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Cross-Boundary Coordination under Organizational Stress: Communication Patterns and Resilience

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Cross-Boundary Coordination Under Organizational Stress: Communication Patterns and Resilience

Coordination is one of the key activities that organizations must carry out on a day-to-day basis to maintain reliable performance in the face of changing conditions. When organizations come under stress it is important that they continue to maintain high levels of coordination. Yet extensive evidence suggests that organizations and individuals within them respond differently to stress, in ways that are sometimes functional and sometimes dysfunctional. We study the Continental air control tower in Newark that was built to co-locate representatives from key airline functions and key external parties in order to facilitate communication among them. Initial research was based on informal interviews and site visits, as well as secondary analysis of company documents and industry reports. In addition, using communication network data, we explore how cross-boundary coordination occurs under conditions of predictable and unpredictable stress, and how co-location can facilitate adaptation to changing conditions.

(145 words)

How do patterns of organizational communication and coordination change when organizations come under stress? Do the communication patterns differ if the stress is predictable as opposed to unpredictable? To answer these questions we modeled the patterns of organizational communication under normal operations and under conditions of predictable and unpredictable stress.

Coordination and communication across functions or other boundaries is a key capability for integrating knowledge and actions, particularly when work is highly interdependent. Coordination, defined as the management of interdependency among tasks (Malone and Crowston, 1994), has been linked with the production of high quality and high efficiency outcomes in multiple settings including research and development (Tushman, 1978), automobile manufacturing (MacDuffie and Krafcik, 1994; Rubinstein and Kochan, 2001), healthcare delivery (Argote, 1982; Shortell, et al, 1994, Young, et al, 2000; Gittell, 2002), pharmaceuticals (Rubinstein and Eaton, 2008) and airlines (Gittell, 2001, 2003). Moreover, coordination is one of the key activities that organizations must carry out on a day-to-day basis to maintain reliable performance in the face of changing conditions (Wildavsky, 1988; Weick and Roberts, 1993; Weick, Sutcliffe and Obstfeld, 1999). It is important therefore, that organizations develop the capacity to maintain high levels of coordination and communication under stress. Yet extensive evidence suggests that organizations and the individuals within them respond differently to stress, in ways that are sometimes functional and sometimes dysfunctional. This can be the case in both bureaucratic and non-bureaucratic organizations, as bureaucracies can be coercive or enabling (Adler and Borys, 1996; Adler 1999). We contribute to the coordination literature by exploring how the patterns of cross-boundary coordination and communication change from normal operations to conditions of stress. Further, we differentiate between stress that is

predictable (i.e., increased airtraffic during holidays) and stress that is unpredictable (i.e., snowstorms) to examine the differences in the patterns of communication and coordination under these different situations. We also examine to what degree the co-location of workers who must collaborate can facilitate effective adaptation to changing conditions.

Communication, Coordination and Resilience

The traditional approach in coordination theory has been to define coordination as the management of interdependencies between tasks or activities (Thompson, 1967; Mintzberg, 1979; Malone and Crowston, 1994). As Crowston and Kammerer (1998) argued, this traditional approach has portrayed coordination as a relatively mechanical process of managing task interdependence through the processing of information. Increasingly, coordination has come to be viewed as a relationship-intensive process. From this perspective, coordination is not only the management of interdependencies between tasks but also the management of interdependencies between the people who carry out those tasks. According to theories of sense-making (Weick and Roberts, 1993; Crowston and Kammerer, 1998), expertise coordination (Faraj and Sproull, 2000; Faraj and Xiao, 2005) and transactive memory (Liang, Moreland and Argote, 1995), effective coordination requires participants to be connected by shared knowledge or shared understandings of some sort. Moreover, the theory of relational coordination suggests that coordination occurs through a network of communication and relationship ties (Gittell, 2006). Building upon more traditional information processing approaches to coordination (Daft and Lengel, 1986), relationships can be viewed as a source of bandwidth or information processing capacity for coordinating work. Due to their greater bandwidth, relational forms of coordination are expected to be more effective for achieving performance, the more uncertain the inputs to the work process (Argote, 1982; Gittell, 2002).

These developments in coordination theory are mirrored by recent developments in theories of resilience. Resilience is the ability to persevere, sustain, and bounce back when faced with threat (Sutcliffe and Vogus, 2003) or the capacity to maintain desirable functions or outcomes in the midst of strain (Edmondson, 1999; Bunderson and Sutcliffe, 2002). It is a trait associated with either individuals or organizations that enables them to persevere in the face of threat. Threat, defined as an impending event with potential negative consequences, often intensified by time pressure (Argote, Turner and Fichman, 1989), typically induces rigidity or the inability to respond effectively (Staw, Sandelands and Dutton, 1981). While threats can take many shapes and forms, one important consequence of threats in the workplace is the creation of stressful conditions for those who work there. Some organizations demonstrate the ability to bounce back stronger than ever when faced by threat while other organizations fall apart and lose their way.

Resilience is believed to result from resources retained by organizations in a form that is sufficiently flexible to cope positively with the unexpected (Sutcliffe and Vogus, 2003). Relationships appear to be one such resource that enables resiliency. Positive work relationships have been linked to resilience and recovery in individuals (Ryff and Singer, 2002; Seeman, 1996) as well as in organizations (Cameron, Bright and Caza, 2004; Spreitzer, Sutcliffe, Dutton, Sonenshein, and Grant, 2006; Gittell, Cameron, Lim and Rivas, 2006). The literature on social support is consistent with these findings, showing that supportive relationships lessen the negative impact of stressful events on the levels of stress reported by individuals and work teams (Aiello and Kolb, 1995) and on the outcomes that they achieved (Moyle and Parkes, 2000; Schaubroeck and Fink, 1998). Resilience is thus increasingly understood as a relational process, just as coordination has come to be understood as a relational process. The mechanism through

which relationships contribute to organizational resilience is not entirely clear however. Though the literature describes and documents the impact of relationships on coping, reducing stress, and reducing the negative impact of stressful events on performance, the path through which relationships act remains to be further explored.

One path through which relationships contribute to resilience may be through their ability to create higher bandwidth forms of coordination under stressful conditions, when those forms of coordination are most needed. People can respond to stress in a resilient way by increasing their support for each other, becoming more focused on their common goals, and sharing more information than they would under normal conditions. But people can also respond to stress in a non-resilient way by withdrawing support from others, losing sight of their common goals, and failing to provide critical information on a timely basis. The non-resilient response was described by Staw, Sandelands and Dutton (1981) who suggested that individuals, groups and organizations have a tendency to behave rigidly in threatening situations, which generates two effects. First, the ability to process information, to interpret information or to use proper communication channels is reduced. Second, threatening situations may restrict control in a way that power and decision-making may become more centralized. Staw and colleagues suggested that the effect of the threat on both information processes and control processes would become more rigid and return to a more centralized organizational structure under stressful conditions. However, if increased centrality means increased bureaucracy it is important to understand whether the bureaucracy is coercive, dampening the ability of employees to exercise judgement, solve problems and engage in meaningful decision making, or whether it is enabling employees to perform through providing opportunities for learning, greater support, deeper understanding, and feedback on performance (Adler and Borys 1996; Adler 1999, Heckscher 2007).

We explore whether organizations can counteract a tendency toward a non-resilient response by establishing a context that is conducive to strong social ties among workers whose tasks are highly interdependent and in need of coordination. Resilient responses to stress are more likely to occur in organizations that have established such a context, and non-resilient responses are more likely to occur in organizations that have not.

We also propose that a resilient response to stress depends on the nature of the threat. Some threats can be anticipated based on past historic changes in the market or operating conditions, which allow the organization to anticipate external pressures that may create stress for day-to-day operations. We will call this "predictable stress." Some threats are highly unexpected however. Changes in the market or conditions that the company operates in can be highly unpredictable. We will call this "unpredictable stress." However, we do not believe that predictable and unpredictable stress are on linear continuum, rather they represent very different organizational challenges.

In organizations that have established a context for strong social ties among workers whose tasks are highly interdependent, we expect coordination networks and the social ties that comprise them to become denser and less centralized under conditions of predictable stress relative to normal conditions, and denser and less centralized under conditions of unpredictable stress than under conditions of predictable stress, in order to increase responsiveness. In organizations that have not established such a context, the reverse is expected to occur.

Moreover, we anticipate that a resilient response to both predictable and unpredictable stress depends on the quality of relationships among individuals. In that sense, scholars have advanced the need for promoting social capital (Adler, 2002) to address questions of quality of relationships in organizations. Nahapiet and Goshal define social capital as "networks of

relationships that constitute a valuable resource for the conduct of social affairs" (1998: 243). Moreover, Putnam (1993) points out that social capital is a composite of norms, trust and networks that enable participants to act together effectively to pursue shared goals. The literature on social capital stems from two dimensions of social capital: the content and the structural. Several studies offer evidence that the content dimension of social capital (the web of norms, shared understanding and those factors that hold people of the community together) increases the quality of information sharing, trust, and therefore coordination among individuals (Cohen and Prusak, 2001; Fukuyama, 1999; Putnam and Goss, 2002). Other authors point out that the structural conditions of the network (social organization of the community and the types of ties and relations) increase information sharing, knowledge creation, mutual respect, and decision-making (Coleman, 1988; Nahapiet and Ghoshal, 1998; Woolcock, 1998).

One way to reunite both dimensions of social capital is by considering the notion of pragmatic collaboration (Helper, MacDuffie, and Sabel, 2000). Such form of collaboration includes and transcends personal bonds (friendship, familiarity or informal ties) to embody relationships that draw on trust, timeliness and solutions changing networks of external and internal ties based on flexible teamwork (Brown, Durchslag, and Hagel, 2002; Eccles and Crane, 1988; Powell, 1990; Snow, Miles, and Coleman, 1992; Uzzi, 1997). This leads to a pragmatic form of collaboration in which "once the cooperative exploration of ambiguity begins, the returns to the partners from further joint discoveries are so great that it pays to keep cooperating" (Helper, MacDuffie and Sabel, 2000: 444). Thus, in what refers to the quality of relationships, both dimensions of social capital (structural and content dimensions) provide the basis for coordination (Bourdieu and Wacquant, 1992) and shared understanding and resilience (Cohen and Prusak, 2001).

Furthermore, certain types of coordinating mechanisms are expected to increase an organization's ability to communicate, process information and coordinate work under conditions of increasing uncertainty. In particular, boundary spanners are expected to play this role. For example, Galbraith (1973) argued that organizations can span internal boundaries in three ways: informal ties, teams or formal boundary spanner roles. Informal ties are sufficient to link groups that interact readily with few boundaries between them. Teams are more costly and complex than informal ties since they require membership selection, planning, meetings and agendas. However, teams may be beneficial when sufficient coordination does not occur informally either because the context requires more coordination or because existing boundaries are more divisive. Boundary spanners are the most costly of the three mechanisms because they constitute a staff whose primary task is to integrate the work of other people across functional boundaries. They should be used only when the context requires a great deal of coordination and when existing boundaries are highly divisive.

Organizational theorists have increasingly highlighted the relational role of boundary spanners, arguing that boundary spanners function successfully by building networks across boundaries. Spekman (1979) explored the use of social power by boundary spanners while Currall and Judge (1995) and Friedman and Podolny (1992) explored boundary spanners' ability to build trust. More recently, Gittell (2002) explored the impact of boundary spanning staffing on cross-functional networks of shared goals, shared knowledge and mutual respect, and showed that this impact was greater, the greater the uncertainty of the work process. Each of these studies goes beyond the traditional information-processing role of boundary spanners to account for the relational role that boundary spanners can play. Together they suggest that boundary

spanners work not only by sharing information, but also by building connections among those who reside on opposite sides of a boundary.

We build on this work by suggesting that boundary spanners should develop denser networks than other employee groups as the organization comes under increasing levels of stress. Although networks in general are expected to become less centralized under stress in well-functioning organizations, we anticipate that boundary spanners will play an increasingly central role in those networks, due to their ability to coordinate work across critical boundaries and therefore to increase responsiveness to threat.

In this paper, we explore these communication patterns in an organization that appeared to have established a context for social capital among workers whose tasks were highly interdependent by building a new facility enabling their co-location. The idea of co-locating individuals, placing individuals within close physical proximity for greater communication, has been supported by both theoretical argument and empirical evidence. There is ample research in experimental settings as well as field research in R&D and marketing teams that support the importance of co-location for effective coordination (e.g. Okhuysen and Eisenhardt, 2002; Allen, 1977; Keller, 1986; Van De Bulte and Moenaert, 1998; Griffin and Hauser, 1996; Brown and Duguid, 1991). Co-location is expected to facilitate interaction, improve communication such as information sharing, understanding and effective problem solving. Staw et al. (1981) pointed out that stress (i.e. external threats) have negative impacts on communication channels, which is likely to be amplified by geographically dispersed members of a team. We extend this logic and argue that co-location should facilitate coordinating activities across boundaries under stressful conditions allowing employees to respond faster and more effectively to occurring problems. Furthermore, co-location should facilitate the development of social ties between workers that

enable resilient responses to stress, in particular by facilitating communication networks that can be mobilized in response to predictable and unpredictable stress.

We use communication network techniques and a longitudinal methodology to observe the networks that exist among the people who worked together in a common location and the changes that occurred in these networks under different conditions. We aim to assess in particular how these coordination networks, and the specific communication and relationship ties that comprise them, change and adapt to conditions of predictable and unpredictable stress.

RESEARCH CONTEXT

The research reported in this paper was conducted in the air control tower for Continental Airline's Newark operations. Continental is one of the largest air carriers in the world and in the US. The company operates throughout the world, serving more than 150 US and 130 international destinations and employees more than 40,000 people. Due to global economic downturn, fear of terrorist attacks, and the Iraq war, the US airline industry underwent a considerable economic crisis in the last years. In the 1999-2003 period, the industry shrunk with a compound annual growth rate (CAGR) of –1.4% (Datamonitor, 2005). Such a poor outlook for the US industry forced airlines to redesign their strategies. Most of them have followed a trend already set by low-cost carriers: streamline costs and competitiveness based on price.

Continental Airlines was not entirely indifferent to that trend. Under the leadership of Frank Lorenzo in the 1980s and early 1990s, Continental engaged in highly conflictual efforts to reduce wages and benefits, putting the airline through multiple bankruptcies in order to win from employees what leadership was unable to win through contract negotiations. In the mid-1990s, Continental experienced an historic turnaround under the leadership of CEO Gordon Bethune, who attempted to undo the negative effects of multiple bankruptcies and their influence on

employee morale. The organization adopted a customer-centric strategy by providing its customers with higher reliability, flexibility, and better quality service and later by building strategic alliances that provided new flight services and destinations and boosted its international service. Such focus on customer service proved to pay back. Continental Airlines has won several awards for customer service and is consistently among the top three airlines on the Department of Transportation's ranking for on-time performance and customer satisfaction.

When we met with Continental's Newark management team in June 2002 to explore the potential for collecting data, we asked Newark Vice President Charles Scully to describe how the turnaround had influenced the Newark operations. According to Scully: "Morale has improved because now people have enough resources. They have the tools to do the job." Continental's Newark hub, with about 12,000 employees and $4 billion per year in revenue, had always been operationally challenging for Continental due to the high volume of both domestic and international flights, 33,622,686 total passengers in 2000, making it the 10th busiest airport in the nation. "Only 30% of our traffic is connecting," Scully explained, "but you have a lot of local complexity due to originating and terminating passengers." Furthermore, it was the only major airline hub located in the crowded Northeast corridor. Due to the combination of weather and congestion, Newark Airport had "the worst airspace in the world" (Flint, 2001).

Airline operations are highly complex even in non-hub airports (Gittell, 2001; Knez and Simester, 2001). A flight departure requires coordination among twelve distinct employee functions, including pilots, flight attendants, gate agents, ticket agents, ramp agents, freight agents, baggage transfer agents, cleaning crews, caterers, fuelers, mechanics and operations agents. A high level of coordination must be achieved among these functions in order to ensure on-time performance, accurate baggage handling, customer satisfaction, as well as efficient use

of costly resources including gates, aircraft and employees themselves. According to an executive vice president of operations for another major U.S. airline: "Flight departures are the most complex thing that we do every day." Hub operations Continental's Newark hub increase complexity even further due to their operational scale and due to a higher percentage of passengers connecting.

The day-to-day complexity of airline operations is further exacerbated by two types of operational threat: 1) high volumes of passenger traffic, particularly on holidays and 2) bad weather days. On high volume days, normal turnaround times at the gate are often exceeded due to large numbers of travelers, many of whom are less accustomed to air travel and who thus take longer to check baggage and board the flight. Exceeding scheduled turnaround times at the gate causes departure delays, and arrival delays for other flights that cannot pull up to the gate due to another aircraft still occupying the gate. The additional impact of high volume days is that passengers from any flight that might be cancelled, due to a mechanical or scheduling problem, are very difficult to rebook due to the heavy load factors in the remaining flights. On bad weather days, many flights go off-schedule due to delays in arrivals or delays in departures. High volume days like holidays can be anticipated, and they therefore represent a condition of "predictable stress." Bad weather days cannot be anticipated with as great certainty, and they therefore represent a condition of "unpredictable stress."

The airport division is in command of all the key airline functions at the airport. There are around 12 job units that could be roughly split into two core categories: ramp and customer services. The first would revolve around the plane routine, which means coordination around and between the landing and take-off of the plane. The second represents the interaction between customers and their particular needs (ticketing, connection, luggage, delays). Ramp has

traditionally commanded the division's operations. However, and partly motivated by Continental's overall strategic shift, there have been more ambitious goals, followed by a more complex strategy for the airport operations: to coordinate customer and ramp operations together in order to improve customer satisfaction while having a more efficient control of the airport operations. In consonance with the organization plan, the division faced a strategic need for offering a more cohesive vision of these two groups.

In an effort to foster collaboration across functional units and to disseminate the novel strategic vision, Continental built an operations tower that would co-locate approximately 200 functional employees previously dispersed in different locations at the airport. The configuration of the air tower is shown in Figure 1. The zone coordinators with responsibility for coordinating individual flight departures were all seated around the perimeter of the tower along with maintenance, cargo, catering, fueling, air traffic systems and international connections. More centered in the tower were customer service, connection planning, plane move team, and gate planning. These people were co-located in the tower to formalize interactive work processes and centralize information flows between ramp and customer service.

[Insert Figure 1 about here.]

In addition to co-location in the tower, Continental's Newark management team created an informal group of employees to be in charge of bridging across functions while bringing awareness about customer service to the forefront. These boundary spanners are multi-skilled employees who are able to accomplish both ramp and customer service operations while pursuing horizontal collaboration as a central aspect of their work duties.

METHODS

Data and Measures

To the questions above, we conducted qualitative and quantitative data through a variety of methods including interviews, direct observations of the operation, and network data measuring communication and coordination and relationships among 165 employees who worked directly in the Continental Newark air tower. We observed the tower and collected communication network data on six different days that included two days of normal operations, two high volume holidays (predictable stress), and two bad weather days (snow storms which represented unpredictable stress). At the end of their shift on of these days all employees in the tower were asked to complete a communication network analysis survey. This survey contained the names of all employees in the tower and asked the respondent to indicate who they had communicated with on that day, the number of times communication had taken place, the method of communication (face to face, email, phone, radio), the subject of communication, and the purpose of communication (sharing information, coordinating tasks, problem solving.) The survey also asked about the quality of the interaction – trust, respect, timeliness, shared goals. The network surveys were analyzed using UCINET (Borgatti, Everett, and Freeman, 1999), and standard network analysis measures were used including density and centrality. Density indicates how close-knit (Wasserman and Faust, 1994) a network is and measures the number of links between network members out of the number of possible links and is reported as a percentage. Centrality measures the degree to which individuals are positioned to control the flow of communication in a network and therefore indicates the degree to which a network is hierarchical or participatory. We also analyzed the centralization of the entire network using an

index that measures the variance in individual centrality scores thus indicating how hierarchical a network is.

ANALYSES

Tower Network Centrality

In our analysis of the centrality of the tower network we compared three groups (regular employees, boundary spanning employees (who were trained to perform multiple jobs) and management (including supervisors) over each of the three conditions (normal operations, predictable stress, and unpredictable stress).

The results of the network analysis (Table 1) show that regular employees were most central in the network on days of normal operation (purple indicates the highest centrality for each category of employee). This is true whether the purpose of communication was information sharing, coordination or problem solving. The boundary spanning employees were most central during days of predictable stress – high volume holidays, and management was most central during periods of unpredictable stress such as snow storms. In addition, the index of overall network centralization was highest on the days of unpredictable stress.

[Insert Table 1 about here.]

These patterns of centrality and centralization can be seen in the network graphs - Figures 2 through 4 below - where blue nodes represent regular employees, green nodes represent multi-skilled employees, and red nodes represent management and supervision. The size of the node represents the centrality of that individual in the network – the larger the node the greater the centrality. The lines between nodes indicate communication links between individuals. The networks graphs in Figures 2 through 4 illustrate the same centrality pattern revealed in Table 1 – regular employees are most central under normal conditions, boundary spanning employees are

most central under conditions of predictable stress, and management becomes more central under conditions of unpredictable stress.

[Insert Figures 2, 3 and 4 about here.]

Tower Network Density

A similar pattern can be seen when we examine network density. Table 2 shows the density of communication between regular employees, regular employees to boundary spanning employees, boundary spanning to boundary spanning, boundary spanning to management, management to management, and management to regular employees, under all three conditions – normal, predictable stress and unpredictable stress. The table also compares communication for information sharing, coordination of tasks, and problem solving. The density results show a pattern similar to the centrality results in Table 1 – communication between regular employees is greatest under normal operations, communication between boundary spanning employees is greatest under predictable stress, and communication between managers is greatest under unpredictable stress. This pattern is consistent across different types of communication: information sharing, coordination and problem solving. In network analysis there is typically no significance testing for densities since density is a group level measure with only one value per group and therefore no variance to use for testing.

[Insert Table 2 about here.]

Comparing Occupations

Figure 5 compares communication densities by occupation. Under normal operations we can see fairly high levels of communication density within and between operations, ramp,

suppliers, customer service and maintenance. When we examine predictable stress days the communication density within and between these groups decreases, while the density of managerial communication increases. Finally, when we examine unpredictable stress days, management communication density is at its highest level and the communication densities of the other occupational groups are at their lowest levels.

SUMMARY OF FINDINGS

For regular employee – employee communication, density was greatest under normal operations for all three categories examined – information sharing, coordination and problem solving. However, while employee – employee communication density decreased as the organization came under stress, the density increased for communication within the multi-skilled group and between multi-skilled and regular employees during days of predictable stress. Further, communication density increased within management and between management and other groups during days of unpredictable stress.

Similarly, changes in the centrality patterns depended upon the employee group under consideration and the condition of stress facing the organization. Under normal operations regular employees had their greatest level of centrality, under predictable stress the multi-skilled employees had the greatest level of centrality and under unpredictable stress management had the greatest level of centrality.

Further, we found that organizational responses differed for predictable versus unpredictable stress. Under predictable stress the density of boundary spanning employee communication increased as they became more central to the coordination process while under unpredictable stress managerial linkages became denser and their centrality increased.

In summary, under normal conditions – employees coordinated activity more directly between themselves. When the tower experienced predictable stress under periods of high volume, boundary-spanning employees stepped forward to provide help in coordinating tasks, information, and problem solving. However, when the tower came under unpredictable stress (snow storms) management filled a central coordinating role.

DISCUSSION and THEORETICAL CONTRIBUTIONS

Our findings that under normal operations regular employees had their highest levels of centrality in the tower network and that multi-skilled boundary spanners had the highest levels of network centrality under conditions of predictable stress were consistent with our expectations and with the literature on organizational responsiveness and resiliency. We also found that the patterns of organizational response differed when stress is predictable relative to conditions of unpredictable organizational stress. We have not found a literature on these different types of stress and the ways that organizations respond to them, and therefore we think this study makes a unique contribution and opens up opportunities to further investigate the varied nature of organizational stressors.

While our finding of increased managerial centrality under unpredictable stress is inconsistent with our prediction of greater responsiveness through reduced centrality, it is consistent with the theory of increased rigidity when an organization comes under threat (Staw, et al. 1981). Drawing on several different streams of research, there are two possible explanations that may shed some light on these findings. One answer may lay in the argument that managerial coaching and feedback increases capacity to handle greater demands (Gittell, 2001). This suggests we may need to reexamine our assumptions about the meaning of centrality and bureaucracy in organizational responsiveness (Adler and Borys 1996; Adler 1999; Heckscher 2007). Another answer may lay in the argument that deference to expertise during crisis is a hallmark of a resilient organization (Weick, Sutcliffe, Obstfeld, 1999).

Enhancing the Coordinating Capacity of Frontline Employees through Enabling Bureaucracy: It has long been recognized that managers can carry out their roles in ways that

are either facilitative or directive (Likert, 1961; Tannenbaum, 1968). Facilitative managerial styles involve coaching and feedback, and are expected to be particularly valuable when tasks are highly interdependent, requiring high levels of coordination (Jermier and Berkes, 1979; Fry, et al, 1986). When supervisors play a facilitative role, they increase the capacity of front-line employees to effectively coordinate tasks with each other (Gittell, 2001). When they play a directive role, they instead displace or replace the capacity of front-line employees. Gittell, (2001) in her in her study of the role of supervisors in the flight departure process, found that supervisors who played a more facilitative role enhanced coordination among front-line employees. Supervisors in these sites used their role to add capacity through coaching and feedback, rather than taking over and replacing or undermining the capacity of front-line employees. The result was combined expertise and resources from both supervisors and front-line employees. Thus, increased managerial centralization does not necessarily mean that the managerial bureaucracy exerted coercive control. Centralized bureaucracies can be enabling as well as coercive (Adler and Borys 1996; Adler 1999).

This finding suggests that supervisors who are trained and otherwise supported to play a facilitative role can add coordinative capacity under stressful conditions, thus constituting a flexible resource that enhances organizational resilience. Extending this logic to the tower, we would expect to see higher density networks between front-line personnel in addition to denser managerial networks as conditions grew increasingly stressful. Instead, we see managerial networks replacing front-line employee networks rather than adding to them, suggesting that overall capacity was not enhanced as it would be expected to be if supervisors were playing a facilitative/enabling role. These patterns suggest supervisors in this tower are playing a different role than simply enhancing the capacity of the employees they supervise.

Expertise Deference: An alternative explanation of our results is the principle of deferring to expertise during abnormal situations – relying on the person with the best expertise during times of crisis. Weick, Sutcliffe and Obstfeld (1999) argued that during crises, decisions tend to migrate to the individuals best able to resolve them, which is commonly the person directly involved with the task holding the most accurate and clear understanding about the problem. This usually entails shifting authority down to those closest to the problem (e.g., from the maintenance coordinator in the tower to the maintenance mechanic located on the tarmac). Although this argument might at first seem counterintuitive given the results of increased centrality during unpredictable crisis, if one reverses the argument the logic of expertise deference may provide some insights.

During normal conditions, employees are trained and empowered to make decisions as they deem fit as long as standard procedures are followed; employees in the tower also leverage each others' expertise in case questions occur or if they need information not readily available. This would explain the high communication patterns between employees during normal operating conditions. Moreover, managers in the tower have extensive training and experience, which is a prerequisite for becoming a manager. During normal conditions, managers appeared confident that employees could handle standard problems that had been dealt with and solved before. However, during crisis, drawing on the expertise deference rationale, managers holding extensive experience would step in and handle the operation – a reverse expertise deference process. This reverse phenomenon has also been reported in a recent study by Klein et al. (2006) in their study on leadership roles in trauma resuscitation teams. They observed a complex interplay between physicians, nurses, and residents contingent upon the situation, which they referred to as dynamic flexibility. During routine tasks, residents were given the opportunity to

gain practical expertise by hands-on practice treating the patient as the physician would observe the progress from the side. However, during occasional complex incidents, the physician would quickly intervene and handle the crisis by drawing on his/her expertise and experience. Once handled, the resident would be allowed to continue the treatment. Klein and her colleagues suggested that this dynamic flexibility with evolving leadership allowed for greater performance and the least experienced team member to gain coaching and gain experience.

The notion of expertise deference also appears to explain the intermediate role of multi-skilled employees during conditions of predictable stress. As discussed earlier, the role of multi-skilled employee resembles that of boundary spanners who could bridge the gaps between the knowledge of the different functional groups represented in the air tower (Gittell, 2002). Multi-skilled employees held substantial training and expertise in several areas and operated as substitute managers in case regular managers were not on the floor. During predictable stress, our results indicate greater density and centrality of multi-skilled employees. Drawing on the reverse expertise deference, it seems that managers would allow multi-skilled employees to intervene based on their expertise and training, much as the physicians did in Klein et al's (2006) findings which may explain the variance in the level of communication in the tower across different conditions. Moreover, our results provide a unique context to the extant literature on high reliability organizations. The data reinforces how distinct the control tower is from other high reliability organizations (HRO) in that in the control tower during normal operations facilitates interaction among employees holding a good deal of decision-making authority. In contrast, in typical HROs (like aircraft carrier flight decks), hierarchy and formal chain of command dominates decision-making during normal operations. This study may offer a unique

context that inverts the relationships that one would typically observe in HRO's, yet still operates through the same mechanism of expertise deference.

This suggests that while managerial centrality increased under unpredictable organizational stress because supervisors and managers had special knowledge and experience that enabled employees to more effectively handle the unpredictable stress that the snow storms presented to the tower. Managerial expertise can be more critical in the control tower under conditions of unpredictable stress as needs for coordination become tighter and time frames are shortened.

This study also offers a unique contribution to the extant HRO literature. It sheds some light on the complex nature of resilience and the role of different occupations and positions. Specifically, it extends and adds to Weick, Sutcliffe and Obstfeld's (1999) notion of expertise deference by illustrating the potential role of knowledge and expertise can have that may facilitate reverse resilient responses.

CONCLUSIONS AND LIMITATIONS

Although this study offers important clues to better understand organizational responsiveness and resilience, several limitations are worth noting. The study indicates a dynamic interplay between employees, multi-skilled employees and managers contingent upon different conditions of stress. However, our findings must be interpreted with caution since this is a single case study. An additional site for comparison would of course strengthen our arguments and conclusions. Thus, we encourage scholars concerned with organizational resilience to address this limitation in further research.

Our data do not let us definitively answer the question as to why managerial centrality increased under conditions of unpredictable stress. While some evidence – the decreasing density of employee networks while the density of managerial networks simultaneously increased appears to the support the view that the unpredictable stress led to deference to expertise. However, this may also have to do with the managerial culture of airlines – management feels the need to be "in the mix" when trouble occurs. When storms hit the airport, managers tend to leave their offices below the tower and take the elevator upstairs to be in the heart of the action. At one point during our data collection efforts, managers even walked out to on the tarmac to physically supervise the de-icing of the planes and during these storms employees were sometimes moved out of their seats to allow managers to take over. However, this evidence is anecdotal and not systematic enough to draw a conclusion.

Another possibility is that while the tower co-located employees to provide links across functions by building a network with all intra-organizational functions and inter-organizational units, the architecture alone cannot achieve a change in patterns of coordination, particularly under periods of unpredictable organizational stress. Significant training is required along with new direction from leadership. Absent this type of support a change in organizational culture is unlikely. What we may be witnessing in the Newark Tower is a change in progress and not yet a completed transformation. More research on these questions is needed to draw definitive conclusions.

While our understanding of organizational resilience is still in it infancy, this study has contributed to the growing stream of research. Our study has shed light on the ways different occupational groups collaborate under conditions of organizational stress to provide responsiveness and resiliency. We also believe our use of communication network analysis

methods to map the patterns of collaboration across different conditions of organizational stress is unique in the literature. Further, we show the difference between organizational stress that is predictable from that which is unpredictable and demonstrate that the organizational response to each is different. Many questions remain however, and we encourage scholars concerned with these issues to further explore the different conditions that underlie organizational stress and the varied responses that contribute to resiliency in order to improve our understanding of the ways firms deal with uncertainty and ultimately organizational survival.

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Figure 1: Continental Air Tower at Newark International Airport

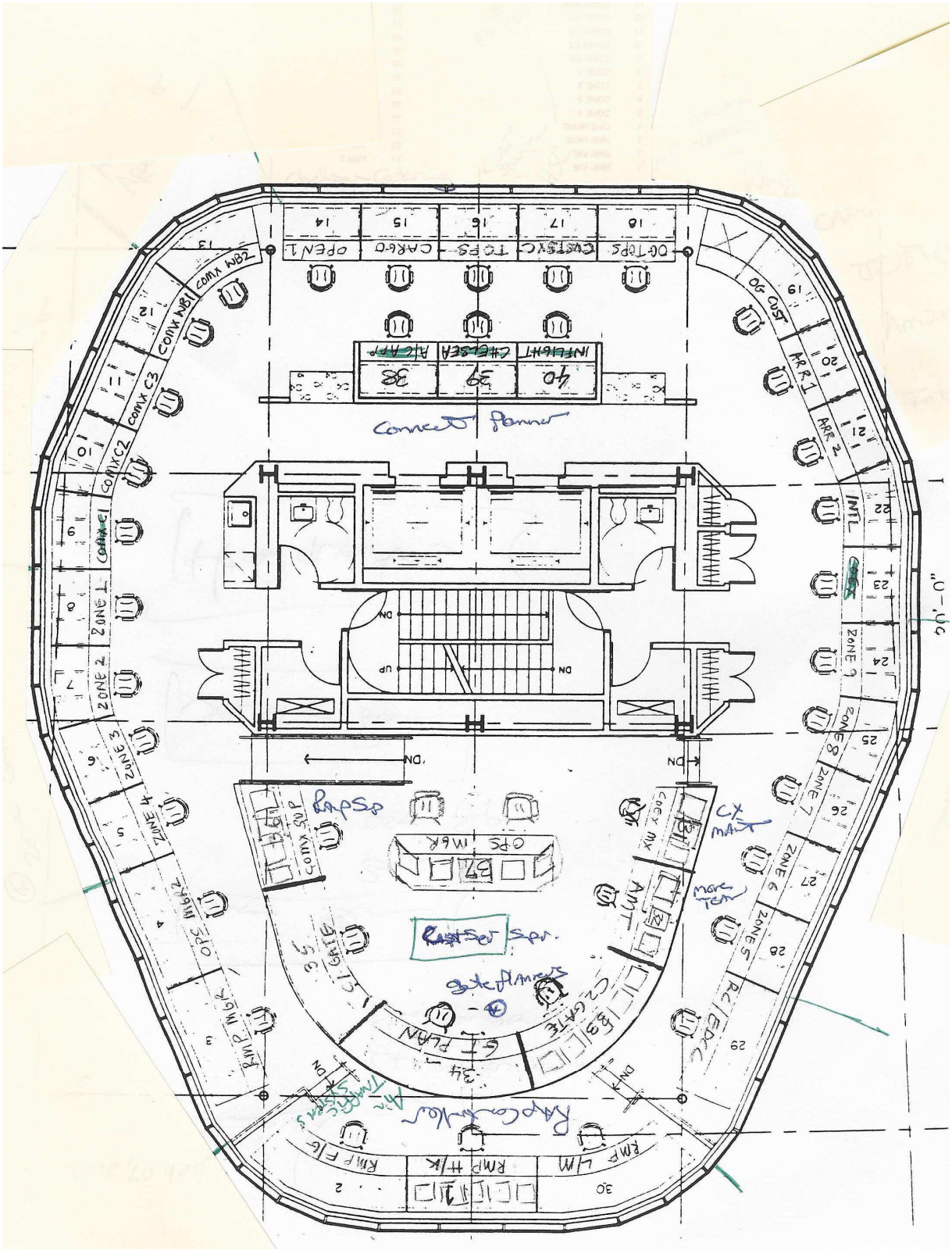

Figure 2: Tower Network Under Normal Conditions

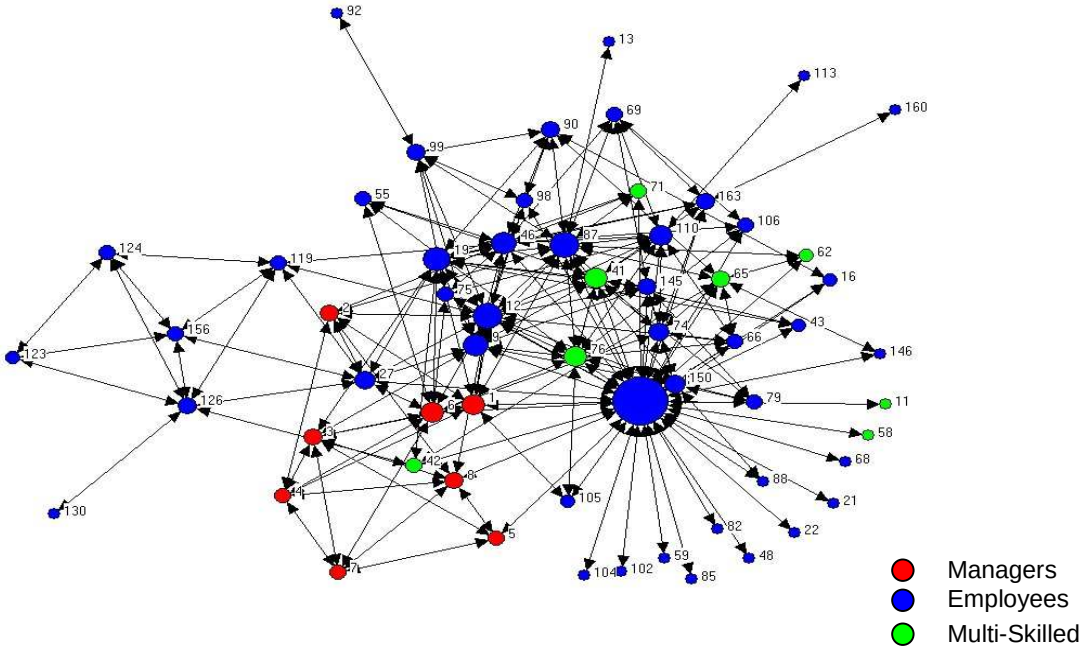

Figure 3: Tower Network Under Predictable Stress

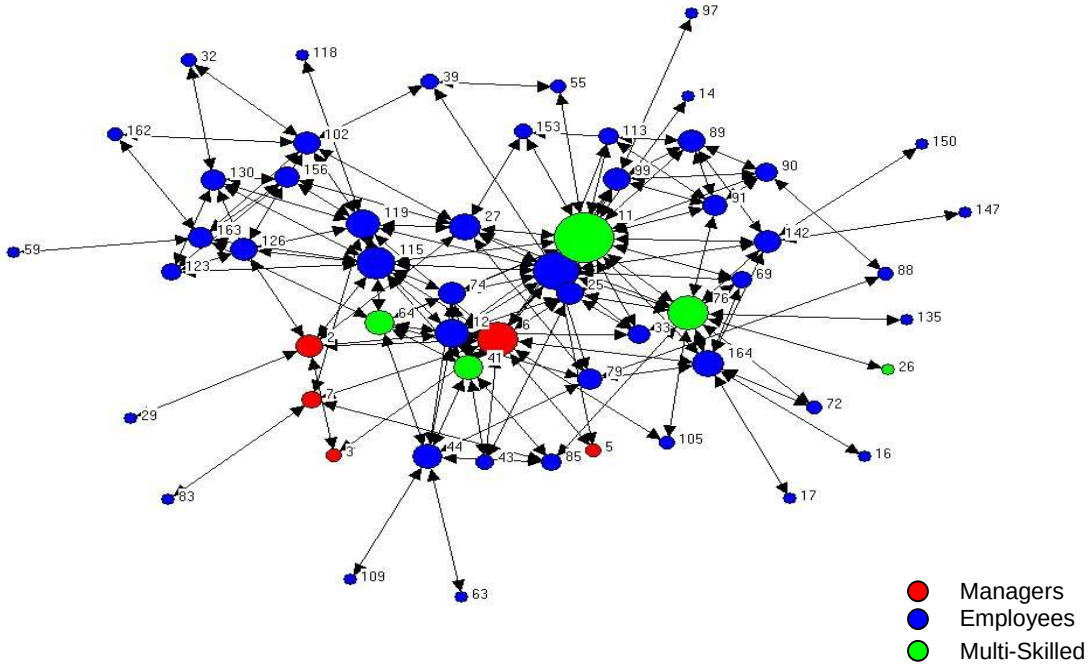

Figure 4: Tower Network Under Unpredictable Stress

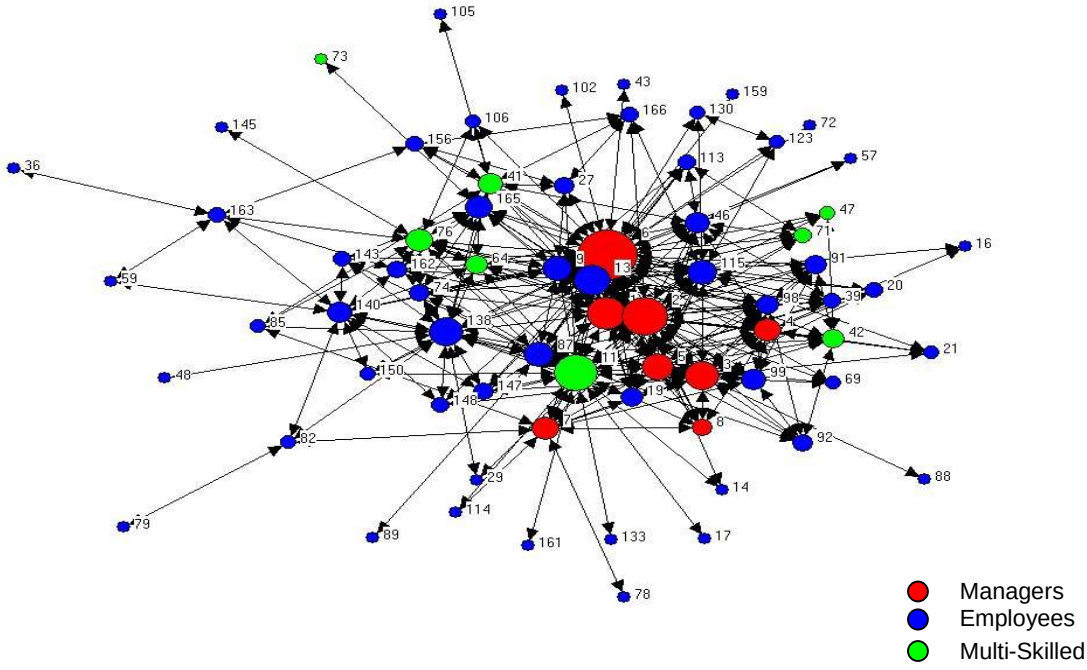

Figure 5: Communication Densities by Occupation

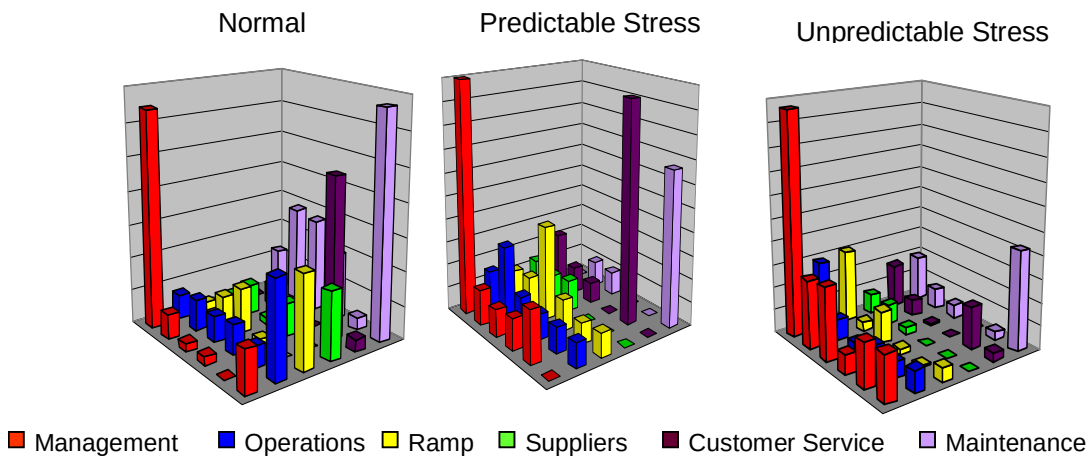

Table 1:
Centrality of Network Ties Under Normal Conditions,
Predictable Stress and Unpredictable Stress

	Information Sharing			Coordination			Problem Solving		
	Normal	Predictable	Unpredictable	Normal	Predictable	Unpredictable	Normal	Predictable	Unpredictable
Employees	12.33	9.28	8.41	10.57	9.97	7.11	11.39	10.47	7.23
Multi-skilled	15.08	20.07	12.57	9.166	22.11	11.83	13.16	24.78	11.78
Management	18.92	18.47	26.67	12.29	11.7	26.85	8.41	7.73	20.2
Network	1.36	1.47	1.56	1.72	1.5	1.83	1.35	1.51	1.88

Table 2: Density of Network Ties Under Normal Conditions, Predictable Stress and Unpredictable Stress

	Information Sharing			Coordination			Problem Solving		
	Normal	Expected	Unexpected	Normal	Expected	Unexpected	Normal	Expected	Unexpected
Emp-Emp	**0.118**	0.091	0.059	**0.122**	0.076	0.067	**0.107**	0.088	0.052
Emp-Multi	0.116	**0.251**	0.096	0.13	**0.183**	0.102	0.103	**0.219**	0.084
Multi-Multi	0.143	**0.483**	0.134	0.306	**0.466**	0.157	0.107	**0.400**	0.145
Multi-Mgmt	0.061	0.082	**0.247**	0.139	0.184	**0.274**	0.016	0.100	**0.346**
Mgmt-Mgmt	0.476	0.350	**0.678**	0.679	0.69	**0.857**	0.643	0.600	**0.839**
Mgmt-Emp	0.033	0.050	**0.13**	0.134	0.139	**0.200**	0.061	0.073	**0.19**