AN EXPLORATION OF PROJECT MANAGERS' COMMUNICATION BEHAVIORS AND THEIR RELATION TO INFORMATION SYSTEMS USE AND PROJECT TECHNOLOGIES

By

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ABSTRACT

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There is considerable interest in characteristics of project managers that are associated with their effective performance, especially with regard to their communication competencies in team settings. However, efforts to develop a research-based framework of “effective” project managers' behaviors must consider a complex array of project sizes, duration, complexities, pace, objectives, constraints, and managerial styles. This study examined a broader set of communication behaviors associated with project managers across several industries. Key finding from the purposive sample (n = 157) of project management team members revealed significant differences between the importance of “messy talk” and its reported use in their project teams as well as between the importance of open communication and its reported presence. Analyses further indicated that reported messy talk use and reported information system use significantly predicted project success. These findings offer tentative insight into the importance of communication behaviors role in project settings in general and in project managers actions in particular.

To my mother who is a constant source of strength and has always been there with me in times of despair.

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CHAPTER ONE

Introduction

Organizations rely on project managers to plan, organize, motivate, and control resources, procedures, and protocols to achieve specific goals. Project managers have considerable influence on project quality and project team performance (Ammeter & Dukerich, 2002; Henderson, 2008). Typologies of project team manager behaviors emphasize coordinating activities and tasks, updating and persuading stakeholders, maintaining an open communication environment, and among others (e.g., Sommerville, Craig, & Hendry, 2010). In addition, project managers within matrix organizations are said to coordinate across functional and organizational environments, though sometime lacking formal authority (Cleland, 1995), and lead teams consisting of members from different disciplines, requiring technical and managerial skills (Ammeter and Dukerich, 2002).

Project teams are readily used across almost all industries and organizational structures for the occasional task or product (Thamhain, 2004). Project-based organizations (PBOs) undertake projects to fit the bespoke designs for customers (Ajmal & Koskinen, 2008). PBOs use project teams as central feature of their organizational design to accomplish projects of a limited duration (i.e., with a beginning and a completion date) (Hobday, 2000; Whitley, 2006). In addition, interorganizational collaborations use project teams as a means to access monetary, intellectual, official, production, advertising, and circulation resources (Das & Bing, 2000; Miller, Scott, Stage, & Birkholt, 1995; Parmigiani & Rivera-Santos, 2011; Schmidt & Kochan, 1977). Given the use and importance in multiple settings, there is considerable interest in characteristics of project managers that are associated with their effective performance, especially with regard to their communication competencies in team settings (Henderson, 2008).

Many analyses of project manager behaviors, however, are anecdotal (e.g., Chen, 1997; Gaddis, 1959) or prescriptive in nature (e.g., Pettersen, 1991; Rwelamila, 1989; Turner & Muller, 2005). One problem with anecdotal or prescriptive analyses concerns the generalizability of findings (Lukka & Kasanen, 1995), since these studies are based on authors' limited experiences and rarely consider extenuating factors (Tsang, 1997). Efforts to develop a research-based framework of "effective" project managers behaviors must consider a complex array of project sizes, duration, complexities, pace, objectives, constraints, and managerial styles (Raz, Shenhar, & Dvir, 2002). Given variation in project context and commensurate leadership challenges, it is not surprising that there is a lack of agreement in the literature regarding what attributes constitute a good project manager (El-Sabaa, 2001) and which behavioral categories are relevant and meaningful (Turner & Muller, 2005; Yukl, Gordon, & Taber, 2002).

One particularly important context concerns the project team's information knowledge systems, which greatly shapes the process of managing data and tasks (Jashapara, 2004; Tiwana, 2000; Zack, 1999). At one end of the spectrum, information technology (IT) centric systems focus on identifying, accessing, and reusing information and knowledge (Carrillo & Chinowsky, 2006; Earl, 2001). At the other end, human resource management (HRM) centric systems focus on fostering a learning environment that helps members develop, enhance, and utilize their knowledge to achieve project goals (Carrillo & Chinowsky, 2006; Harman & Brelade, 2000). A second, important context pertains to technological throughput (e.g., design and material transformation) processes, which are embedded with types and levels of uncertainty as well as coordination challenges (Little, 1981; Roussel, Saad, & Erickson, 1991; Shenhar, 1998; Shenhar & Dvir, 1996). As research forays into employee communication competencies (e.g., Jablin, Cude, House, Lee, & Roth, 1994; Jablin & Sias, 2001) would suggest, any consideration of

project managers' behavioral "effectiveness" in organizations must consider the context and its demands upon the person and team.

This study proposes to examine the communication behaviors associated with project managers across several industries. In particular, the aim is to develop a more thorough range and explication of pertinent communication behaviors starting with those identified in research and industrial publications related to project management. This study will also conduct an exploratory test of measures related to project managers' communication behaviors in a cross-section of industrial settings. To do so, the proposal first reviews and critique the literature on project manager behaviors and competencies of successful project managers. To provide a context for understanding project managers in action, information knowledge technology strategies of organizations, and design and material transformation processes during project initiation will be considered. Next, following the literature review, research questions aimed at understanding the communication behaviors of project managers will be proffered along with a methodology to examine those behaviors.

Project Managers

Projects are defined as a set of interconnected activities with pre-defined goals and time that utilize well-defined resources (Hobday, 2000). These projects are managed through planning, organizing, controlling, and directing resources to accomplish tasks for meeting specific goals (Kerzner, 1979). Project managers oversee individuals' overall efforts to accomplish project goals (Chen, 1997). Thus, project managers coordinate overall activities of team members (Ajmal & Koskinen, 2008), deal with both subcultures within the team and overall organizational culture, and disseminate information across team and stakeholders (Hobday, 2000).

Prescriptive Behavioral Skills of Successful Project Managers

By almost any admission, project management requires a wide range of skills and training to effectively lead multi-disciplinary projects (Chen, 1997), which are laden with uncertainty, diversity, and bulk of information (Shenhar & Dvir, 1996). The role of a project manager is thought to be a challenging one because they work across functional and organizational environments (Cleland, 1995) and lead personnel from different disciplines (Anantatmula, 2008). A number of writings (e.g. Pettersen, 1991) seek to describe the essential qualities of project managers that are associated with efficiency and successful project delivery. Table 1 summarizes the most frequently mentioned characteristics of effective project management. For illustration purposes, the presentation of these characteristics follows Stickney and Johnston's (1980; Pettersen, 1991) categorization of human, business, and technical skills

To begin, writers suggest that, project manager's human skills are primarily concerned with general leadership efforts to motivate, inform, and consolidate team efforts. For example, project manager is expected to motivate personnel, involve members in decision making, support members' personal growth, communicate "effectively through writing, reading, speaking and listening" (p. 2), and build multi-disciplinary teams (Chen, 1997). They are idealized as excellent communicators who transfer ideas and information in the context (Meredith, Posner, & Mantel, 1995). In addition, the ability to resolve conflicts, build a team environment, motivate and support employees, delegate authority, and exhibit patience and flexibility are presented as important human skills for effective project management (Chen, 1997; Kerzner & Thamhain, 1984; Pettersen, 1991). In a nutshell, project manager human skills are synonymous with their ability to involve team members in decisions and foster open information sharing environments.

Business skills focus on project managers' accomplishing short-term tasks and achieving

Table 1. *Skills and Qualifications of Effective Project Managers.* [a]

Human Skills	Business Skills	Technical Skills
Effective communication, both oral and written	Accurate planning and scheduling	Project knowledge and understanding
Motivate and support personnel development	Realistic goal setting	Sound understanding of methods and processes
Mobilize mental and emotional energy of subordinates	Negotiate tasks and operations with other organizations	Ability to integrate business, technology, and human objectives
Exhibit flexibility, patience, and persistence	Approach project holistically considering all aspects	Expertise in the tools and technology used
Delegate authority and empower subordinates	Monitor subordinate performance	Understanding of the market and product applications
Create multi-disciplinary project teams	Contract management and risk analysis	
Maintain harmony among team members	Reduce changes and detect trends and deviations	

[a] Extrapolated from Chen (1997), El-Sabaa (2001), Kerzner & Thamhain (1984), Meredith et al. (1995), Pettersen (1991), and Rwelamila (1989).

project goals. Planning, organizing, team supervision are some of the important business skills that a project manager should possess (Kerzner & Thamhain, 1984; Pettersen, 1991). Other skills include making effective decisions, delegating work and authority, tracking project progress and employee performance, estimating costs and risks, reducing changes, and managing contracts (Chen, 1997). Additionally, setting realistic goals, taking a holistic approach to the project, and considering environmental factors while making decisions are set forth as necessary skills for project management (Pettersen, 1991).

Finally, prescriptive writings also advocate "technical skills" (El-Sabaa, 2001, p. 2), or the ability of project managers to understand the technology and apply that knowledge to practice (Pettersen, 1991) in order to ensure successful project delivery. Kerzner and Thamhain

(1984) identified technical skills as one of the important competencies possessed by effective project managers. These skills also involve project managers' ability to integrate business, technical, and people objectives, as well as understand tools and procedures, market trends, and product applications (Chen, 1997). Finally, a project manager should have a global view of the project, consider the multi-disciplinary nature of the project, and stay in close contact with engineers, contractors, owners, and customers at all times (Pettersen, 1991; Rwelamila, 1989).

In sum, prescriptive project manager materials offer initial guidelines for organizations and managers in so far as they identify behaviors thought to be central to project success. However, lacking substantive empirical support, they primarily showcase idealized traits (e.g., Chen, 1997; Gaddis, 1959; Pettersen, 1991) rather than behaviors verified as central to project leader success. The next section reviews empirical studies that focus on the competencies of successful project managers.

Measured Communication Behaviors of Project Managers

Over the past two decades, empirical research aimed at identifying behaviors related to "successful" project management has generally adapted constructs developed to assess the attributes and behaviors of executives and general managers. For example, one of the more widely used frameworks derives from Dulewicz and Higgs' (2004) leadership dimensions, which were based on managers. Their intellectual competency dimension involves critical analysis and judgment, vision and imagination, and strategic perspective. Their framework also includes managerial competency (e.g., engaging communication, managing resources) and emotional competency dimensions (e.g., self-awareness, emotional resilience).

Of particular interest to this proposal are constructs that seek to measure project managers' communication behaviors. Table 2 presents a summary of the various constructs of

project managers' communication behaviors. Studies were included in this list if they sampled project managers. Some of these studies focus explicitly on project managers' behaviors (e.g., Ekvall & Arvonen, 1991; Muller & Turner, 2010). Other studies (e.g., Yukl et al., 2002) address general managerial behaviors, but feature project managers in their samples. In turn, some

Table 2. *Measured Communication Behaviors of Project Managers.* [a]

Relational Behaviors	**Task Behaviors**	**Change Behaviors**
Empowering • Develop member skills and foster member growth • Express confidence in member skills • Provide encouragement and support • Collective decision making	Initiate Structure • Create order and standardize procedures • Clearly state task objectives • Clearly state role expectations • Precise planning and scheduling	Creative • Provide creative solutions • Encourage creative thinking • Foster innovative thinking • Risk taking
Unbiased treatment of employees	Monitoring • Check project and member performance • Keep a check on operations • Keep project within budget and on track	External environment • Keep a check on external environment • Networking
Friendly and considerate	Disseminate information	Futuristic planning
Recognize contributions		

[a] Extrapolated from Ammeter & Dukerich (2002), Anantatmula (2008), Dvir et al. (2006), Ekvall & Arvonen (1991), Geoghegan & Dulewicz (2008), Malach-Pines et al. (2009), Muller & Turner (2010), Schmid & Adams (2008), Shenhar & Dvir (1996), Sommerville et al. (2010), Thamhain (1999), Turner et al. (2009), and Yukl et al. (2002).

studies assess a single communication construct (e.g., Initiating structure; Anantatmula, 2008) while others consider an array of communication constructs (e.g., Ekvall & Arvonen, 1991; Yukl et al., 2002). It should also be noted that no one study to date explicitly sets forth a typology of

project managers' communication behaviors. Some well-developed project manager typologies follow the trend in the general management literature to organize discussions around behavioral sets, which in fact focus on interpersonal communication between managers and employees or group communication dynamics (Morgeson, DeRue, & Karam, 2010). In one such typology, Yukl et al. (2002) posit that project managers' behaviors can be loosely organized into relational, task, and change-oriented skill areas, which will be used here.

Relational-oriented communication behaviors refer to the ability of project managers to work effectively as group members and to build cooperative efforts within the teams they lead. Efforts to measure relational-oriented communication behaviors examine four sub-areas. A common measurement considers the extent to which project managers empower their team members by: developing members' skills and fostering member growth; expressing confidence in member skills; providing encouragement and support; and engaging in collective decision making. Accordingly, survey items assessing the extent to which project managers delegate decision authority, encourage members to take on difficult challenges, help members produce innovative ideas, and encourage others to challenge existing practices, assumptions and policies typify this approach (Ekvall & Arvonen, 1991; Muller & Turner, 2010; Schmid & Adams, 2008; Yukl et al., 2002). Other relational-oriented constructs include the unbiased treatment of employees (Ekvall & Arvonen, 1991), acting in a friendly manner (Ekvall & Arvonen, 1991; Geoghegan & Dulewicz, 2008; Muller & Turner, 2010; Turner, Muller, & Dulewicz, 2009), and recognizing members' contributions (Schmid & Adams, 2008; Yukl et al., 2002).

Task-oriented communication behaviors refer to the ability of project managers to complete tasks in order to accomplish certain project goals or to meet performance standards. Research to date in this area focus on three sets of behaviors, initiating structure, monitoring, and

disseminating information. For example, project managers' ability to initiate structure is one of the most commonly operationalized component in project management literature. Examples include creating order and standardizing procedures, clearly explaining task objectives, clearly stating role expectations, and planning and scheduling (Ammeter & Dukerich, 2002; Anantatmula, 2008; Ekvall & Arvonen, 1991; Sommerville et al., 2010; Thamhain, 1999; Yukl et al., 2002). In addition, research (e.g. Anantatmula, 2008; Schmid & Adams, 2008) focuses on the ability of project managers to monitor the performance of project and team members and check on operations. Task-oriented assessments also seek to measure by the ability of project managers to disseminate information. For instance, Ammeter and Dukerich (2002) point out the importance of keeping team members abreast with information regarding the project and conducting weekly meetings to bring everyone to pace with the project. In turn, Sommerville et al. (2010) operationalized the information dissemination by examining project managers' information sharing activities via emails, reports, memos, and speeches.

Change-oriented behaviors refer to project managers' ability to adapt to dynamic environments and envision opportunities. Accordingly, articulating vision, accepting new ideas, making quick decisions, encouraging cooperation, and taking risks have considerable importance (Yukl et al., 2002). Investigations of project managers in this behavioral set consider three sub-aspects, creative, external monitoring, and futuristic planning. Creative behaviors pertain to project managers providing creative solutions, encouraging members' creative thinking, fostering innovative thinking, and encouraging (Ekvall & Arvonen, 1991; Geoghegan & Dulewicz, 2008; Muller & Turner, 2010; Turner et al., 2009). Another important change-oriented behavior is external monitoring, which refers to the identification of threats and opportunities for the organization by monitoring the external environment (Yukl et al., 2002). Dvir, Sadeh, and

Malach-Pines (2006) underline project managers' propensity to track competitors' product development, and Thamhain (1999) emphasizes on cross-functional communication for innovation in product development. Finally, engaging others in planning for the future is considered to be a critical project manager behavior (Ekvall & Arvonen, 1991; Geoghegan & Dulewicz, 2008; Muller & Turner, 2010; Turner et al., 2009).

Critique. The measurement of project managers' behaviors, communicative and otherwise, represents an important step forward from earlier, prescriptive writings. Project leader behaviors do influence project and team performance outcomes (Ammeter & Dukerich, 2002), especially those behaviors that are relationally or interpersonally based (Anantatmula, 2008; Christenson & Walker, 2004; Thite, 1999; Weiss & Anderson, 2003). The enumeration of key behaviors is an important next step toward understanding the actions of project managers that are most valued. However, this approach poses a number of challenges. First, there are debates what constitutes "successful" project managers as well as their influences of the project managers. Successful project managers are often associated with successful projects, but, project success is multi-dimensional (Muller & Turner, 2010) and includes "end-user satisfaction with the project's product or service" (p. 440), keeping within budget, satisfaction among project team members, recurring business, and other factors. As an aside, there are also considerable challenges to determining project success related to the methodological practice of aggregating separate measures, obtaining objective measures, and bias in reporting (Scott-Young & Samson, 2008).

Second, it is important that project managers' communication abilities fit with the dynamic nature of an organization and project (Malach-Pines, Dvir, & Sadeh, 2009). Organizational factors such as project goals, standard operating procedures, information systems, and reporting guidelines may shape their tasks as well as how they are judged. Projects differ in

duration, interdependence, authority structure, and member skills to name a few (Hollenbeck, Beersma, & Schoutenm, 2012). Consequently, sets of communication behaviors relevant for leading one project may be more important than in other settings. Further, asking experts or project managers themselves to generalize across multiple projects and team compositions risks over simplification of complex contingencies and masking critical actions used on occasion.

Third, much of the research exploring project management behaviors is atheoretical in its articulation of behaviors, in part due to their exploration of managerial ability from a skills perspective. Muller and Turner (2007) and others (e.g., Crawford, 2005; Henderson, 2008) suggest that researchers embrace a multi-dimensional view of managerial behaviors and consider situational factors such as project type that will contextualize findings.

Project Managers Communication Competencies

General managers' competencies in enacting sets of behaviors have been an interest to organizational researchers for many years. In one of the most thorough and theoretically sound explications of managerial competence, Boyatzis (1982) states that an action (i.e., demonstrating certain behavior) can be best understood in the context of the demands and requirements of a specific job. Making inferences about a certain behavior assumes a direct relationship to an underlying characteristic. Competencies are then sets of behaviors needed to successfully perform a task within a given context, and skills refer to knowledge and/or demonstrating a high level of performance in a certain behavior. Those interested in communication competencies follow a similar framework. For example, communication skills differ from communication competencies mainly as the former refers to "the ability of an individual to perform appropriate communicative behavior in a given situation" whereas, the latter refers to "the ability of an individual to demonstrate knowledge of the appropriate communicative behavior in a given

situation" (McCroskey, 1982, p. 5). McCroskey (1982) and others (e.g., Jablin et al., 1994; Jablin & Sias, 2001) note that organizational members can be "effective without being competent and may be competent without being effective" (McCroskey, 1982, p. 3).

In terms of general project management competencies, researchers have primarily explored the relationship between skills and perceived managerial effectiveness. For instance, the most widely-cited explication of project managers' competence links technical (e.g., planning and scheduling), managerial (e.g., leadership, delegation, negotiation), financial (e.g., establishing budgets), legal (e.g., drafting contracts), communication (e.g., presentations), and general (e.g., chairing meetings) skills with importance in professional competence (Edum-Fotwe & McCaffer, 2000). Crawford (2005) states that project managers who are top performers, as perceived by upper management, "concentrate on using time, human resources and procurement practices, with particular attention to monitoring and controlling of cost and time, establishing and negotiating contracts and managing project finalization" (p. 15).

More recent investigations consider the relationship between knowledge and problem-solving. For instance, Muller and Turner (2010) find that project managers with strong intellectual (e.g., critical thinking), managerial (e.g., managing resources, empowering, developing), and emotional (e.g., sensitivity, influence, motivation, conscientiousness) competencies were most successful in engineering projects. They also report that projects of high and medium complexity demanded competencies in all three areas. In turn, Brill, Bishop, and Walker (2006) link core project management competencies with contextual knowledge, problem-solving, leadership, and communication expertise.

To date, few investigations explicitly examine project managers behaviors from a communication competence perspective. For instance, Henderson (2008) reports that project

managers' clarity in information giving was positively related to team member's satisfaction and productivity while their information receiving abilities (e.g., listening, reading) were associated only with members' satisfaction. Drawing from Monge, Bachman, & Dillard (1982), this study only considers two dimensions of communication competencies. Similarly, Brill et al.'s (2006) reference to communication expertise is limited to "listen effectively" and "has strong verbal communication skills" (p. 127). However, it seems worth noting Jablin and Sias's (2001) concerns about the conceptualization and measurement of communication competencies in organizational settings, which can be applied to project managers. They point to a number of shortcomings that diminish the usefulness of research, noting among others:

1. Communication competence research tends to focus only on the member interacting on the individual and/or dyadic-interpersonal level of analysis whereas interactions with higher level (i.e., upper management) as well as parallel (i.e., other work units) entities that should also be considered;
2. Research has compiled inventories of communication skill capabilities that are important in organizational settings, but often ignore individuals' capability to know when to enact various communication behaviors;
3. Lists of skills suggest threshold communication competencies that are sufficient to accomplish tasks, but fail to provide insight into superior levels of communication behavior performance necessary for outstanding performance;
4. Competency conceptualizations are typically based on an "ideal communicator" model, which does not recognize that individuals do not have to be outstanding in all dimensions to be "effective;"

5. “Ideal communicator” conceptualizations do not consider the dynamic, changing nature of changing work and project requirements;
6. There is a tendency in practice to hold one dimension of an individual's competency in high regard, creating a "halo effect" that overshadows the lack of communication competencies in other areas;
7. The literature tends to view competence as discrete, being present or not present, rather as a continuous variable, ranging from low to high.

With respect to consideration of project managers’ communication behaviors as well as competencies, noticeably missing is the explicit examination of actions that enhance group or team coordination and information sharing processes. Research investigations into project team managers’ communication behaviors (see Table 2) examine actions that certainly have group- or team-level implications. For example, “recognizing contributions” and “monitoring” imply that the project team manager is communicating to multiple members of the team. Yet, these actions could also be directed to individuals in a dyadic context and provide little insight into the extent to which project managers encourage information sharing or address political ramifications of decisions (Dossick & Neff, 2011; Lewis, 2000, 2011). In particular, project teams working on complex assignments at times need to engage in "messy talk" (Dossick & Neff, 2011, p. 84), that is, discussion of design specifications or changes, materials, production orders, and the like, in order to consider the ramifications of past and impending actions.

Whether discussions are facilitated via face-to-face conversations or intranet white-boards, the review of actions and their implications can have a marked impact on product quality and cost (Adler, 1995; Dossick & Neff, 2011). Setting project teams apart are managers’ maintaining open communication environments within the team in keeping with project

demands, arranging formal and informal meetings to disseminate information and spur conversations, responding quickly to queries and issues, and involving others (e.g., customers, contractors, and upper management) in making decisions (Adler, 1995; Dossick & Neff, 2011; Dvir et al., 2006; Malach-Pines et al., 2009). Investigations into the extent to which project managers' facilitate team interaction would fall into line with previous research that emphasizes the importance of managerial communication related to considering project complexity, group norms, politics, and team decision making (Druskat & Wheeler, 2003; Poole, 2011).

A series of recent articles (e.g., Kozlowski & Bell, 2011; Morgeson et al., 2010) also point to the importance of examining leadership purposefully at the group level and suggest that behaviors associated with structuring and planning, setting expectations for the team, and monitoring team performance are essential for work group success. The ability to initiate structure (e.g. incorporate standard reporting procedures), keep projects within budget and on schedule, and avoid excessive modifications to design (Dvir et al., 2006; Shenhar, 1998) requires both knowledge and social skills. Yet, as Shenhar (1998) notes, some projects require managers primarily to be administrators while others require project managers to be technical leaders who add to the project via knowledgeable decisions and seeking others' input.

In short, the ability of and the degree to which project managers engage team members in a way required by the project is more than a fanciful notion. How project managers facilitate team progress, create open communication environments through their interactions with others, by monitoring team members' responses to routine information, and promote discussions to non-routine information appears to be at the heart of investigations into project manager effectiveness or competence. To better understand the communicative challenges of project managers, this research asks,

RQ1 According to team members, what project manager communication behaviors were important given the challenges of their project?

RQ2 According to team members, how well did their project managers enact communication behaviors related to the challenges of their project?

Information Sharing Systems

Information sharing systems within organizations differ in the extent to which their members analyze and interact over explicit and tacit knowledge (Earl, 2001; Nonaka, 1994; Whyte, Ewenstein, Hales, & Tidd, 2008). Explicit knowledge refers to information that can be captured, codified, and communicated in a systematic formal language. Tacit knowledge is personal, possessed alone, rooted in involvement in a specific context and, thereby, difficult to codify and communicate (Polanyi, 1966). However, for explicit knowledge to be maximally applied, it must be coupled with tacit knowledge or awareness (Whyte et al., 2008). For example, "the reasoning behind the selection of a steel structure (as opposed to concrete or wood)" (Dossick & Neff, 2011, p. 85). Aspects of the rationale for using steel may be included in designs, analysis reports, or meeting minutes, but much of this information is stored in brains of people who made these decisions (Whyte et al., 2008). Two means of accessing explicit and tacit knowledge in project development are IT and HRM centric systems (Carrillo & Chowsky, 2006).

IT Centric. This information sharing system is designed to circulate explicit information among its members (Earl, 2001). Explicit information includes standard operating procedures, best practices guide, drawings, 3D models, task assignments, and contracts (Carrillo & Chinowsky, 2006). Project participants here are mainly concerned with the search, access, implementation, and reuse of information (Earl, 2001). Consequently, IT centric systems form the modern backbone of conventional coordination mechanisms such as formalized rules,

procedures, plans, schedules, policies (Adler, 1995; Van de Ven, Delbecq, & Koenig, 1976). Dossick and Neff (2011) refer to the emphasis on explicit knowledge as "the what" (p. 85) information sharing system. Clearly codified coordination mechanisms align well with impersonal forms of coordination that require minimal verbal communication between project participants (Galbraith, 1973). As a type of standard operating procedure (Thompson, 1967) or, in this case, standard reporting procedure, deviations from reporting are easily visible. The IT centric mode is particularly useful when dealing with routine tasks characterized by low uncertainty (Daft & Lengel, 1986; Galbraith, 1973; Tushman & Nadler, 1978).

HRM Centric. The HRM information sharing system focuses on creating tacit knowledge by fostering a discussion based response to the received information (Harman & Brelade, 2000). Tacit knowledge includes wisdom gained through hands-on experiences (Carrillo & Chinowsky, 2006). Dossick and Neff (2011) refer to this as "the why" (p. 85) information sharing system as participants focus on creating a learning environment, where members disseminate or apply lessons learned on previous projects to current project situations. However, documenting tacit information is difficult due to its emergent nature, but can be brought forth through talk and discussion (Whyte et al., 2008). Thus, in addition to explicit information transfer, HRM centric systems make use of face-to-face meetings, liaisons/integrators, white-board discussions, knowledge transfer sessions, and telephonic conversations (Dossick & Neff, 2011), which may particularly be useful in addressing non-routine tasks characterized by high uncertainty (Daft & Lengel, 1986; Van de Ven et al., 1976). In short, HRM centric systems can more easily address issues requiring debate or commentary due its ability to deliver a discussion-based response to the incoming information (Dossick & Neff, 2011).

Several types of product modeling software facilitate the interoperability of information. Design tools like Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) and others (e.g., Building Information Modeling, BIM; Computer Aided Three-dimensional Interactive Application, CATIA) enhance the consistency of information used by participants from different disciplines and help participants generate design alternatives swiftly (Faraj, Alshawi, Aouad, Child, & Underwood, 1999; Liston, Fischer, & Winograd, 2001). Other software like Enterprise Resource Planning (ERP) and Systems, Applications, and Products (SAP) allow organizations to store data at a common platform, which is then available for analysis and interpretation. In addition, Group Support Systems (GSS) allow teams to be productive during meetings by providing electronic support (e.g., screen sharing, group authoring) for members' needs. However, the use of software to post or retrieve data may or may not facilitate team members' interaction over that information. In the first place, the visualization software produce images that support members' coordination efforts (Liston et al., 2001), but the software may not offer (or top management may not have enabled) features that enable team members to expound on the implication of a design addition or change. Consequently, considerable effort may be required to engage members in discussion of a potential or emerging issue. Second, with regard to interdisciplinary teams, these software design tools may have difficulty supporting teams with interchangeable membership. Third, the voluminous and detailed information associated with a complex project can also be overwhelming for project participants (Liston et al., 2001). Consequently, information systems that offer the ability to annotate in a synchronous or asynchronous manner are an important first step in improving designs, reducing unintended consequences, and advancing project success. The extent to which

project managers facilitate interaction among members when necessary or advantageous, whether or not software offers annotation or discussion options, seems to be an important issue.

Project Managers and Information Systems. A rudimentary concern revolves around how project managers make use of available information systems or work around such systems. For instance, in the IT centric information sharing system, a chief role of project managers is to maintain an optimum information reporting procedure and create conversations pertaining to non-routine information. On one hand, project managers seek to maintain schedules and formal reporting procedures, and on other hand, project managers avoid extreme levels of formal reporting procedures as it may lead to frustration and conflict among team members (Van de Ven & Walker, 1984). In keeping with Daft and Lengel (1984, 1986; Lengel & Daft, 1988), these materials are relatively explicit in nature and their meanings and significance would be understood and processed in routine ways. However, equivocality and uncertainty are associated with data entries or their ramification, project managers are known to take the unusual step of hosting informal meetings and promoting discussions to reduce error in project design and outcomes (Dossick & Neff, 2011). Again, possibly operating outside of work unit design, project managers may also monitor the subsequent responses to previous information interactions of team members and stakeholders (e.g., contractors, customers) to insure that members are actively processing available information.

In contrast, project team managers in HRM centric systems are thought to face challenges associated with rich information. Namely, information systems that offer annotation or holding discussions via white-boards enable consultations on issues, creative solutions, and mindful consideration of the ramifications of the team's decisions (Dossick & Neff, 2011). Yet, project managers must still keep projects on schedule and within budget. As such, a considerable

challenge is promoting efficient responses to routine information while promoting discussion-based responses to non-routine information. It is anticipated that project managers regularly host formal meetings to review entries and decisions of team members as well as host informal meetings to discuss non-routine information. Consequently, to better understand the communicative challenges that project managers encounter with prescribed information systems, this study asks,

RQ3 According to team members, what are the communication challenges of project managers when operating with IT-centric and HRM-centric information systems?

Technological Uncertainty

During project initiation, technological uncertainty can impact project coordination mechanisms as well as team members' and project managers' communicative behaviors (Dvir et al., 2006; Shenhar 1998; Shenhar & Dvir, 1996). Uncertainty, in its simplest terms, refers to the difference between the required amount of information to complete a task and the amount of information actually available for organizations' disposal (Galbraith, 1973). Technological uncertainty often begins in the product specification and production processes (Harris & Woolley 2009). In terms of product specification, the project's usefulness, functionality, or quality can be unclear or not specified completely primarily due to the newness of the technology or the project team's unfamiliarity with the technology (Hall & Martin, 2005). With regard to production uncertainty, changes in production technology lead to alterations in the tools, devices, techniques, and knowledge that mediate between input and output (Daft & Lengel, 1986; Tushman & Anderson, 1986), and these alterations are associated with increases equivocality and the need for more and detailed or richer information (Daft & Macintosh, 1981; Daft & Lengel, 1984). As information processing requirements increase and equivocality of the meaning

and importance of information increases, the need for units to engage in face-to-face and group exchanges and hold unscheduled meetings increase (Daft & Macintosh, 1981). A common way to describe levels of uncertainty associated with project initiation and production processes is base, key, and pacing technology (Little, 1981; Roussel et al., 1991; Shenhar & Dvir, 1996).

Base Technologies. Base technologies are relatively well-known and widespread (i.e., mature). These technologies are commonly owned or leased from suppliers, and in most cases production costs associated with technological process are stable (Little, 1981). Projects that incorporate base technology have their designs finalized (e.g., "build to print," Shenhar & Dvir, 1996, p. 36) before the execution phase, such as found in manufacturing, utility, construction, and road-building projects. The project technology in and of itself, in most cases, offers no competitive advantage. Consequently, uncertainty related to base technologies is largely absent, even if projects are on a large scale (Shenhar, 1998).

Key Technologies. These technologies offer some degree of competitive advantage by adding a new throughput or transformation feature (Little, 1981); Roussel et al., 1991). Such projects deliver incremental innovation (Shenhar, 1998) and are typically developmental products within well-established industries (Shenhar & Dvir, 1996). Technological uncertainty in these projects is moderate, and organizations tend to keep a well-known technology as a back-up alternative. Finally, the designs in such projects may go through one or two design cycles and are frozen before the first or second quarter of project execution (Shenhar, 1998).

Pacing Technologies. Pacing technologies exist, possibly in some industries but not in others or have yet to be employed in an industry. As such, they have the potential to displace organization's base or key technologies (Little, 1981). Projects undertaken here may incorporate more than 50% of the new technology in the throughput process or even undertake a new product

line altogether (Shenhar, 1998). Projects in this category include military defense or high-tech industrial products that use newly developed technologies. The technological uncertainty in such projects is high as members deal with non-routine technology and issues (Daft & Lengel, 1986) and discuss the ramifications of these issues (Raz et al., 2002; Song & Montaya-Weiss, 2001). Pacing technologies offer a competitive niche, but are also risky (Shenhar & Dvir, 1996). Finally, the designs in such projects may go through more than two design cycles and are generally frozen by the second or third quarter of project execution (Shenhar, 1998).

Project Managers and Technological Uncertainty. Regardless of the nature of their task, project managers must adapt to the technology with which they are given or, in some cases, are creating. In considering project managers' communication challenges, it may be useful to consider the technological challenges pertaining to the specification and process of the projects. To begin, base technology projects require little or no developmental work, and, before the execution phase begins, the project designs are frozen (Shenhar, 1998; Shenhar & Dvir, 1996; Raz et al., 2002). Given the relatively low levels of technological uncertainty, project efficiency is likely linked with the adoption of standard operating procedures, rules, plans, and carefully designed contractual agreements (Sadeh, Dvir, & Shenhar, 2000). According to Shenhar (1998) and colleagues (e.g., Shenhar & Dvir, 1996), formal channels, documents, standardized forms, and regular meetings provide an adequate basis for information exchange and dissemination. Thus, project managers with base technologies may serve more than adequately in the role of administrator rather than a technical leader, being mainly concerned with keeping projects on schedule, within budget, and aligned with initial project design (Shenhar, 1998).

Project teams using key technology, however, experience medium uncertainty in the technological process related to the project, and they are thought to require occasional

clarification or discussion regarding non-routine information. Thus, project managers may host occasional informal meetings and promote discussions on developments or information considered to be non-routine. Unlike conditions with base technology, project managers involved with key technology are likely to encourage actively information processing of others' data design entries and feedback, provide feedback to project members, and attempt to maintain open communication channels (Daft & Lengel, 1988; Poole, 2011).

Pacing technology projects differ from other technologies in that they involve long periods of development, testing and redesign (with possibly two or three design cycles), and may be frozen in second or third quarter of project execution phase (Raz et al., 2002; Shenhar, 1998; Shenhar & Dvir, 1996). Project managers in these conditions may form clan-type organizational structures, where project and participant goals align, rules, plans, and operation procedures are meticulously followed (Ouchi, 1980; Williamson, 1975). Communication in these projects has been characterized as highly intense, with on-going formal and informal meetings (Shenhar, 1998; Shenhar & Dvir, 1996). Accordingly, project managers disseminate information via asynchronous written and emailed reports, meeting minutes, and memos as well as verbally through synchronous face-to-face conversations with individuals or groups and telephonic means. Due to the dynamic, evolving nature of project issues, project team managers are reported to be in constant discussion with members in order to derive appropriate responses to information requests and problems (Shenhar, 1998; Shenhar & Dvir, 1996). Research across several industries suggests that use of information systems such as BIM (Dossick & Neff, 2011), CAD/CAM (Adler, 1995), and Computer-Augmented Design And Manufacturing (CADAM, Argyres, 1999) are in-and-of-themselves not sufficient to achieve the degree a high level of integration and information sharing. Rather, these coordination modes must be complemented

with the regular tools that promote rich information sharing (Jensen, Johansson, & Lofstrom, 2006; Lengel & Daft, 1988; Van de Ven et al., 1976).

In order to better understand the communicative challenges that project managers encounter with technological uncertainty, this study asks,

RQ4 According to team members, what are the communication challenges of project managers when working with base, key, and pacing technologies?

Project Success

The successful accomplishment of project goals is of paramount importance to the project team, management, customers, and shareholders. Each interest group (e.g., shareholders, customers) can define success differently. For most managers, successful project delivery means finishing the project on time, within budget, and according to specifications (Dvir et al., 2006). Yet, user requirements must also be met if recurring business has to be achieved. Consequently, Muller and Turner (2007, 2010) and others (e.g., Sadeh et al., 2000; Dvir et al., 2006) report that client satisfaction is also a vital criterion for project success, and the measurement of project success must reflect a range of different viewpoints.

According to Sadeh et al. (2000), project success consists of at least four dimensions that include meeting design goals, benefit to the end user, benefit to the developing organization, and benefit to the national and defense infrastructure. Other criterion include meeting project's overall performance, user requirements, client and end-user satisfaction, supplier satisfaction, project team's satisfaction, and stakeholder's satisfaction (Muller & Turner, 2007, 2010).

Projects are a set of interconnected activities with pre-defined goals and time, while utilizing well defined resources (Hobday, 2000). One of the biggest challenges faced by project team members is information dissemination due to the diverse array of team members, who may

or may not have worked together in the past and may have unique points of views and interests (Ajmal & Koskinen, 2008). Thus, coordinating tasks across disciplines and sharing information across organizational departments (Baiden & Price, 2011) is an explicit and implicit task of project leaders. At times, project managers emphasize team cultures that facilitate decision making norms and coordination (Ajmal & Koskinen, 2008). Prior research suggests relationships between project success and project managers' leadership styles, especially with regard to emotional, managerial, and intellectual competencies (Muller & Turner, 2007, 2010), and project managers' personalities that include personality dimensions such as openness to experiences, driven by punctuality, risk-taking tendency, and investigative and enterprising (Dvir et al.,2006). However, this study seeks to explore the relationship between project managers' communication behaviors, implicit in prior work, and project success. Messy talk, monitoring, and open communication environment are the backbone to information dissemination, which is at the heart of project success (Baiden & Price, 2011). Initiating structure and planning are essential to effective unit functioning (Morgeson et al., 2011; Sydow, Lindkvist, & DeFillippi, 2004). Consequently, this study asks,

RQ5 What is the relationship of project team member's perceptions of their project leaders' communication behaviors, information system use, and technological uncertainty to project success?

CHAPTER TWO

Methodology

Sample

This study pursued a purposive sample of experienced project team members in order to explore the relationships identified in this research. Therefore, the study focused on organizational members who had worked on project teams and had two or more years of work experience in large engineering, information technology, building and construction, and manufacturing industries. Such organizational members were thought to have had a range of experiences with a range of project managers, worked with several team members, and performed several roles as members of project teams. The targeted sample included engineering graduates working in construction, software, manufacturing, mechanical, and automobile industries in India and United States. A total of 335 individuals were sent invitations to complete the survey through emails, social media, and third party contacts. Although considerable organizational culture differences exist between these two countries (Hofstede, 1983), each nation has well-developed engineering-based education systems that feed into information technology, construction, and manufacturing industries. Therefore, the American and Indian samples were combined.

One hundred and fifty-seven individuals responded to the invitation to participate in the research study, a 47% response rate. Fifty-two responses either contained incomplete data or missing values, thus these responses were removed from the study resulting in 105 usable responses. Based on information provided by these participants, they are best described as: mostly young (M = 27.2, SD = 3.3), male (n = 68, 74%; 24 females, 26%); highly educated (bachelor's degree, n = 49, 53%; master's degree, n= 41, 44%, doctorate, n=3, 3%) majoring in

the computer science (n = 26, 35%) and electronics fields (n = 23, 31%). Research participants worked in the information technology (n = 45, 53%), computer science (n = 19, 22%), mechanical (n = 9, 11%), and manufacturing (n = 8, 9%) industries. Participants' projects were chiefly delivered to companies in the United States (n = 72, 61%), India (n = 46, 39%), and United Kingdom (n = 15, 13%) into the construction (n = 10, 9%), manufacturing (n = 18, 16%), software (n = 76, 66%), and automobile (n = 11, 10%) industries. In addition, participants worked for mostly male managers (n = 91, 91%), in project teams whose members belonged to same organization (n=102, 76%), operated from more than one physical location (n=83, 61%), and met face-to-face for important meetings (n=101, 75%).

Procedure

Several studies focus on project team managers' self-reports (e.g., Cohen, Ornoy, & Keren, 2013; Dvir et al., 2006). However, this study sought to avoid biases related to self evaluations and to better understand, from project team members' point of views, the work context in which the project team is situated. In addition, assessing the viewpoint of a second party was thought to enable researchers to move away from idealized depictions of project team leader communication behaviors toward competency depictions based on what the context required and the extent to which project team leaders manifested behaviors relevant to satisfactory performance (Jablin et al., 1994; Jablin & Sias, 2001).

Survey requests were sent to individuals working in select industries and to graduates from Amravati University who met the study's minimal qualifications. These individuals were contacted through personal contacts via email and social media. Also, through industry contacts, permission from managers and human resource personnel was granted to ask individuals, who fit the study's minimal qualifications, to participate in the research study. In most cases, managers

and human resources personnel sent emails to such individuals, copying the researcher on emails. Organizational members were given four weeks to complete the survey questionnaire voluntarily, and the researcher sent two friendly reminders.

As noted earlier the sample size was reduced to 105 participants, and even within their responses, there were occasional missing item scores to the measurement scales. These data were handled via SPSS' mean function procedure, which aggregated and then averaged existing scale item responses to form an overall response score. Rather than substitute the average score or insert a new value for missing items, the mean function calculates the mean using only those items that were reported (e.g., using the four out of five possible responses). The mean function procedure assumes a flat inter-item correlation matrix with items contributing equally (Hunter, 1980; Hunter and Gerbing, 1982) and allowed the researcher to retain as many responses as possible without data imputation or mean score replacement. All further data analyses were computed using listwise comparisons.

Measures

Four group-focused communication constructs were assessed in this study through survey measures: Messy talk, monitoring, open communication environment, and initiating structure and planning. The project team context was assessed through two constructs, information systems and technological uncertainty. The criterion variable, perceived project success, was also measured through a survey instrument collected at the same time as the other measures. All measures were simultaneously subjected to a principal component, varimax rotation factor analysis. Results of the factor analysis are reported in Table 3.

The survey first asked participants to indicate the perceived importance of messy talk, monitoring, open communication environment, and initiating structure and planning to the

project. The prompt for perceived importance responses read, "In your opinion, with regard to your most recent/current project team experience, please indicate how important were/are the following behaviors of the project manager in addressing the challenges of the project." The scale anchor set for perceived importance ranged on a scale of 1-5 from "not important" to "very important." The survey then asked participants to indicate their perceptions of "actual" or enacted messy talk, monitoring, open communication environment, and initiating structure and planning behaviors. This second prompt, inquiring into the enactment of those behaviors, read, "As you reflect on your Project Manager's behaviors during this project, please indicate the extent to which your Project Manager demonstrate the following behaviors." Scale anchors ranged on a scale of 1-5 from "to a very little extent" to "to a very great extent."

Factor analyses were conducted in the following manner. First, the four perceived importance communication scales plus information systems, technological uncertainty, and project success scales were computed through SPSS principal components, varimax rotation simultaneously. Items not loading or cross loading on multiple factors were dropped. As discussed below, dropped scales included monitoring as well as initiating and planning structure. Second, perceived importance of messy talk and open communication environment scales, actual messy talk and open communication environment scales along with information systems, technological uncertainty, and project success scales were computed at the same time. All scales demonstrated heterogeneity except for actual messy talk and open communication environment scales, which loaded on the same factor. When the actual open communication environment scale items were removed from the analysis, all items loaded on their respective factors. Subsequent factor analyses with actual messy talk scale items with project success scale items and open communication environment with project success scale items demonstrated

heterogeneity, respectively. Consequently, a factor analysis was performed on perceived importance of messy talk, perceived importance open communication environment, actual messy talk, information systems, technological uncertainty, and project success scales, and these results are reported in Table 3. As the average inter-item correlation for the open communication environment-actual scale items, when subjected to the multi-scale factor analysis and the bi-scale factor analysis, remained at r = .64 and the scale demonstrated a unique factor structured when compared to project success, the scale was retained and its factor loadings when analyzed with project success are reported in Table 3.

Messy Talk. A chief behavior of project managers in the team or group setting pertains to communication behaviors that enhance group or team coordination and information sharing processes. Projects can be a combination of routine, day-to-day problems and non-routine, new problems. Dossick and Neff (2011) suggest that project team members may have to engage in messy talk in order to effectively deal with these complex and/or new problems. Project managers' ability to facilitate discussion is one of the communication behaviors this study attempts to measure. As noted earlier, messy talk is defined as "the interstitial dialogue between and after formally organized agenda items" (Dossick & Neff, 2011, p. 84). To examine the extent to which project managers facilitate messy talk, items were developed around three key elements or components: interstitial dialogue or the interspersing of commentary or idea generation during ideation flow on online software, conversation prior to and following meetings, and general discussion of issues and ideas. Items related to this construct are presented in Appendix A.

Factor analytic results of the importance of messy talk revealed a five item, unidimensional factor, accounting for 12% of the variance (see Table 3). A subsequent factor analysis of reported actual messy talk indicated that its five items loaded on the same factor as

the five-item reported actual open communication environment. The factor comprising these combined scales accounted for 18% of the variance. For comparison purposes in this study, the five-item reported actual messy talk scale was entered as a separate variable in subsequent analysis as (a) the perceived importance of messy talk scale constituted a separate factor and (b) the reported actual use of messy talk scale also constituted a separate factor when run without reported actual open communication environment.

Monitoring. Monitoring refers to actions of observation and feedback. Morgeson et al. (2009) define monitoring as the examination of team's processes, performance, and the external team context. Monitoring a team can take different forms, including observation of work operations, reading written reports, holding progress review meetings, and inspecting quality of work (Yukl et al., 2002). Luthans and Lockwood (1984), Morgeson et al. (2009), and Yukl et al. (2002) suggest monitoring at the team level has three manifestations: checking project and team member performance, checking operations, and keeping the project on track and within budget. In creating a measure of monitoring, this study incorporated items from Luthans and Lockwood (1984), Morgeson et al. (2009), and Yukl et al. (2002), which are reported in Appendix B.

Results of the factor analysis revealed that a majority of the monitoring items cross-loaded on the reported actual messy talk factor, with items of both scales correlating between $r = .45$ and $r = .70$. As messy talk and monitoring depict two distinct behaviors and represented an instance of multicollinearity, monitoring scale was subsequently dropped from the study.

Open Communication Environment. Maintaining open communication environment within the team has been identified as critical to project, unit, and organizational success (e.g., Dvir et al., 2006; Malach-Pines et al., 2009; Poole, 2001). An open communication environment refers to an environment in which members perceive others to be willing and receptive listeners,

Table 3. *Results of the Principal Component, Factor Analysis and Cronbach's Alphas*.

Factors, Scale Items, and Cronbach Alphas	Factor Loadings
Messy Talk - Perceived Importance[a] (α = .89)	
In your opinion, with regard to your most recent/current project team experience, please indicate *how important* were/are the following behaviors of the project manager in addressing the challenges of the project.	
• encourage team members to incorporate discussion tools (e.g. whiteboards or blackboards, notepads, visual diagrams or models) during meetings?	.64
• encourage team members to raise concerns during face-to-face or online meetings?	.71
• converse with others about design or task issues during face-to-face or online meetings?	.82
• prompt members to make comments, annotate, or raise questions using software (e.g. group support systems, product model software)?	.75
• encourage project team members to engage in discussions after face-to-face or online meetings?	.72
Open Communication Environment - Perceived Importance[a] (α = .92)	
In your opinion, with regard to your most recent/current project team experience, please indicate how important were/are the following behaviors of the project manager in addressing the challenges of the project.	
• encourage team members to talk openly with each other?	.78
• encourage team members to talk to openly to him/her regarding task related issues?	.77
• make sure all team members were sharing information about the project?	.73
• help team members to be comfortable sharing issues/problems with each other?	.84
• make members comfortable in asking advice from others?	.79
Information Systems[a] (α = .81)	
• To what extent did the information sharing mediums allow members to ask questions and obtain answers as they arise?	.70

Table 3 (Cont'd)

• To what extent did the information sharing mediums allow members to have discussions (e.g., group chat, whiteboard, annotations) before responding or executing a task?	.87
• To what extent did the information sharing mediums support multiple communication cues such as body language, voice, tone, etc.?	.84
Technological Uncertainty[a] (α = .60)	
• To what extent have project teams in your organization used this technology in the design process or throughput process?	.70
• To what extent did the project go through multiple design cycles before it reached final configuration and final specification (i.e., frozen)?	.78
• To what extent did the project involve computerized planning?	.53
Project Success[a] (α = .88)	
• were the suppliers satisfied with the project's product or service?	.74
• were other stakeholders satisfied with the project's product or service?	.70
• did the project meet its overall performance goals (functionality, budget and timing)?	.57
• were the user requirements met?	.80
• was the project's purpose met?	.50
• was the client satisfied with the project results?	.75
• was the project successful (based on what you define as success)?	.50
Messy Talk - Actual Behaviors[a] (α = .87)	
As you reflect on your Project Manager's behaviors during this project, please indicate *the extent* to which your Project Manager demonstrate the following behaviors.	
• encourage team members to incorporate discussion tools (e.g. whiteboards or blackboards, notepads, visual diagrams or models) during meetings?	.56
• encourage team members to raise concerns during face-to-face or online meetings?	.72
• converse with others about design or task issues during face-to-face or online meetings?	.60

Table 3 (Cont'd)

• prompt members to make comments, annotate, or raise questions using software (e.g. group support systems, product model software)?	.66
• encourage project team members to engage in discussions after face-to-face or online meetings?	.62
Open Communication Environment - Actual Behaviors[b] (α = .90)	
As you reflect on your Project Manager's behaviors during this project, please indicate *the extent* to which your Project Manager demonstrate the following behaviors.	
• encourage team members to talk openly with each other?	.72
• encourage team members to talk to openly to him/her regarding task related issues?	.61
• make sure all team members were sharing information about the project?	.87
• help team members to be comfortable sharing issues/problems with each other?	.81
• make members comfortable in asking advice from others?	.70

[a] Factor loadings derived from multi-scale analysis.
[b] Factor loadings derived from analysis with open communication environment – actual behaviors and project success scales.

and avoid giving responses which might be seen as negative (Eisenberg & Witten, 1987). Open communication environments are characterized by supportiveness, participation, and candid sharing of feelings (Redding, 1972). To measure the extent to which project managers facilitate open communication environments in their teams, items were incorporated from prior studies (e.g., O'Reilly and Roberts, 1977) and literature reviews (e.g., Poole, 2011; Redding, 1972) as well as were created and are reported in Appendix C.

Results of the factor analysis of the importance of open communication environment revealed a five-item unidimensional factor, accounting for 13% of the variance. As noted earlier, a subsequent factor analysis of reported actual open communication environment loaded on the

same factor as the five-item reported actual messy talk factor. For comparison purposes in this study, the five-item reported actual open communication environment scale was entered as a separate variable in subsequent analysis as (a) the perceived importance of open communication environment scale constituted a separate factor and (b) the reported actual use of open communication environment scale also constituted a unique factor when run without the reported actual messy talk scale.

Initiating Structure and Planning. A series of recent articles (e.g., Kozlowski & Bell, 2011; Morgeson et al., 2010) point to the importance of examining leadership purposefully at the group level and suggest that behaviors associated with structuring and planning as essential for work group success. The ability to initiate structure (e.g. incorporate standard reporting procedures) requires both knowledge and social skills and project managers' ability to initiate structure is one of the most commonly operationalized component in project management literature. Morgeson et al. (2010) state that structuring and planning a team involves "determining or assisting in determining how work will be accomplished (e.g., method), who will do which aspects of the work (e.g., role clarification), and when the work will done (e.g., timing, scheduling, work flow)" (p. 12). Manifestations of project managers' ability to initiate structure include creating order and standardizing procedures, clearly explaining task objectives, clearly stating role expectations, and planning and scheduling (Ammeter & Dukerich, 2002; Anantatmula, 2008; Ekvall & Arvonen, 1991; Sommerville et al., 2010; Thamhain, 1999; Yukl et al., 2002).

To measure initiating structure and planning, this study employed Morgeson et al.'s (2010) establish expectations and goals and structure and plan scales, reported in Appendix D. Factor analytic results revealed that the importance of structuring and planning cross-loaded on

the perceived importance of communication factor, with items between scales correlating between r = .42 and r = .67. As the importance of initiating structure and planning scale cross-loading on the importance of open communication environment scale items represented an instance of multicollinearity, the initiating structure and planning scale was subsequently dropped from the study.

Information Systems. As noted earlier, IT-centric information sharing systems circulate explicit information among its members (Earl, 2001). Examples of explicit information that typically are included in IT-centric systems are standard operating procedures, best practices guide, drawings, 3D models, task assignments, and contracts (Carrillo & Chinowsky, 2006). HRM-centric information sharing system include explicit information in IT-centric systems but enable the sharing of tacit knowledge by fostering discussion-based responses to received information (Harman & Brelade, 2000). HRM-centric systems, in addition to explicit information transfer, make use of face-to-face meetings, white-board discussions, telephonic conversations, integrators, knowledge transfer sessions, and (Carrillo & Chinowsky, 2006).

For this study, project team use of IT-centric and HRM-centric systems was conceptualized as operating on a continuum, ranging as it were from less information rich assignments, models, reports to more information rich dialogues and creative brainstorming (Daft & Lengel, 1986). Items for this construct were drawn from concepts and examples from several field observation studies (e.g. Carrillo & Chinowsky, 2006; Dossick & Neff, 2011; Whyte et al., 2008) and are reported in Appendix E. Results of a principal components factor analysis revealed a three-item, unidimensional factor, accounting for 7% of the variance.

Technological Uncertainty. The foundational aspects of base, key, and pacing technologies are well-known means of describing the maturity of throughput technologies and

the uncertainty related to idea or product transformational processes (Little, 1981; Shenhar, 1998; Shenhar & Dvir, 1996). Uncertainty related to these technologies is conceptualized as ranging from minimal in base contexts to maximum in pacing contexts: (a) in base technology, there are relatively few surprises in using or adapting the technology in product creation; (b) key technologies projects deliver incremental innovations and are associated with moderate technological uncertainty; (c) uncertainty in pacing technology projects is high as members deal with non-routine matters and issues, and members must regularly discuss the ramifications of these issues (Daft & Lengel, 1986; Raz et al., 2002; Song & Montaya-Weiss, 2001).

To determine what type of technology was undertaken by project team members, items were adapted from previous literature reviews (e.g. Little, 1981; Roussel et al. 1991) and research investigations (e.g. Shenhar, 1998; Shenhar & Dvir, 1996) as well as created for this study and are reported in Appendix F. Results of the factor analysis revealed the presence of a two-item, unidimensional factor, named technological uncertainty. This factor accounted for 5% of the variance.

Project Success. Cooke-Davies (2002) defined project success as the achievement of planned business results using the project's outcome. Muller and Turner (2007, 2010) state that project success is not a fixed target and it comprises of several factors including the end-users', clients', suppliers', stakeholders' and project team members' satisfaction. The ten-item project success scale was adapted from Muller and Turner's (2007, 2010) work. Scale items used are reported in Appendix G. Factor analytic results indicated a seven-item, unidimensional factor, accounting for 11% of the variance, and are comparable to results presented in Muller and Turner's (2010) factor analysis.

Project Manager. Organizational titles, for those who oversee others' overall efforts to accomplish project goals in a team setting, are known primarily by two titles, project manager and project leader (Ajmal & Koskinen, 2008; Chen, 1997; Hobday, 2000; Kerzner, 1979). To avoid confusion, this study first asked participants to state the title of the individual: "Across different industries and organizations, a range of titles are given to those individuals whose responsibility is to plan, organize, control, and direct resources to accomplish specific goals. These individuals oversee the project's progress, monitor team members, coordinate their activities, disseminate information, and deal with other management issues." Second, the electronic survey inserted the exact same title named by participants when asking them to respond to scale items related to the project manager. The electronic insertion was an effort to focus participants' attention on the same individual and avoid potential confusion from the use of multiple titles (e.g., project manager, project lead, delivery manager).

Research Design

This study was primarily a descriptive one. The study initially sought to obtain profile characteristics related to project team members' perceptions of the managers' communicative behaviors. In particular, they were asked to identify how important certain project manager communication behaviors were in their current or most recent project and how well their project managers performed those particular communication behaviors.

Next, the study sought to determine the association between the importance and manifestation of project manager communication behaviors, the projects' information system use, technological uncertainty, and perceived project success. The association of communication behaviors and systems and context with project success as the criterion variable was tested through multiple regression, stepwise procedure.

CHAPTER THREE

Results

Variable means, standard deviations, and bivariate correlations are reported in Table 4. The first research question inquired into team members' perceptions of the importance of project managers' communication behaviors. Analysis of mean scores indicated that responses to messy talk-perceived importance (M = 4.02, SD = .77) and communication environment-perceived importance (M = 4.16, SD = .80) were significantly different, $t(90) = -1.96$, $p = .05$, $\eta^2 = .04$.

Table 4. *Means, Standard Deviations, and Bivariate Correlations.* [a]

	Variable	$\bar{x}$	s.d.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1)	Messy Talk - Perceived Importance	4.02	.77	-						
(2)	Messy Talk - Actual Behaviors	3.83	.80	.66	-					
(3)	Open Communication Environment - Perceived Importance	4.16	.80	.60	.62	-				
(4)	Open Communication Environment - Actual Behaviors	3.87	.86	.56	.84	.59	-			
(5)	Technological Uncertainty	3.55	.88	.36	.35	.17	.30	-		
(6)	Information Systems	2.97	1.00	.11	.21	.16	.08	.19	-	
(7)	Project Success	3.79	1.20	.20	.30	.08	.24	.25	.29	-

[a] N=97; r greater than .19, p<.05

The second research question sought to learn team members' perceptions of differences between the importance of project managers' communication behaviors and their enactment. A paired samples t-test compared the perceived importance of messy talk (M = 3.99, SD = .77) and reported actual messy talk (M = 3.83, SD = .80), indicating a significant difference between the two means, $t(91) = 2.34$, $p = .02$, $\eta^2 = .06$. A similar paired samples t-test compared differences between the perceived open communication environment (M = 4.17, SD = .74) and reported actual open communication environment (M = 3.88, SD = .86) and found a significant difference, $t(84) = 3.69$, $p = .001$, $\eta^2 = .14$, between the means. An additional post-hoc analysis revealed that

perceptions of messy talk - actual reported (M = 3.87, SD = .76) and open communication environment - actual reported (M = 3.87, SD = .86) were not significantly different.

The third research question inquired into the communication challenges of project managers with their information system use. Comparisons of project team members' reports of information system use did not significantly vary across the industry to which the project was delivered, whether team members were co-located or not, and whether or not they were from the same organization.

The fourth research question sought to assess communication challenges of project managers associated with technological uncertainty. Project team members responses indicated a significant association between technological uncertainty and messy talk – perceived importance (r = .36), messy talk – actual behaviors (r = .35), open communication environment – actual behaviors (r = .30), and use of information systems (r = .19). Additional comparisons of project team members' reports of technological uncertainty did not significantly vary across the industry to which the project was delivered, whether team members were co-located or not, and whether or not they were from the same organization.

The final research question examined the relationship of project team member's perceptions of their project leaders' communication behaviors, information system use, and technological uncertainty with project success. Results of a stepwise linear regression revealed that messy talk – actual behaviors (β = .25, t = 2.40, p <.02) and use of information systems (β = .24, t = 2.28, p <.03) significantly predicted project success (R^2 = .15). No other variables contributed significantly to the equation.

CHAPTER FOUR

Discussion

Over the years, construction, engineering, and information technology industries have benefited in a number of ways from the use of collaborative project teams (Adler, 1995; Barringer & Harrison, 2000). In particular, project teams can maximize the knowledge and skills of members, facilitate members' negotiating divergent opinions, and integrate a constant flow of information in addressing complex issues (Adler, 1995; Dossick & Neff, 2011; Muller & Turner, 2010). Project teams are especially important for organizations that want to achieve intra- and inter-organizational coordination and develop innovative and efficient processes (Lawrence & Lorsch, 1969).

Communication behaviors in project team settings, such as messy talk, monitoring, open communication environment, and structuring and planning, have been observed to enhance coordination and information sharing efforts of project managers (e.g., Dossick & Neff, 2011). There has been considerable interest in exploring communication behaviors of project managers associated with effective performance (e.g., Crawford, 2005; Edum-Fotwe and McCaffer, 2010; Henderson, 2008). Yet, as noted before, many earlier studies exploring communication behaviors of project managers are prescriptive and anecdotal in nature, and investigations rarely focus on the communication behaviors of project managers that have implications for group or team outputs. In the context of prior project manager research, this study advances a set of behaviors associated with information analysis and refinement, not the typical listing of idealized structuring and planning behaviors (e.g., Globerson & Zwikael, 2002). Moreover, these communication behaviors are linked to team settings and effective team performance. By comparing team members' perceptions of the importance of their project managers'

communication behaviors to the demonstrated project managers' communication behaviors in their most recent project, this research moves closer to understanding what project team members perceive to be important communication behaviors enacted by their project managers and the consequences of those communicative acts.

Messy Talk

Messy talk is particularly valuable as a communication construct as it explores "interstitial dialogue" (Dossick & Neff, 2011, p. 84) among project team members during brief episodes or over long periods of time. Messy talk is thought to assist in effectively parsing out confounding elements within complex and/or new problems (e.g., Liston, Fischer, & Kunz, 2000; Liston et al., 2001). Studies indicate that project managers can also encounter considerable difficulty coordinating tasks across disciplines and sharing information across the organizational departments (Baiden & Price, 2011). Even if organizations use various product-model software for sharing information across disciplines, software only improves the interoperability of information; software usage alone does not foster the explication of design inputs that are often discipline-specific and where others are not cognizant of their implications (Dossick & Neff, 2011; Liston et al., 2001). In such scenarios, it is vital for project team managers to spur messy talk to address effectively complex issues.

The term, messy talk, originates from building and construction industry (Dossick & Neff, 2011), but it has clear relevance to other project based industries. A major function of messy talk is to spur discussions that help team members engage in complex projects to consider the ramifications of past and impending actions. As applied to other industries, messy talk can also address the need of project members to go beyond data entry and assuming that others are knowledgeable of the consequences of decisions in design, development, and testing or analysis

phases (Adler, 1995). In any project, be it construction, manufacturing, software, or electronics industry, disseminating information and spurring conversations is deemed to be of vital importance and associated with better product quality and cost (Adler, 1995; Dvir et al., 2006; Malach-Pines et al., 2009).

Messy talk, by iterative exchanges and permission to revisit issues, assists members by jogging their mental associations of past experiences and creating temporal venues to learn different perspectives and generate unique solutions (Dossick & Neff, 2011). Both Adler (1995) and Liston et al. (2001) state that use of visual tools and conversational references help individuals to better solve problems and raise concerns or issues related to problems. A major assumption with regard to project manager communication competencies is that project managers across all industries will recognize the need for and facilitate messy talk when addressing complex issues, especially under conditions of high technological uncertainty.

This study reports the development of a five-item scale to measure messy talk. Following Dossick and Neff (2011), the items assessed means for spurring dialogue by using discussion tools (e.g. whiteboards, notepads, visual diagrams) during meetings, raising concerns during and after meetings, discussing face-to-face on task or design related issues, and prompting or annotating using software. In this study, around 80% of participants' projects involved medium or high levels of technological uncertainty, which would be appropriate for messy talk engagements. In the present study, messy talk - actual reported and technological uncertainty were also significantly correlated ($r = .35$), suggesting evidence for concurrent validity. Future research investigating messy talk should consider the conversational references (Dossick & Neff, 2011), which both precede and are embedded in the discussion of project issues. Certainly, greater attention to the history amongst the parties involved, politics within teams and

organizations, and the norms of project team interactions would provide insights into challenges of facilitating messy talk and maximizing its use.

Open Communication Environment

The measure of open communication environment, created for this study, focused on identifying project managers' communication behaviors that encouraged team members to talk openly with each other, talk openly regarding tasks, share information about the project, and help them feel comfortable seeking advice and sharing issues/problems with each other. Poole (2010) stated that an open communication environment is a one in which members perceive others to be willing and receptive listeners, and avoid giving responses which might be seen as interpersonally negative (Eisenberg & Witten, 1987). Such workgroup environments have parallels to conceptualizations of ideal communication climates (Redding, 1972), marked by supportiveness, participation, and information sharing. The five-item scale for open communication environment may be said to have face or content validity as assesses the aspects of open communication climates identified in earlier research (Jablin & Sias, 2001; Redding, 1972). Pertinent to project manager behaviors, items here not only asked questions about openly sharing information with other team members, but also about asking advice and sharing information with managers.

Both messy talk – importance with open communication environment – importance and messy talk – importance with open communication environment – actual were significantly correlated ($r = .60$, $r = .84$, respectively), suggesting concurrent validity. It is important to note that participants worked in a range of industries, from construction, engineering, information technology, manufacturing, electronics, and automobile to mechanical. Additional investigations are needed to understand the relationship between enactment of messy talk behaviors and open

communication environments. For instance, project teams interfacing with base technologies, where messy talk may be rarely needed, might have open communication environments but little report of messy talk behaviors.

Project Success

A number of factors contribute to project success, whether success is determined from the end-users', clients', suppliers', stakeholders' or project team members' perspectives (Dvir et al., 2006; Muller & Turner, 2007, 2010; Sadeh et al., 2000). Though project success has been tied to project managers' leadership styles and personality orientations (Dvir et al., 2006; Muller & Turner, 2007, 2010), the nature of communicative behaviors associated with project success has been speculative in nature. The findings here, that messy talk-actual behaviors and use of information systems were significant predictors of project success, are particularly helpful as both messy talk and open communication environments address the coordination challenges associated with diverse membership and decision making norms (Ajmal & Koskinen, 2008; Baiden & Price, 2011).

Although these findings are preliminary in nature, questions regarding the development of project team managers' and team members' messy talk skills immediately come to mind. Specifically, what skills are necessary to interface with both technological skills such as a whiteboard and the interpersonal skills to persist in directing team members to the implications of an action? What training best facilitates leaders' and members' vigilantly engaging in messy talk behaviors over an extended period of time? Similarly, how is an open communication environment created and sustained in a project team setting? The elements of an open communication climate, a theoretically related construct, have been long known (Redding, 1972), but how to cultivate an open environment is less known. Given prospective importance of

messy talk and open communication environments, it is hoped that future investigations will explore the relationship of these behaviors in project team settings.

Limitations

In an effort to gain greater insight into the communication behaviors of project managers, this study sought out individuals with two years of project team experience. The rationale for seeking this sample population was to avoid project managers' self-reports (e.g., Dvir et al., 2006). The present study's sample consisted of 157 individuals, out of which there were approximately 100 usable responses, which hindered the ability to identify weak statistical associations (Cohen, 1988), in part due to large confidence intervals ($r = \pm .13$ at $p<.05$). The relatively small sample size also introduces volatility into factor loadings and dimensionality for principal components factor analyses. Thus, findings from this study should be viewed with caution pending further testing.

The study also sought to investigate projects across a range of industries. However, the sample was skewed towards software and electronics, and responses from participants in those industries may not be readily applicable to manufacturing industries, for example. The scale developed for technological uncertainty initially composed of six items. Following factor analytic tests, the remaining three items (e.g., to what extent did the project go through multiple design cycles before it reached final configuration and final specification/i.e., frozen?) may also be more suitable for high tech industries versus the manufacturing industry. At the same time, it should be noted that significant differences in information systems and technological uncertainty were not found due to industry type, bolstering confidence in the generalizability of the findings across industries and pointing to the need to consider differences in technological uncertainty in future investigations as potential moderators.

In terms of other investigations of project managers across a range of industries (e.g., agriculture, chemistry, commercial high tech, construction, defense, engineering, information and telecommunication, software), limited comparisons of their samples (Dvir et al., 2006; Malach-Pines et al., 2009; Muller & Turner, 2010; Turner et al., 2009) with the present study are possible. Distributions of males and females, educational achievement, and popular product delivery locations (e.g., North America) are similar. Other studies tend to sample individuals who are older in age (e.g., M = 38 years, Dvir et al., 2006). However, this study sought to access the perceptions of team members, who with two years project team experience, could report on their project managers. As such, participants in this study were younger (M = 27.2, range 24 to 43).

As individuals might perceive project teams' communication needs differently with a greater number of project team experiences, future investigations should endeavor to secure a sample with a broader age range as well as range in project team experiences. Differences in perceptions where greater need for messy talk, for example, is associated with age or number of experiences might suggest individuals receiving assignments of greater difficulty or longer duration.

In terms of assessing the internal validity of measures in this study, factor analytic tests provided insights into the association and dimensionality of scale items. Confidence in the scale validity would be increased by sampling individuals from a range of industries and who are at various stages of project completion (e.g., design phase, delivery phase, maintenance phase). In addition, reports from project team members about their team managers would be bolstered by open-ended questions asked through structured interviews that may provide insights into the emergence and use of messy talk behaviors and open communication environments.

Future Research

Organizations strategically (or unwittingly) structure their project teams to immerse their members in explicit information or to develop tacit knowledge (Carrillo & Chinowsky, 2006; Dossick & Neff, 2011; Whyte et al., 2008), which speaks to the need to understand the use of messy talk, especially in tacit knowledge contexts. Table 5 presents a framework for how project managers' communication behaviors might vary across technological uncertainty environments and information system availability. The materials in the table emerge from an agency orientation, where the project manager is assumed to be responsible for capitalizing on opportunities and address project challenges or match their abilities with the present contingency. For the sake of brevity, only the aspects of coordination challenges are presented here.

Where project team information system are a primary organizing tool, IT centric information systems provide its users with information through advanced design tools, emails, standard operations guides, diagrams, charts, rules, plans, and schedules (Adler, 1995; Dossick & Neff, 2011). In base technology projects, managers are likely to act primarily as administrators and focus their energies on keeping project schedule on track, within budget, and aligned with initial project design (Shenhar, 1998). Major communication challenges in IT-centric information system facing those project managers include: creating conversations among participants; and prompting participants to discuss the implications of data entry iterations.

Key technology projects typically have weekly or biweekly meetings, but BIM and CAD systems alone may not facilitate sufficient integration. Hence, project managers are likely to host occasional informal meetings and promote discussions on non-routine information, actively encourage the sharing of tacit knowledge, provide feedback, and maintain open communication

Table 5. *Integrated Framework of Technological Uncertainty and Information Systems*

Information Sharing Modes	*Technological Uncertainty*		
The "What"/ IT Centric	**Base Technology**	**Key Technology**	**Pacing Technology**
	1. Projects deal with base technology and little or no developmental work	1. Projects deal with key technology and some developmental work	1. Projects deal with pacing technology and lot of developmental work
	2. Design and specifications clearly stated before execution phase	2. Design and specifications go through a few design cycles before execution phase	2. Design and specifications go through multiple design cycles before execution phase
	3. Members mostly deal with routine information and gather known objective data	3. Members deal with routine and occasional non-routine information; gather known and new objective data	3. Members mostly deal with non-routine information and gather new objective data
	4. Action based response to routine information is expected	4. Action based response to routine information is expected	4. Action based response to routine information is expected
	5. Explicit information transferred via diagrams, models, and structures	5. Explicit information transferred via diagrams, models, and structures	5. Explicit information transferred via diagrams, models, and structures
	6. Project manager keeps design schedule on track, and project within budget	6. Project manager keeps design schedule on track, and avoids excessive design changes	6. Project manager is flexible with design schedule, and ensures some slack time before design is finalized
	7. Project manager monitors quick responses to routine information	7. Project manager monitors quick responses to routine information, and promotes discussion based responses to non-routine information	7. Project manager promotes discussion based responses to both routine and non-routine information
	8. Project manager hosts monthly or bimonthly formal meetings and promotes discussions on updates and routine information	8. Project manager hosts weekly or biweekly formal meetings and promotes discussions on updates and routine information	8. Project manager hosts frequent formal meetings and promotes discussions on routine information and its impact on non-routine information
	9. Project manager hosts sporadic informal meetings to create conversations that will not normally happen	9. Project manager occasionally hosts informal meetings to promote discussions on non-routine information	9. Project manager hosts regular informal meetings to promote continuous discussions on non-routine information

Table 5 (Cont'd)

Information Sharing Modes **The "Why"/ HRM Centric**	*Technological Uncertainty*		
	Base Technology	**Key Technology**	**Pacing Technology**
	1. Projects deal with base technology and little or no developmental work	1. Projects deal with key technology and some developmental work	1. Projects deal with pacing technology and lot of developmental work
	2. Design and specifications clearly stated before execution phase	2. Design and specifications go through a few design cycles before execution phase	2. Design and specifications go through multiple design cycles before execution phase
	3. Members mostly deal with routine information and gather known objective data	3. Members deal with routine and occasional non-routine information; gather known and new objective data	3. Members mostly deal with non-routine information and gather new objective data
	4. Decision based response to non-routine information is enabled via 'messy talk'	4. Decision based response to non-routine information is enabled via 'messy talk'	4. Decision based response to non-routine information is enabled via 'messy talk'
	5. Tacit information transferred using face-to-face communication and white-board discussion	5. Tacit information transferred using face-to-face communication and white-board discussion	5. Tacit information transferred using face-to-face communication and white board-discussion
	6. Project manager keeps design schedule on track, and project within budget	6. Project manager keeps design schedule on track, and avoids excessive design changes	6. Project manager is flexible with design schedule, and ensures some slack time before design is finalized
	7. Project manager promotes quick responses to routine information	7. Project manager promotes quick responses to routine information, and monitors discussion based responses to non-routine information	7. Project manager monitors discussion based responses to both routine and non-routine information
	8. Project manager hosts monthly or bimonthly formal meetings and monitors discussions on updates and routine information	8. Project manager hosts weekly or biweekly formal meetings and monitors discussions on updates and routine information	8. Project manager hosts frequent formal meetings and monitors discussions on routine information and its impact on non-routine information
	9. Project manager hosts sporadic informal meetings to create conversations on non-routine information	9. Project manager hosts frequent informal meetings to discuss non-routine information	9. Project manager hosts on-going informal meetings, with occasional involvement of outside experts, to continuously discuss non-routine information

channels (Daft & Lengel, 1988; Dossick & Neff, 2011; Poole, 2011; Van de Ven et al., 1976). In turn, pacing technology projects undergo considerable testing and redesign (Shenhar, 1998; Shenhar & Dvir, 1996; Raz et al., 2002). Due to the dynamic nature of the project evolution in this setting (Shenhar, 1998; Shenhar & Dvir, 1996), project managers are likely to analyze and disseminate information and regularly provide feedback to team members. In addition, project managers under pacing technology conditions are likely to be additionally challenged with coordinating information dissemination across specialties, host regular informal meetings, and maintain open communication channels (Daft & Lengel, 1988; Poole, 2011; Van de Ven et al., 1976).

In contrast, HR-centric information sharing systems are designed to assist project participants' discussion of tacit information through white-board discussions, scheduled and unscheduled meetings. The extent to which members engage in messy talk will reduce errors in processing information. In base technology projects, annotation tools in the software may be largely unneeded as data should be relatively routine and standard and excessive discussion may spur information overload and confusion (Lengel & Daft, 1988). Thus, communication challenges of project managers in base technology conditions with HR-centric information systems include: the monitoring of conversations to promote efficient responses to routine information; ensuring discussions via the software and in meetings on non-routine information; and keeping projects on schedule and within budget.

In key technological projects, it is very important that project managers assist team members to respond efficiently to routine data and ensure discussion-based responses to non-routine information (Daft & Lengel, 1988; Dossick & Neff, 2011; Dvir et al., 2006). The HR centric information system is expected to provide a good fit to key technology projects due to its

ability to reduce errors in processing information due to annotations and regular meetings (Carrillo & Chinowsky, 2006; Whyte et al., 2008). Communication challenges of project managers in this setting are: to monitor participant discussions; to promote efficient responses to routine information; to encourage annotations for the sharing of tacit knowledge and host informal meetings to discuss non-routine data; and to avoid excessive costs due to design changes and keep project on schedule. For pacing technology projects, communication is likely to be intense with on-going formal and informal meetings as follow up to and leading to annotations (Shenhar, 1998; Shenhar & Dvir, 1996). Given the probability of multiple design cycles, the communication challenges of these project managers include administrating the project (e.g., keep within budget, on-time), maintaining an open communication environment, actively providing feedback and encouraging information sharing, facilitating informal meetings, and, in some cases, inviting external experts to the project in order to solicit insights to the project.

Although this study primarily categorized projects based on their technological uncertainty, project complexity, novelty, and pace (Malach-Pines et al., 2009) are also major influences on the strategic selection and development of project coordination systems (Daft & Lengel, 1986; Van de Ven & Walker, 1984). To better understand the enactment of formal and informal micro-information exchange sharing systems, future investigations might be well-served by considering the development as well as the evaluation of communicative protocols surrounding "successful" and "unsuccessful" projects. For example, standard use of more formal information systems and reporting procedures, common to IT centric information systems, may be adequate at the initiation of a project, but then become a hindrance (Dossick & Neff, 2009).

Organizations may promote the use of messy talk interactions, but its implementation may be flawed or not supported by the team or organization (Dossick & Neff, 2010).

Future studies should also consider longitudinal investigations where responses are solicited from members of the same team over time. The value of collecting responses from members of the same team, working on the same project, and under the same manager over time can lead to a better understanding of the viability of messy talk under a range of conditions, how open communication environments emerge and are reconstituted following conflicts (Druskat & Wheeler, 2003; Lewis, 2000), and how team members as well as outsiders perceive the project team's operations (Crawford, 2005). Longitudinal investigations can also improve scale validity through confirming factorial dimensions over different points in time and establishing predictive validity through the use of more elaborate criterion variables associated coordination processes (Adler, 1995; Argyres, 1999; Daft & Lengel, 1986) and with project outcomes (Dvir et al., 2006; Muller & Turner, 2007, 2010; Sadeh et al., 2000).

Summary

This study sought to explore project managers' communication behaviors in cross section of industry settings. The study was comprised of five research questions, in which the first two questions inquired into the perceived importance and the actual communication behaviors of project managers given the challenges of their projects. The next two research questions inquired into the communication challenges of project managers when working with different types of information systems and different types of project technologies respectively. The final research question aimed at identifying the relationship of team members' perceptions of their project leaders' communication behaviors, information system use, and technological uncertainty to project success.

Important contributions of this study to the project management research literature include the development of measurement scales for messy talk, open communication environment, information systems, and technological uncertainty, which may enable researchers to understand better how project teams' exchange information and their contextual challenges. Findings also reveal significant differences between team members' perceptions of the importance of project managers' communication behaviors (messy talk and open communication environment) and actual reported project managers' communication behaviors (messy talk and open communication environment). Furthermore, messy talk - actual reported and information systems use were found to be significant predictors of project success. It is hoped that these findings, though tentative, will assist in understanding the nature and role of project managers' communication behaviors in all phases of project development.

APPENDICES

Appendix A

Project Manager Communication Behaviors

Messy Talk

To what extent did your project manager…

encourage team members to incorporate discussion tools (e.g. whiteboards or blackboards, notepads, visual diagrams or models) during meetings?

encourage team members to raise concerns during face-to-face or online meetings?

converse with others about design or task issues during face-to-face or online meetings?

prompt members to make comments, annotate, or raise questions using software (e.g. group support systems, product model software)?

encourage project team members to engage in discussions after face-to-face or online meetings?

Appendix B

Project Manager Communication Behaviors

Monitoring

To what extent does your project manager…

monitor team and team member performance?

keep informed about what other teams are doing?

request task-relevant information from team members?

refer to regulations pertaining to the process or product?

check project progress?

provide feedback on team's performance?

inspect the team's work?

Appendix C

Project Manager Communication Behaviors

Open Communication Environment

To what extent did your project manager…

encourage team members to talk openly with each other?

encourage team members to talk to openly to him/her regarding task related issues?

make sure all team members were sharing information about the project?

help team members to be comfortable sharing issues/problems with each other?

make members comfortable in asking advice from others?

Appendix D

Project Manager Communication Behaviors

Initiating Structure and Planning

Establish expectations and goals

Defines and emphasizes team expectations

Asks team members to follow standard rules and regulations

Communicates what is expected of the team

Communicates expectations for high team performance

Maintains clear standards of performance

Sets or helps set challenging and realistic goals

Establishes or helps establish goals for the team's work

Ensures that the team has clear performance goals

Works with the team and individuals in the team to develop performance goals

Reviews team goals for realism, challenge, and business necessity

Structure and plan

Defines and structures own work and the work of the team

Identifies when key aspects of the work need to be completed

Works with the team to develop the best possible approach to its work

Develops or helps develop standard operating procedures and standardized processes

Clarifies task performance strategies

Makes sure team members have clear roles

Appendix E

IT-Centric/HRM-Centric Information Systems

Directions:

The following questions pertain to information sharing mediums used by your project management group during your last project.

By information sharing mediums, we refer to design tools such as Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Building Information Modeling (BIM), Computer Aided Three-dimensional Interactive Application (CATIA), Enterprise Resource Planning (ERP), Systems, Applications, and Products (SAP), or Group Support Systems (GSS).

1. In your last project, please indicate which of the following information sharing mediums were used by your project management group (please check all that apply):

___ Computer Aided Design (CAD)

___ Computer Aided Manufacturing (CAM)

___ Building Information Modeling (BIM)

___ Computer Aided Three-dimensional Interactive Application (CATIA)

___ Enterprise Resource Planning (ERP)

___ Systems, Applications, and Products (SAP)

___ Group Support Systems (GSS)

___ Other (please name _____)

2. To what extent did the information sharing mediums allow members to ask questions and obtain answers as they arise?

3. To what extent did the information sharing mediums allow members to have discussions (e.g., group chat, whiteboard, annotations) before responding or executing a task?

4. To what extent did the information sharing mediums support multiple communication cues such as body language, voice, tone, etc.?

5. To what extent did the information sharing mediums allow members to express the intensity of their opinions or feelings in their entries?

6. To what extent did your project team follow standard operating procedures (SOPs) to share information?

Appendix F

Technological Uncertainty

Directions:

The following questions address the "technology" that your project is using to produce a product or outcome (e.g., software application).

1. How well known or widespread (i.e., mature) was the technology used in creating the product or outcome?
2. To what extent did the project technology processes require modification or development work?
3. To what extent have project teams in your organization used this technology in the design process or throughput process?
4. To what extent did the technology to create the product or outcome not exist in the past or was new to your industry?
5. To what extent did the project go through multiple design cycles before it reached final configuration and final specification (i.e., frozen)?
6. To what extent did the project involve computerized planning?

Appendix G

Project Success

Indicate the extent of your project's success along these measures

1. End-user satisfaction with the project’s product or service
2. Suppliers’ satisfaction
3. Project team’s satisfaction
4. Other stakeholders’ satisfaction
5. Meeting project’s overall performance (functionality, budget and timing)
6. Meeting user requirements
7. Meeting the project’s purpose
8. Client satisfaction with the project results
9. Reoccurring business with the client
10. Meeting the respondent’s self-defined success factor

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