	$\beta$	Error	Sig.
Constant	3.41	.22	.000	3.23	.30	.000	3.21	.28	.000	3.18	.31	.000
Age	.01	.24	>.50	.00	.27	>.50	.03	.21	>.50	.02	.21	>.50
Gender	-0.06	.22	>.50	-0.04	.21	>.50	-0.03	.25	>.50	-0.04	.24	>.50
Yrs Professional Experience	.00	.15	>.50	.00	.14	>.50	.00	.11	>.50	.00	.12	>.50
Predisposition to Sharing	.36	.14	.153	.42	.04	.000	.36	.24	.13	.41	.18	.000
Difficulty Treatment (0,1)	-.87	.29	.005	-.73	.21	.002	-.76	.21	.004	-.75	.26	.003
Task Efficacy (moderator)	.16	.09	.089	.26	.10	.020	.14	.09	.090	.21	.09	.029
Treatment x Task Efficacy				.31	.12	.007				.32	.09	.004
	$R^2$	.29		.45			.32			.46		
	<i>Adjusted</i> $R^2$	.26		.42			.29			.43		
	<i>Maximal VIF</i>	2.14		2.37			3.12			3.13		



**Figure 1: Conceptual Relationship Between Difficulty of Project-work Planning and Resource Sharing and the Moderating Role of Task-Efficacy**

Figure 2: Snapshot of Project Management Interface Used in Experimental Task

**Your Role :** Project Manager

**Your Task :** Assign your staff (workers "A" through "E") to somehow cover all 10 steps in a project.

**Your Goal :** Minimize the *Total Estimated Time to Completion* for the project.

**Your Approach :** In general, you can assign anyone to any step. You do not need to use all workers, or use all workers equally (i.e. you could assign "A" to handle step 4, and "C" to handle the rest). In developing your solution consider both individual time-to-complete-step data (table), as well as any incremental costs of 'transferring' work to others (grid). (See data on the right)

**Your Limitations :** You can **Commit to** and **Submit** (click) your assignments at any point, but will only be given **2 minutes** within which to make all of your assignments for a project (at that point your most recent set of assignments will be recorded as a final solution).

Practice Trial

**Your Data**

Minimum estimated number of hours needed for a given worker to complete each step at a sufficient level of quality

Step #	Worker A	Worker B	Worker C	Worker D	Worker E
1	8	8	6	6	7
2	7	7	6	6	6
3	7	4	6	8	9
4	8	6	9	6	7
5	7	6	8	7	8
6	5	7	6	7	7
7	7	8	8	7	7
8	7	7	8	7	7
9	7	7	8	4	9
10	7	7	6	8	8

Estimated additional % of time required to complete any given step, if certain previous steps are not completed by that same individual (Note these 'transfer costs' are cumulative). All highlighted squares represent steps that must be completed prior to starting a higher-numbered step.

..if not done by person doing Step #

Increase in time for Step #	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6	13%					24%			
7			33%						
8					6%	25%	3%		
9									
10				32%				1%	22%

**Your Decisions**

Timeline (hours)

**Your Willingness to Adjust**

If another project manager at your level requested that your assigned worker be taken off one of these steps, leaving you to find a replacement among your staff, how willing would you be to accept the request? (answer for each case independently; 1="Not willing", 7="Fully willing")

Submit "willingness" Ratings

**Your Workplace Scenario**

Scenario

Your employer, XYZ Firm, operates in an environment wherein approaches to work assignment are likely to change from project to project. For some projects, benefits emerge from the use of a diversity of workers capitalizing on job-specific skills. In other projects assigning the majority of jobs to a single worker has benefit (from a transfer cost perspective). Being able to recognize and plan for these project differences is thought to be essential to minimizing completion times.

Start Test

**Result** → Total Estimated Time to Completion = 40.7 hrs

Time left to make your Decisions 01:57 Commit to and Submit Assignments

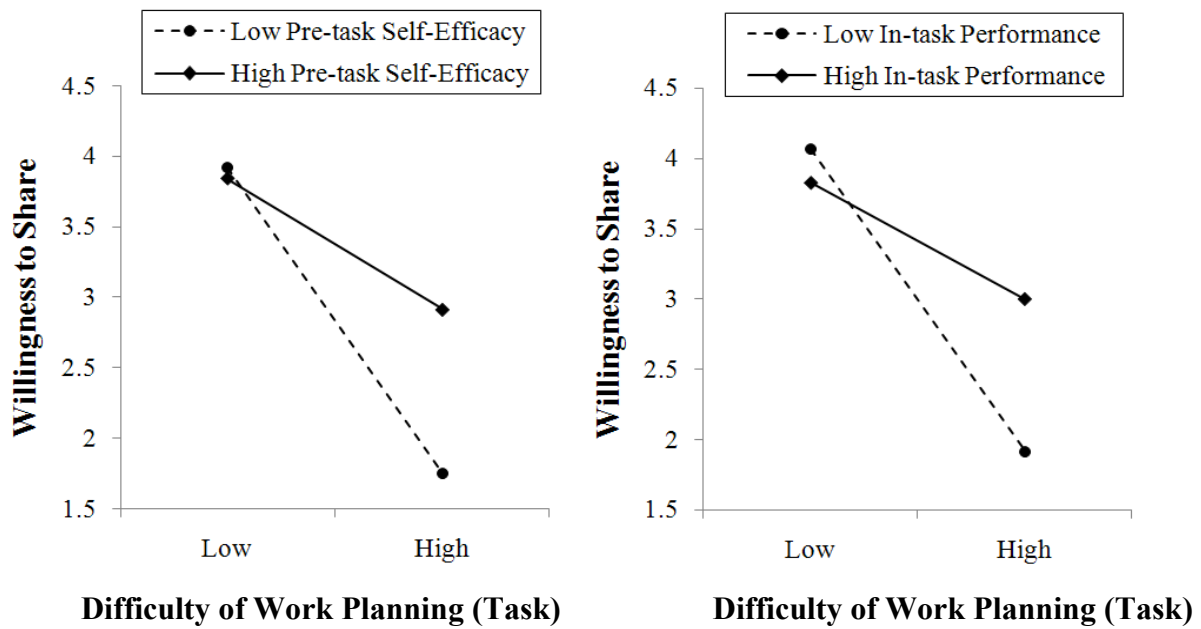


Figure 3: Simple Slopes Comparison of Resource Sharing Across High and Low levels of Controlled Work Planning (Task) Difficulty at Different Levels of Task Efficacy

## Appendix A

### Notation and Automation Mechanisms

Used in the translation of participant worker assignment decisions to project-step timing, Gantt Chart visualization and estimates of total project completion times.

$x_{kj} = [0,1]$  Denoting worker  $k$ 's assignment to step  $j$  of project

Constrained such that

$$\sum_{k=1}^K x_{kj} = 1, \quad \forall j \in J$$

$P_{ij} = [0,1]$  Denoting whether work on step  $i$  can begin before  $j$ 's completion

$t_{kj}$  "Base" time estimate for worker  $k$  to complete step  $j$

$e_{ij}$  Information transfer cost. Defined as % additional time needed for work on  $j$  if such work is not carried out by the same person who worked on step  $i$ .

$$TT_j = \sum_{k,i}^{K,I} (x_{kj} \cdot t_{kj} + x_{ki} \cdot x_{kj} \cdot e_{ij} \cdot t_{kj}) \quad \text{Total time needed for step } j$$

$$S_j = \text{Max} \left\{ \begin{array}{l} \text{Max}_i^{I \in i < j} (P_{ij} \cdot (S_i + TT_i)) \\ \text{Max}_{k,i}^{K, I \in i < j} (x_{kj} \cdot x_{ki} \cdot (S_i + TT_i)) \end{array} \right\} \quad \text{Start time for step } j$$

Objective : Choose  $x_{kj}, \forall j, k \in J, K$ , such that  $\text{Max}_j^J (TT_j)$  is minimized.

## **Appendix B**

### *Example Low Difficulty narrative:*

Your employer, XYZ Firm, values a consistent approach to work assignment that involves scheduling jobs across different workers so that work is assigned based on who has the skills and experience to complete specific portions of projects most efficiently. This approach is believed to minimize the time required to complete all projects. A consistent adherence to this strategy is viewed as the most effective approach to this facet of project management.

### *Example High Difficulty narrative:*

Your employer, XYZ Firm, operates in an environment wherein approaches to work assignment are likely to change from project to project. For some projects, benefits emerge from the use of a diversity of workers capitalizing on job-specific skills. In other projects assigning the majority of jobs to a single worker has benefit (from a transfer cost perspective). Being able to recognize and plan for these project differences is thought to be essential to minimizing completion times.