ABSTRACT

Title of dissertation: UNDERSTANDING DYNAMIC CAPABILITIES AT THE SUBUNIT LEVEL: OPERATIONAL FLEXIBILITY AND THE CRUCIAL ROLE OF ORGANIZATION DESIGN AND INFORMATION SHARING

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Organizations are currently facing increasingly dynamic environments that require fast action in high-velocity settings. Recent research on dynamic capabilities purports that organizations need to build these capabilities to successfully confront increasing uncertainty. Among these capabilities, authors suggest that flexibility may be a key ingredient needed to adapt to uncertainty and change. Yet, a review of the literature reveals that there is a gap that neglects subunit level activities at the lower levels of the firm, and thus it is difficult to determine how to build flexibility at this level. In this study, I examined key factors related to operational flexibility, defined as the ability of subunits to change day-to-day or within a day with the operational problems and changes.

Utilizing organizational design, information theory, and organizational learning theory, I developed and tested a model of subunit design factors and information sharing

relationships with operational flexibility and in turn subunit performance. I conducted a national field study of emergency departments in level I and II trauma centers examining these relationships. Data were collected from 110 trauma centers throughout multiple levels in the emergency department within each participating organization. Using hierarchical regression analysis, results indicate that subunit design factors and information timeliness and accessibility are significantly related to operational flexibility. Additional analyses further show that these subunit design factors are also related to subunit performance. Results also indicated that operational flexibility was not related to subunit performance, yet a combined operational flexibility index was.

The findings contribute to the emerging field of dynamic capabilities by establishing operational flexibility as one of these important qualities at the subunit level. Second, this study furthers research at the meso or subunit level of the organization supporting the notion that organizational functioning is a combination of micro and macro concepts as well as contextual issues. Moreover, the results help identify possible antecedents of operational flexibility, yet fall short of empirically linking the separate dimensions with performance. Finally, the field setting of this dissertation provides a distinct contribution through the examination of concepts in a rarely studied setting: emergency departments in level I and II trauma centers.

# UNDERSTANDING DYNAMIC CAPABILITIES AT THE SUBUNIT LEVEL: OPERATIONAL FLEXIBILITY AND THE CRUCIAL ROLE OF ORGANIZATIONAL DESIGN AND INFORMATION SHARING

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# CHAPTER 1

# INTRODUCTION

Organizations are currently functioning in increasingly dynamic environments (D'Aveni, 1994) that require fast action in high-velocity settings (Eisenhardt, 1989). Some organizations, such as nuclear power plants, aircraft carriers and the like, must act reliably and quickly because in complex high-velocity work environments, failures can lead to system-wide breakdowns that often have catastrophic impacts (e.g., Grabowski & Roberts, 1999; Perrow, 1984; Weick & Roberts, 1993). In service and manufacturing organizations, such as restaurants or automobile plants, there may even be critical stoppages. Because these businesses may require a large volume of product to be created in a short span of time, the organizations must continuously and effectively manage their changing working conditions or risk losing customers during any of these failures or stoppages. Consequently, qualities or capabilities that overcome this uncertainty are increasingly important.

Recent research on dynamic capabilities purports that organizations need to build these capabilities to successfully confront existing uncertainty (Eisenhardt & Martin, 2000; Galunic & Eisenhardt, 2001; Teece, Pisano, & Shuen, 1997). According to this research, dynamic capabilities are broadly defined as "the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece, Pisano, & Shuen, 1997: 516). Studies investigating dynamic capabilities at the firm and corporate level examine such processes as knowledge transfer (e.g., Galunic & Rodan, 1998; Zander & Kogut, 1995), integrative capabilities (e.g., Brown & Eisenhardt, 1997; Henderson, 1994), and architectural competence (Henderson

& Cockburn, 1994) as critical qualities needed by the firm. The emerging perspective is that of a new organizational form that is trying to respond to the increased velocity of the environment (Child & Gunther McGrath, 2001) through development of specific capabilities.

Among these capabilities authors suggest that flexibility, defined generally as the capacity to accommodate circumstances and demands (Sennett, 1998), may be a key ingredient needed to adapt to uncertainty and change (e.g. Child & Gunther McGrath, 2001). In fact, many researchers actually consider flexibility to be critical in an uncertain environment (Burns & Stalker, 1961; Duncan, 1972; Hall, 1991; Thompson, 1967). Here, the firm must be flexible and adapt to changing market conditions as top managers restructure the organization, determining other capabilities that may aid in building productive assets. Although it is difficult to identify such specific dynamic capabilities, researchers have just begun to ascertain and establish what they are (e.g., capability-building - Makadok, 2001). Clearly identifying and operationalizing these specific processes, such as firm flexibility, may thus be a crucial link that has yet to be explored.

Currently, scholars have investigated flexibility at the corporate and industry level, at the organizational level, and in manufacturing and operations functions (e.g. strategic flexibility: Sanchez, 1993; organizational flexibility: Volberda, 1998; manufacturing flexibility: Bordoloi, Cooper, & Matsuo, 1999). In spite of these advances, research has not addressed and developed the construct of flexibility at lower levels of the firm, namely the subunit level. The subunit level addresses a department or unit that is part of a larger organization, and includes a department or subunit head and the subordinates that work within it. Additionally, because a department or subunit may

include many different work tasks and / or projects, it can include a variety of different functional employees and their respective supervisors. It is also more than a single work group because it includes these different work tasks and / or projects executed by a variety of groups.

I am focusing on this level of analysis because investigating flexibility at the subunit level may further provide a more complete picture of the construct, adding to research focused on other levels of analysis such as the organizational level and group level. This investigation can further develop and identify dynamic capabilities at work throughout the organization, as the subunit level provides a somewhat different focus from the group and organizational levels of analysis. For instance, the group level of analysis includes groups that usually consist of approximately ten or fewer members, unlike a subunit that may be much larger, such as an entire marketing department for a large corporation. Based on the above definition, this department or subunit may consist of many different task groups and functional groups and these differences can influence the interactions and processes of the subunit members. One study shows that as group size increases, performance results may not be the same as in smaller groups (e.g. sharing information Cruz & Boster, 1997). With a larger subunit consisting of many members and teams, group concepts such as cohesiveness may be adversely affected, co-location may be cumbersome, and communication can be more difficult, thus influencing phenomena investigated at the subunit level. This dissertation examines concepts at the subunit level of analysis and helps to ascertain what concepts are most salient.

Additionally, at the organizational level of analysis, researchers tend to examine all parts of the organization as a whole in their studies, and thus they incorporate all of

the many subunits that comprise the entire organization. In the ensuing analyses, subunits are assumed to contribute to organizational level constructs and are not examined independent of the organization. There may be different processes and results at the lower levels of the organization that are not detected because of this combined view. Subunits may or may not contribute to higher level processes, namely dynamic capabilities, and thus examination is needed at differing levels to establish whether this phenomenon exists throughout the organization. This dissertation investigates flexibility at the individual subunit level and thus the findings will contribute in such a way that the assumption that lower level subunits contribute to organizational level phenomena may be tested.

Further, the meso level approach captures the sense that there are both micro and macro concepts incorporated in organizational research as well as contextual characteristics to be considered (House, Rousseau, & Thomas-Hunt, 1995). Instead of examining just one set of concepts or the other, the meso approach considers a more comprehensive view. Investigating both micro and macro level constructs, processes and theories at this middle level, the subunit or departmental level, will help to maximize our understanding of flexibility through our further understanding at a different level of the organization.

Thus, as current businesses push responsibility down to the lower levels of the organization (e.g. self managing work teams: Kirkman & Shapiro, 1997; Spreitzer, Cohen, & Ledford, 1999; participation and empowerment: de Leede, Nijhof, & Fisscher, 1999; superleadership: Manz, Muto, & Sims, 1990), it is crucial to identify this critical capability of flexibility. Changing and volatile environments demand that organizations

develop dynamic capabilities in order to be better performers, and lower levels of the organization must also contribute and develop these important capabilities. Yet, flexibility at the subunit level is more narrowly focused than its general definition of the capacity to adapt (Golden & Powell, 2000) expressed at more macro levels, such as the organizational level. At the subunit level, management priorities are not focused on restructuring the organization and strategic change, but rather on problem solving of day-to-day issues. In this short-term focus, uncertainty and change is composed of staffing problems, resource issues, possible product and service issues, and the like and is not focused on major market and product change at the organizational level. Thus, issues salient at the macro level, the corporate, industrial, or organizational level, such as a long-term focus or fluctuating industrial trends, may not be quite as prominent at the subunit level. At the subunit level, these different priorities among members may change processes, which in turn may influence variable relationships and a more focused definition of flexibility should be utilized. Determining just how to build operational flexibility, defined as the ability of subunits to change day-to-day or within a day with the operational problems and changes encountered, is a key concern.

Acknowledging the need for research at the subunit level investigating operational flexibility, this dissertation focuses on answering the following three research questions:

(1) What is operational flexibility?

(2) What are the antecedents of operational flexibility? and

(3) Is increased operational flexibility related to increased performance?

To answer these questions, I draw on the organizational design literature to build a model of antecedents to operational flexibility. This stream of literature provides a base of

knowledge in which the conceptual model can be designed. I then draw upon information processing theory and organizational learning theory to complete the model, suggesting that operational flexibility is driven not only by subunit design factors, but is also driven by information sharing in the subunit. Further, information sharing moderates the subunit factor—operational flexibility relationship. A conceptual model of the relationships is presented in Figure 1.

This research aims to contribute to the literature in many ways. First, the findings will contribute to the emerging field of dynamic capabilities by establishing operational flexibility as one of the important qualities at the subunit level. By determining dimensions of operational flexibility and linking it to performance, dynamic capabilities research will move one step closer to operationalizing and establishing specific capabilities at the subunit level that may ultimately contribute to these higher level processes or routines. Future research in this area may provide even further development as more constructs are tested within the model. Second, it will further needed research at the meso or subunit level of the organization through findings that will help support the notion that organizational functioning is a combination of micro and macro concepts as well as contextual issues. Findings may help to establish a potential link between operational flexibility at the subunit level and organizational flexibility at the organizational level in future research. Moreover, the results will contribute to specific research on flexibility by identifying antecedents of operational flexibility and empirically linking it with performance. Finally, the field setting of this dissertation provides a distinct contribution by examining the concepts in a rarely studied setting: emergency departments in level I and II trauma centers. This context provides a unique

opportunity to access a highly uncertain environment in which critical decisions must be made at an extremely rapid pace. The results from this study will contribute to the growing research that examines very intense environments.

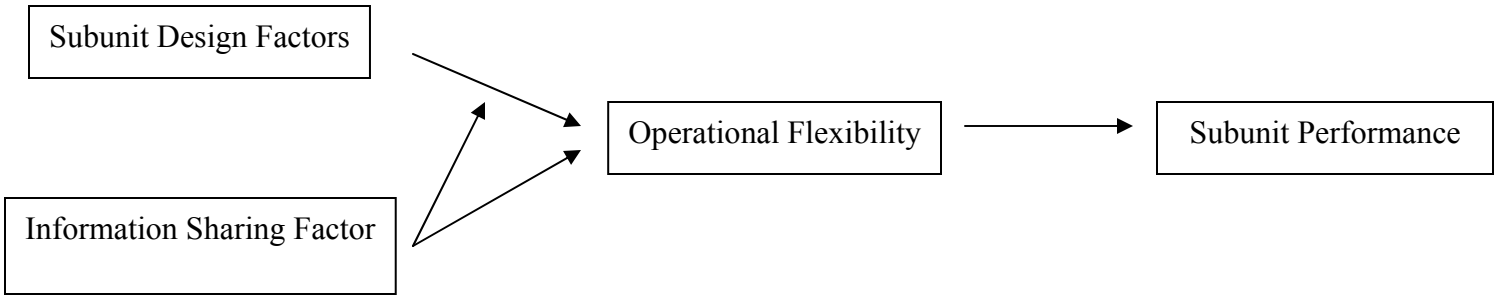
The findings and implications of this study also make significant practical contributions. First, by linking antecedents of operational flexibility and thus operational flexibility to performance, this model will help prescribe methods of increasing business execution and implementation for managers. It will help managers align their subunits or departments with organizational level goals of their firms. Second, the findings of this study will help managers to develop programs to increase operational flexibility of their subunits.

The remainder of this dissertation is organized into four chapters. Chapter 2 describes the relevant literature on processes and performance, focusing on the organizational and informational drivers of operational flexibility, as well as the concept of operational flexibility itself. This chapter also presents coordinating hypotheses for all variables. Chapter 3 describes the methodology used for this study and for testing the hypothesized relationships. Chapter 4 presents the study findings in relation to the hypotheses. Finally, Chapter 5 concludes with a discussion of the findings in terms of their theoretical and practical implications, alternative explanations, generalizability of the findings, and future research directions.

FIGURE 1

PROPOSED CONCEPTUAL MODEL:

ANTECEDENTS OF OPERATIONAL FLEXIBILITY IN THE ORGANIZATIONAL SUBUNIT



## CHAPTER 2: LITERATURE REVIEW AND HYPOTHESES

### Importance of Flexibility in Uncertain Environments

A widely held view in different streams of literature is that flexibility is a central feature of organizational success. For example, research in the operations management literature argues for the use of advanced manufacturing technologies and the level of flexibility associated with them, assuming that there is a link to increased performance. Authors in this field have focused on flexibility as a competitive weapon (De Meyer, Nakane, Miller, & Ferdows, 1989) and as a response to environmental uncertainty (Gerwin, 1993; Swamidass & Newell, 1987). Rapid technological change, global competition, and demanding customers are seen as just a few of the factors that are influencing the external environments of firms today. Because of these factors, there is increasing demand for flexibility in the organization and much of this literature shows that flexibility is seen as a 'good thing' (Adler, 1988; Avison, Powell, Keen, Klein, & Ward, 1995).

Elsewhere, in the strategic management literature, environmental dynamism is assumed to be the normal state of affairs as hypercompetition (D'Aveni, 1994) erodes a firm's competitive advantage through erosion of its market position and resource advantages. In order to combat hypercompetition, "a firm must have the flexibility to respond advantageously to its changing environment" (Sanchez, 1993: 252). This area of research emphasizes the key role of strategic flexibility in an uncertain environment. These theoretical claims are seen in the increased use of contingent workers, strategic alliances, outsourcing, and the like.

Further, in much of the early management and organization theory literature, researchers suggest that organizations should align their structures with the different levels of uncertainty in the external environment. For example, Burns and Stalker (1961) argued that as the environment becomes more complex and / or unpredictable, firms should adopt a more organic structure and those in a more stable environment should align themselves with a more mechanistic structure. The more organic the structure, the less specialized and complex the jobs will be, allowing for more flexibility. This is in contrast to the greater division and simplicity of tasks and jobs in the mechanistic organization. These authors imply that organizations with a higher level of flexibility can adapt to changes in the environment and this ability leads to more success (Burns & Stalker, 1961; Hall, 1991; Thompson, 1967). The question still remains if this argument holds true at the subunit level of the firm.

Because organizations are facing increased uncertainty and change in the environment, these arguments support the notion that they must be able to continually adapt and be flexible. If flexibility is critical for organizations' continued performance, researchers should focus on models that help explain specific forms of flexibility and identify how it can be increased. However, as stated earlier, most of the literature on flexibility does not explicitly prescribe how to build this capability at the subunit level and what factors can help increase flexibility. Thus, researchers may better serve managers and organizations, and further theoretical exploration by helping to define the concept of flexibility and how to increase it at the subunit level.

This chapter will first define flexibility at the subunit level, namely operational flexibility as it is used in this manuscript. Further, because there is little research on

flexibility at the subunit level, I rely on the organizational design literature to define the subunit characteristics that lead to operational flexibility (Burns & Stalker, 1961; Lawrence & Lorsch, 1967). Because subunits in an organization are expected to contribute to organizational level flexibility and performance, I expect the organizational factors identified below to contribute to operational flexibility at the subunit level. Additionally, in my model these subunit factors do not seem to present a complete picture of the antecedents of operational flexibility and thus I draw upon information processing theory and organizational learning theory to make the model more complete. I suggest that operational flexibility is driven not only by subunit factors, but also information sharing as well. I will conclude with the development of hypotheses regarding how subunit and information sharing factors can lead to operational flexibility.

## Operational Flexibility

### Defining Flexibility

Flexibility is not a new concept. It was originally introduced in the 15th century and was designated as a way to describe how tree branches can bend to the wind without breaking and then return to their original positions (Sennett, 1998). In academic research, economists have studied it for over 60 years (Hart, 1937; Upton, 1995) and early focus of the concept centered on the ability of a production facility to produce something different than intended (Golden & Powell, 2000). Flexibility as a concept is not easy to define as research has found that it is not only multidimensional (Suarez, Cusumano, & Fine, 1995), but also polymorphous (Evans, 1991). In addition, definitions are often influenced by managerial situations or problems (Upton, 1994). Yet, even with this difficulty, the many definitions of flexibility have characteristics in common with each other. Recent

explanations have defined flexibility as the ability to react quickly to changing conditions (Reed & Blunsdon, 1998), the capacity to adapt (Golden & Powell, 2000), as well as "a firm's ability to quickly reconfigure resources and activities in response to environmental demands" (Wright & Snell, 1998: 757). In this dissertation, a similar broad definition of general flexibility will be adopted: the capacity to accommodate circumstances and demands (Sennett, 1998). Yet, further review of the literature finds that there are many different conceptual dimensions of flexibility depending on the specific definition and the circumstances of study. It is thus important to clearly elucidate the type of flexibility to be studied and its dimensions.

In the past, researchers have suggested overlapping typologies grouping flexibility into operational, competitive and strategic categories (Eppink, 1978) or steady-state, operational, structural, and strategic categories (Volberda, 1998), to name just two. What distinguishes the different types of flexibility from each other is the type of change they are related to, the variety of actions, and the speed of the action itself. Further, a review of the management literature shows that recent investigation has focused mainly on strategic flexibility with an emphasis on manufacturing and production (e.g. Sanchez, 1995; Volberda, 1996). This type of research focuses on the organizational level, examining how the organization adapts to changing market conditions and product competition.

However, as mentioned above, management priorities at the subunit level are not focused on restructuring the organization and strategic change, but rather on problem solving of day-to-day issues. Managers are usually focused on problems and changes in their immediate environment (Eppink, 1978; Gustavsson, 1984; Upton, 1994; Volberda,

1998) and not on long-term product competition as the top managers at the organizational level. At this subunit level, there is a short-term focus where uncertainty and change is composed of staffing problems, resource issues, possible product and service issues, and the like and is not focused on major market and product change at the organizational level. Thus, organizational or strategic flexibility may not correspond to what occurs at the lower levels of the organization because of its macro level focus. Instead, a more narrowly focused definition is required. Operational flexibility in the subunit is internally oriented focusing on the participants and resources within the organization (Golden & Powell, 2000) that are required to deal with modifications that often lead to temporary changes in activity level in the subunit (Eppink, 1978). Specifically, operational flexibility is defined as the capability to adapt to day-to-day operations and issues among members and resources within the subunit.

From the definition of operational flexibility developed and a review of the literature, I propose that operational flexibility is composed of three dimensions. These dimensions are derived from the fact that operational flexibility is internally oriented focusing on the participants and resources within the organization. With this internal focus, managers encounter human resource problems as they try to have adequate numbers and experienced staff on hand; they may face physical resource problems as they try to adapt to subunit needs and an uncertain environment; and, they must try to be responsive as they attempt to adapt to these temporary changes. The three major dimensions of operational flexibility in this study correspond to each of these issues: human resource flexibility, physical resource flexibility, and responsiveness.

Human resource (HR) flexibility. With the changing and dynamic environments faced by modern firms, there is an increasing need for adaptive workers (Edwards & Morrison, 1994; Ilgen & Pulakos, 1999; Smith, Ford, & Kozlowski, 1997). Evolving technologies, mergers, and the like call for workers to operate effectively and be versatile in many different situations (Pulakos, Arad, Donovan, & Plamondon, 2000). This functional or occupational flexibility focuses on supplying employees with needed training to make them more versatile, enabling employees to do more than one occupation, and increasing internal mobility (Kanawaty, Gladstone, Prokopenko, & Rodgers, 1989; Ng & Dastmalchian, 1998; Treu, 1992). In addition, labor flexibility has focused on having the appropriate numbers of employees and the ability to alter the size of the workforce (Ng & Dastmalchian, 1998; Treu, 1992). In this study, HR flexibility includes both numerical and functional flexibility as contributors to the ability of the subunit to deal with operational problems that may arise in its dynamic environment. Specifically, HR flexibility is defined as the extent to which human resources provide the subunit with the ability to accommodate changing circumstances through the number of staff and employees' abilities to do different functions.

For instance, daily issues such as lack of staff on one occasion can create predicaments for a subunit providing services, products, and projects. If there are not enough employees to staff the phones in a customer service department on one particular day, management will have to try to compensate for this in order to alleviate more potential problems, perhaps by utilizing employees from other departments or calling in more staff. With lack of staff, customers may perceive this as poor service and this may impair future sales of the company. In addition, there will be more strain on the existing

employees on the service shift because they will have to handle more telephone calls than they are normally accustomed to, and in turn there may be more dissatisfaction and lower morale. On a consistent basis, this may increase turnover and thus cause the company to invest more money in hiring and training. It is therefore imperative that the subunit adapt to this problem to ensure good performance. They may do this by utilizing employees with abilities to do different tasks, as well as building the sheer volume of staff by borrowing other members in different areas.

Physical resource flexibility. This dimension of operational flexibility pertains to the ability of the subunit to utilize its internal physical resources. It refers to the extent of use of a resource as well as the ability to redefine, reconfigure, and redeploy a resource (Sanchez, 1995). For instance, some subunits may encounter different operational problems that require the movement and adjustments of physical resources to cope with certain issues. A hospital emergency department (ED) may find that there are no more beds vacant and available for incoming patients. In order to deal with this operational issue, they may adjust and use an available bed in the intensive care unit (ICU) in which to place their patients. In other cases, there may not be this availability due to rules or regulations that do not allow emergency patients in the ICU. These differing levels of physical resource flexibility may impact unit performance because as fewer patients are brought into the ED or the ED has to close for a certain period of time, the subunit faces a reduction in patient revenue that will impact subunit performance.

Different organizational subunits may attempt to accommodate these changes in different ways. Some subunits of the organization may choose to build up their physical resources in order to create excess inventories to allow them more operational flexibility

(Volberda, 1998). Still others may learn certain routines that help them maneuver physical resources to adapt to changes. Regardless of the method, the subunit may attempt to increase its physical resource flexibility if this level will positively impact subunit performance.

Responsiveness. Some researchers have suggested that flexibility can be seen in how responsive the organization is (Bolwijn & Kumpe, 1990; Eppink, 1978; Evans, 1991; Golden & Powell, 2000). Specifically, Bolwijn and Kumpe (1990) suggest that responsiveness is the ability to 'change quickly' and Evans (1991) suggests that responsiveness is dealing effectively with unpredictable circumstances. In the manufacturing literature, Upton (1995) views flexibility as how quickly the plant can change between process states. Other researchers have described flexibility in terms of mobility, responsiveness, agility, suppleness or litheness (De Leeuw & Volberda, 1996; Upton, 1994). Volberda (1996) asserts that one metric of flexibility is the speediness in which organizations can respond to change. Drawing from these definitions and the overall definition of operational flexibility stated above, responsiveness in this study is defined as the ability to respond to change in an appropriate timeframe (Golden & Powell, 2000) within the subunit. This definition focuses on the capability of the subunit to respond quickly to change and uncertainty and ensure that temporary issues are accommodated rapidly.

In summary, the three dimensions of operational flexibility of interest in this research are HR flexibility, physical resource flexibility, and responsiveness. Further, different areas of literature allude to this concept of flexibility in various ways, and it is important to acknowledge the relationships of these other concepts. Related to and

overlapping in some ways are the concepts of organizational improvisation and organizational coordination. Below I briefly describe each and explain how they are related to operational flexibility.

Related Concepts

Organizational improvisation. Organizational improvisation is rooted in the analogy of jazz and theatrical improvisation. The authors who write about organizational improvisation use the jazz metaphor or theatrical metaphor as a basis to describe the coordination of organizational activities (e.g., Hatch, 1998; Orlikowski, 1996; Weick, 1998). In this metaphor, improvisation deals with the unforeseen and unexpected (Weick, 1998) in which unique features are added to every creation of actions (Berliner, 1994). It is thus important to note the *novelty* expected with organizational improvisation as a way to reconfigure pre-planned material or activities (Berliner, 1994; Miner, Bassoff, & Moorman, 2001).

Further, organizational improvisation is defined as the "degree to which composition and execution [of activities] converge in time" (Moorman & Miner, 1998a: 698). This means that improvisation is concerned with the temporal order of two specific activities and how close they are to each other. It is not concerned with other outcomes such as intuition and innovation. The level of organizational improvisation ranges from (1) modest adjustments to a pre-existing activity or process, to (2) an even stronger variation from the activity or process, and to (3) the most extreme form of improvisation where new patterns are created (Moorman & Miner, 1998b). In this definition, the narrower the time gap between the activities, the more improvisation is present. Weick (1998) further names these degrees of improvisation as interpretation, embellishment,

variation, and full improvisation as each one requires more imagination and concentration.

Based on this description, flexibility and organizational improvisation are similar concepts as researchers of both argue that recombination or reconfiguration of activities is needed to deal with the unexpected and unforeseen. The two definitions do overlap due to the fact that operational flexibility includes a responsiveness component just as improvisation includes a temporal link to events and activities. Yet, although they share this aspect in common, flexibility is a broader and more general construct that does not rely on *extreme* temporal issues in the order of events and activities; organizational improvisation exists when there is a narrower time gap between activities and this is not a requirement for operational flexibility. Further, operational flexibility does not require that these activities be *novel* and unique actions.

Organizational coordination. Another concept related to flexibility is that of organizational coordination. Specifically, organizational coordination "involves fitting together the activities of organization members" (Argote, 1982: 423); it is the effective management of interdependencies of resources (Faraj & Sproull, 2000); or "managing dependencies between activities" (Malone & Crowston, 2001:10). One typology of coordination categorizes coordination methods into programmed and nonprogrammed means (Georgopoulos & Mann, 1962; Georgopoulous & Cooke, 1979). Programmed coordination uses pre-established plans, schedules, formalized rules, and the like, while nonprogrammed coordination does not involve activities specified in advance, but those that are worked out on the spot by organization members. With either of these two means and through other definitions in the literature, coordination emphasizes processes

that focus on *interdependencies* of activities and resources and without these interdependencies, there is nothing to coordinate (Malone & Crowston, 2001).

Based on this description, operational flexibility and organizational coordination overlap in that both concepts pertain to the management of resources in the organization. Yet, unlike coordination, operational flexibility does not focus or rely on the *interdependencies* of activities or processes. In addition, coordination does not specifically focus on confronting the unpredictability of the environment, but speaks to the effective management of resources and not necessarily effective management in the face of change. Operational flexibility on the other hand, is a concept that specifically addresses the ability of the subunit to confront the dynamic and changing environment in a quick manner.

Operational flexibility is by no means a completely separate and distinct concept set apart from organizational improvisation and organizational coordination, but rather it overlaps. It shares in common the characteristic ability to reconfigure some type of resource, and also has an overlapping temporal component as in improvisation. In this dissertation, operational flexibility specifically addresses the subunit level of the organization, while improvisation and coordination theory in current research primarily address the organizational level (with the exception of group coordination research). Although beyond the scope of this paper, these two overlapping metaphors could indeed be applied to the subunit level.

In the following sections, I develop a model and hypotheses concerning how operational flexibility can be built through the use of subunit design factors and an information sharing factor. Specifically, I propose that three subunit design factors

(climate, structure, and technology) are positively associated with the three dimensions of operational flexibility described above (HR flexibility, physical resource flexibility, and responsiveness). Additionally, information sharing (composed of timeliness and access) is also associated with operational flexibility and this construct further helps enhance the relationship between the subunit design factors and operational flexibility. Finally, I propose a link between operational flexibility and subunit performance.

## Antecedents of Operational Flexibility

In order to develop a model of operational flexibility at the subunit level, I reviewed the organizational literature. Unfortunately, as mentioned above, there is little research done at the subunit level of analysis and thus, specific factors have not been clearly identified. Therefore, I relied on the organizational literature for specific organizational design factors that I could apply to the subunit level of analysis. This generalization is appropriate because at the organizational level of analysis, researchers generally measure constructs in different areas of the firm, collecting data from different departments at the individual and group level. They then combine data to give an overall indication of the level of the construct at the organizational level of analysis. This aggregation or combination is based on the assumption that activities at lower levels can be aggregated to form higher level constructs and thus are indicative of their findings. During their investigations, researchers presume that all of the subunits in the organization contribute to the concepts of study, and thus imply that these constructs should hold at the subunit level. In this dissertation, I apply these organizational level concepts to the subunit level and thus not only make the same assumption but also test it in the process of investigation.

Subunit Design Factors

Classic organizational literature, such as Simon's theory of administrative behavior (March & Simon, 1958; Simon, 1976) and Weber's bureaucracy theory (Weber, 1947) contrasted views of the organization as a closed system in which the environment had little or no influence on the organization with the view of the organization as an open system in which the environment is seen as influential (Scott, 1998). In fact, this early management thought focused on how the organization essentially minimizes any possible connections with the external environment (Scott, 1998) so as not to confront the outside surroundings. However, as organizational thought evolved and research began to focus on the organization as an open system (e.g. sociotechnical systems—Trist, 1981; contingency theory—Woodward, 1965), researchers saw the environment as influential to the organization and accommodation of environmental influences has thus become an important aspect to consider. As described below, researchers (Burns & Stalker, 1961; Galbraith, 1978; 1993; LaPorte, 1996; Lawrence & Lorsch, 1967) consider the organization an open system and suggest that how the organization is configured contributes to its flexibility when dealing with these environmental influences. They specifically note that higher levels of certain design characteristics may make the organization more effective when dealing with uncertainty.

First, Lawrence and Lorsch (1967) suggest that there is no one best way to organize and that characteristics of the organization must be able to interrelate with the conditions in the environment. These authors investigated high and low performers in three industries and examined their actions and processes in their different environments. Essentially, they found that the more the environment varied, the more differentiated the

structure of the organization needed to be (Scott, 1998). Specifically, in stable and homogenous environments, more formalized, hierarchical and centralized forms were effective. Yet, in more diverse and changing environments, decentralization and less formalization seemed to be more appropriate. The organization essentially needed to be able to be more flexible in a dynamic environment through such structural factors as decentralization and less formalization. These authors implicitly suggested that structure led to flexibility in the organization and in turn better performance in a dynamic environment. Further, assuming that constructs at the subunit level contribute to organizational level constructs, subunit structure should also lead to flexibility.

Another attempt to identify and explain how organizations should structure themselves was presented by Galbraith (1978; 1993) in his discussion of the lateral organization. Galbraith argued that there is no one best way to organize because there is environmental uncertainty that affects the tasks of the organization in different ways and at different times. He argued that the greater the complexity of these tasks, the greater the amount of information that must be processed in order to confront this uncertainty. According to Galbraith, the challenge is to rely on structural arrangements, which may include rules and programs, schedules, hierarchy, and decentralization, in order to deal with task complexity and environmental uncertainty. Having many options within these formal guidelines provides the organization with the flexibility to use procedures necessary to deal with change. Thus, similar to the arguments of Lawrence and Lorsch (1967), Galbraith implies that less formalization and more decentralization may contribute to operational flexibility, at both the organizational and subunit level, and is thus desired in dynamic settings.

Related research shows that a mechanistic or organic structure (Burns & Stalker, 1961) may be an appropriate response depending on the environment. In their studies, Burns and Stalker (1961) investigated about twenty industrial firms in which they identified these two types of structures that they associated with different types of environments. Specifically, mechanistic firms, in which there is a formal hierarchy and roles are precisely defined, operate in a more stable environment. On the other hand, organic structures, where jobs are less specialized, operate in more dynamic environments where problems cannot be broken down as precisely within a clear hierarchy. In order to confront this dynamic environment, these authors suggest that less formalization in organizational design contributes to flexibility. Assuming that subunit outcomes contribute to organizational outcomes, this notion further supports the idea that structural factors in the subunit may also add to operational flexibility.

Another area of research focuses on high reliability organizations (HROs) and provides more insight into how organizations can encourage flexibility in the face of uncertainty. HROs characteristically perform at an extraordinary level of safety and productive capacity in very demanding circumstances (LaPorte, 1996). They must operate complex technologies on a day-to-day basis without major failures. Structural flexibility and redundancy help the organization adapt and work effectively in a highly contingent environment. Decision making within the HROs can shift and is usually decentralized as the organization makes rapid decisions and implements them "…very quickly with little chance for review, recovery or alteration (LaPorte, 1996: 64)." Here, structural factors, such as decentralized decision making, are paired with complex and sophisticated technologies and help to contribute to operational flexibility.

Further, these organizations rely on a strong culture centered on reliability and safety (Bierly & Spender, 1995). HROs are different from the typical efficiency organization studied in the organizational literature in that HROs choose to place reliability above profit or any other organizational objective (Weick, 1987). They have a culture that seeks to reduce failure and accidents and this culture is important to support individuals in the HRO when they are under intense pressure. These high reliability work settings consist of multi-disciplinary teams that face an uncertain and rapidly changing input environment as they constantly provide reliable performance. In these complex high-velocity work environments communication and coordination failures can lead to catastrophic breakdowns (e.g., Grabowski & Roberts, 1999; Perrow, 1984; Weick & Roberts, 1993). Thus, it is important that they develop structures, technologies, and a culture that support reliable functioning in very challenging conditions (Roberts, 1993; Weick, Sutcliffe, & Obstfeld, 1999).

This culture or value system focused on high reliability and safety suggests that there must be observable practices and procedures that are part of the organization to support its culture. Tellingly, research indicates that an organization's climate signifies to organizational members what the organization expects for behavior and potential outcomes of that behavior (Scott & Bruce, 1994) and is in place to support "the deep structure of organizations" or its culture (Denison, 1996: 624). These expectations provide a strong force and a powerful influence to maintain how members in an organization should act and behave (Schneider, 1975). This influence operates through the control the climate provides as guidance to the employees in the organization and is thus critical as this influence guides the actions and behaviors of the subunits and

employees internal to the organization. For example, one longitudinal study examining nineteen hospitals dealing with a crisis found that certain ideologies exerted a strong force guiding organizational responses to external threats (Meyer, 1982). This theme suggests that in a HRO, a climate that supports a culture for reliability would lead to operational flexibility.

The central argument articulated in the theories and areas of research above is that an organization's ability to confront uncertainty lies in how it configures itself, building flexibility to adapt to the changing environment. The more flexibility a firm has, the better able it is to confront a changing environment. These arguments for the flexible firm suggest that managers try to control the actions of the organization through specific design factors in order to contribute to firm flexibility (Volberda, 1998). Specifically, these factors can be sorted into three categories: climate, structure, and technology factors that provide management with a way to control the actions of the organization. Although the concepts of organizational design tend to conjure up notions that the organization's technology and structure must be developed and transformed in order to contribute to flexibility, additional research suggests that technology and structure are not enough. In the following sections, I build hypotheses outlining how these three design factors are associated with operational flexibility.

Climate. According to Denison, organizational climate concerns "those aspects of the social environment that are consciously perceived by organizational members" (1996: 624) and thus these aspects are in place to guide the members to support the organizational culture. Climate itself is usually assessed by individuals' perceptions of observable policies and practices (e.g. Ashkenasy, Wilderom, & Peterson, 2000;

Schneider, 1990), such as a climate of trust (e.g. James & Sells, 1981), climate for autonomy (Joyce & Slocum, 1984), and climate for innovation (e.g.Drach-Zahavy & Somech, 2001) and have been found to guide members of the organization.

According to research, two types of climate have been shown to impact members' responses in the organization: an innovative climate (Schneider, Gunnarson, & Niles-Jolly, 1994) and level of psychological safety (Edmondson, 1999). First, research indicates that innovativeness is an essential climate necessary for a company to remain competitive (Hosmer, 1996) or even for the success for an organization (Mechling, 1995; Nicholson, 1990; Pinchot & Pinchot, 1996; Schneider et al., 1994). Within the organization, support for innovation in teams has been found to be important for team functioning (Drach-Zahavy & Somech, 2001).

The reason that an innovative climate is important is that it may enable members of the organization and subunit to seek relevant responses and not just focus on standard procedures as in a more conservative climate. In an innovative climate, employees are supported and encouraged to deviate from regular patterns and the norm through creative solutions to everyday problems. The innovative climate allows members in the subunit to create adaptive ways out of sticky situations, possibly utilizing their human and physical resources in different ways. For example, when a staff member in a hospital calls in late to a shift and there are no other members to help, a subunit member may utilize an innovative solution to this issue by calling an adjacent hospital for help with the staffing issue. By utilizing members from a nearby hospital, the subunit member will increase the number of staff in the subunit and bring in different skills with the additional member to help confront this operational issue. Through a support for innovation, members may also

increase their skills by learning new ways to confront changes and uncertainty unlike a more conservative climate, which narrowly focuses on routine processes. The more innovative a climate is, the more it may enhance the operational flexibility of the organization through these innovative ideas and options.

Additionally, other practices and policies underlying the organization culture may help guide the attitudes of the members so that they may contribute to operational flexibility. In the group literature, research shows that psychological safety, or an atmosphere safe for interpersonal risk taking, is critical for group performance (Edmondson, 1999). This is because research has found that the sense of threat in organizations that emerges when individuals discuss problems limits them from problem-solving activities (Dutton, 1993; MacDuffie, 1997). Further, threat may reduce cognitive and behavioral flexibility and responsiveness (Staw, Sandelands, & Dutton, 1981). Similar to interaction within a single group, this process may also occur in a subunit as various groups within the subunit interact working through their many tasks and demands. As the members in the subunit work, the coordination, interaction, and communication among the teams contribute to members' shared beliefs in the subunit. Thus, there is a subunit level construct of the shared belief that members can take interpersonal risks without fear of threat or embarrassment.

In her research, Edmondson (1999) found that groups with higher levels of psychological safety felt that they could violate rules, deviate from the norm, take risks, or make mistakes in order to contribute to performance. (It is important to note that this construct addresses interpersonal safety and not physical safety). This safety is important for members in the organizational subunit because if members feel that it is safe to take

risks with their ideas, they will rely on any and all possible ideas in which to confront changes and challenges. Fellow subunit members will provide a setting in which it is acceptable to try out new actions, behaviors, or routines in the face of uncertainty. This type of climate that tolerates risk and provides members with psychological safety enables them to easily try new skills and work with fellow members, thereby helping them increase their skill sets. Further, members may try to use their physical resources in ways that have not been used before without fear of interpersonal criticism from fellow members. High levels of psychological safety will allow members to feel comfortable confronting uncertain situations and change with different ideas and thus they may learn new behaviors, as well as utilize different functional members and physical resources differently than the norm. Based on the above logic, I expect that an innovative climate and a climate high in psychological safety will be associated with greater HR flexibility and physical resource flexibility.

Although I expect that subunit climate should be positively associated with HR and physical resource flexibility, I do not expect them to be associated with the responsiveness dimension of operational flexibility. As stated above, a sense of threat may reduce cognitive and behavioral flexibility and thus responsiveness (Staw, Sandelands, & Dutton, 1981). These findings indicate that higher levels of psychological safety, where risk and threat is acceptable, should be associated with more responsiveness. On the other hand, an innovative climate may not be more responsive. In a subunit with an innovative climate there is emphasis on active search for relevant responses and not just operations that rely on standard operating procedures. This innovative type of climate encourages deviation and creative solutions, activities that take

time. Deviating from standard operating procedures or creating new actions and creative or innovative behavior may take time to create, learn, use, and activate. Research suggests that innovations take time to implement, and high innovation organizations that are successful take small slow steps, acting incrementally (Schneider, et al., 1994). Because of the time involved in this innovative process, where members may have to develop their behaviors and actions, responsiveness may be impeded no matter what the level of comfort for interpersonal risk taking. Thus, because of the immense time involved in creating and implementing innovative solutions, I do not expect an innovative climate and a climate high in psychological safety to be associated with greater responsiveness.

*Hypothesis 1a: Innovative climate is associated with greater HR flexibility than conservative climate.*

*Hypothesis 1b: Higher levels of psychological safety are associated with greater HR flexibility.*

*Hypothesis 2a: Innovative climate is associated with greater physical resource flexibility than conservative climate.*

*Hypothesis 2b: Higher levels of psychological safety is associated with greater physical resource flexibility.*

Structure. Another subunit factor that contributes to operational flexibility is the structure of the subunit. Structure is more than the formal chart that contains boxes, lines and arrows; it also includes the informal relationships that are not written down which influence the processes contained within the structure (Volberda, 1998). Formalization of structure denotes the degree of codification of jobs, rules, procedures and instructions

(Hage & Aiken, 1967). As argued earlier, a more organic organization or a less formalized structure is appropriate in a dynamic and complex environment (Burns & Stalker, 1961).

More formalized structures have been found to exist in more stable environments (Lawrence & Lorsch, 1967). These rules and regulations may be the mechanisms that guide business processes through methods of standard execution needed in a stable environment. Yet in a dynamic environment, subunit members need to be agile when moving human and physical resources around responding to issues in a timely manner. Less formalized structures should enable members to break old rules and ways of working, allowing them to utilize other subunit members and physical resources within the subunit quickly in response to operational issues. With less formalization, different functional members can work in different areas of the subunit and contribute their skills to help as needed. Physical resources can be redeployed from one situation to the next when there are no formal regulations restricting its use. Based on this logic, I expect that less formalized structures will be associated with greater HR flexibility, physical resource flexibility, as well as responsiveness.

Also contributing to operational flexibility is increased decentralization of decision-making or delegation of decision-making power to subordinates. Decentralization of decision-making is defined as "the selective delegation of authority to the operational level" (Przestrzelski, 1987) and its opposite, centralization of decision-making, refers to the degree that decisions and evaluation of activities is concentrated (Fry & Slocum 1984; Hall, 1977), usually at the top levels of management. Similar to

decentralization, delegation also describes the degree to which decision-making power is transferred down the hierarchy in an organization to subordinates.

Although centralization seems like an efficient way to coordinate organizational decision-making, some researchers (March & Simon, 1958; Mintzberg, 1979; Thompson, 1967) suggest that higher-level individuals may not have the cognitive capacity or information that is needed to understand the decisions that must be made. Decentralization thus enables organizations to take advantage of the capabilities of lower level employees (Ashmos, McDaniel, & Duchon, 1990) and better decisions may be made (Ashmos et al., 1990; Floyd & Wooldridge, 1992, 1997, Zabonjnik, 2002) because these employees may possess needed skills and information.

In particular, research indicates that in a turbulent environment, organizations may need some degree of decentralization or separation away from their parent organization in order to achieve flexibility, adaptability, and responsiveness (Jansen & Chandler, 1994; Lawler, 1996). Further, decision making within HROs can shift and is usually decentralized (LaPorte, 1996) as members may rely on decentralized decision making in order to avoid errors and provide reliable service. Lawrence and Lorsch (1967) also found that decision making power usually exists where the relevant information is present. Through decentralized decision making, subunit members can quickly decide what physical resources to use and where to deploy them in the face of change. Further, they may know which member to utilize in each situation in order to confront the emerging operational issues. For example, if a massive automobile crash sends multiple patients to a local ED, the attending physician working in the ED may try to decide what is needed to confront this situation. Yet, at the same time, the attending physician may be

occupied with a patient in another area of the hospital and may not be able to address the issue in a timely manner. Here, decentralized decision making where members of the ED subunit decide what staff members and physical resources are needed quickly can provide a more effective outcome. Based on this logic, I expect that decentralized decision making will be associated with greater HR flexibility, physical resource flexibility, and responsiveness.

*Hypothesis 3a: Less formalized subunit structures are associated with greater HR flexibility than more formalized subunit structures.*

*Hypothesis 3b: Decentralized decision making is associated with greater HR flexibility than centralized decision making.*

*Hypothesis 4a: Less formalized subunit structures are associated with greater physical resource flexibility than more formalized subunit structures.*

*Hypothesis 4b: Decentralized decision making is associated with greater physical resource flexibility than centralized decision making.*

*Hypothesis 5a: Less formalized subunit structures are associated with greater responsiveness than more formalized subunit structures.*

*Hypothesis 5b: Decentralized decision making is associated with greater responsiveness than centralized decision making.*

Technology. A final organizational factor that contributes to operational flexibility is the technology in the subunit. The technologies that an organization uses are the hardware and software that transform inputs into outputs (Volberda, 1998), and for the type of setting (emergency department) of this research, the example of technology is the computer machinery and equipment in the subunit. More advanced technology may

enhance flexibility potential as it can deal with many exceptions and unanalyzable problems. It may have additional purposes in which there may be more variability of its operations. On the other hand, less advanced technology is simpler and may be more specialized and dedicated to specific issues. With more variability, subunit machinery and equipment can be used for a variety of purposes and thus may contribute to physical resource flexibility.

Research examining technology suggests that it can be used to enhance the quality and timeliness of organizational processes (Huber, 1990). Specifically, more advanced technology has been found to increase problem identification and decision making speed (Leidner & Elam, 1995) and increase problem solving efficiency (Lawler & Elliot, 1996). Elsewhere, advanced manufacturing technologies (AMT) enhance efficiency in production (Barley, 1986) allowing users the capacity to efficiently and quickly produce any range of parts or products (Zammuto & O'Connor, 1992). AMT utilization contributes to significant lead-time reductions (Bessant & Haywood, 1988; Ettlie, 1988) such that these technologies aid in significant responsiveness.

Further, research has even suggested that the technology infrastructure of an organization should focus on speed of implementation and flexibility (Venkatraman, 1994). Technology should thus be designed to be responsive to changes and needs in time of uncertainty. Based on this logic, I expect that more advanced technology will be associated with greater responsiveness.

*Hypothesis 6a: More advanced technology is associated with greater physical resource flexibility than less advanced technology.*

*Hypothesis 6b: More advanced technology is associated with greater responsiveness than less advanced technology.*

Information Sharing Factor

In previous sections, I have argued that subunit climate, structure, and technology are key components to building operational flexibility. With the development of a more information intensive business setting in which organizations operate today (Child & Gunther McGrath, 2001), designing a subunit for operational flexibility through its climate, structure, and technology alone may not be adequate. Organizations have often been viewed in terms of their information processing capabilities (March & Simon, 1995; Tushman & Nadler, 1978), and research in knowledge management (e.g., Conner & Prahalad, 1996; Kogut & Zander, 1992; Nahapiet & Ghoshal, 1998) and communication flows (e.g., Mohr & Sohi, 1995; Schultz, 2001) are just two growing areas that address its importance. Because subunit members are part of the organization, they must also be able to manage information sharing as they gather, collect, and disseminate information so that they may be able to maneuver in their uncertain environment. Neglecting this intangible resource (Barney, 1991) may be catastrophic and it is thus crucial to include information sharing as an important component to create a complete picture of operational flexibility. Specifically, as described in the following pages, information processing theory (Galbraith, 1973; Van De Ven, Delbecq, & Koenig, 1976), and group and organizational learning theory (Argote, 1999; Levitt & March, 1988; March, 1991, Moorman & Miner, 1998a) indicate that information and learning may be key to dealing with any type of organizational functioning and consequently for operational flexibility as well.

First, information-processing theory (Galbraith, 1973; Van De Ven, Delbecq, & Koenig, 1976) states that information flows in an organization are a response to task uncertainty. Organizations need to have adequate information in order to perform a task and thus reduce task uncertainty. Further, as organizations face these task uncertainties, they must process information in order to reduce uncertainty and thus there must be information flowing through the organization. Thus, this information is critical to the subunit as it confronts task uncertainty and faces everyday problems and opportunities. The information that flows through the lower levels of the organization should enable members to deal with possible operational problems that they encounter.

Additionally, group learning theory (Argote, 1999) states that involving group members in sharing, generating, evaluating, and combining knowledge is important for group performance. A major aspect of group learning is acquiring this knowledge by sharing existing information or actual new knowledge that is brought in from outside the group (Argote, 1999). If this information is not shared, there is a risk that the group may not perform well. For example, a case study of a new product development team showed that failure to share knowledge had negative consequences in the form of lack of prospective sales for the actual computer the group designed (Argote, 1999). These negative consequences occurred when critical design features were not shared with a subgroup. This suggests that because groups do interact with other groups embedded within their subunit, it is important that they share, generate and combine their information. Not sharing this information may make it more difficult for the groups in the subunit to know what options they can utilize when dealing with their everyday issues. Thus, without knowing their options, members may not be able to utilize human

resources and physical resources to their full potential in response to uncertainty and this in turn may limit the subunits level of operational flexibility.

Further, organizational learning theory (Levitt & March, 1988; March, 1991) suggests that a balance of both the exploration of new knowledge and exploitation of existing knowledge within an organization is crucial for its survival and prosperity. Exploration includes search, experimentation, discovery, and innovation and exploitation includes choice, production, selection, and implementation (March, 1991). These terms imply that information is a necessary ingredient for organizational learning and thus exploration and exploitation can be viewed as the exploration for new information and exploitation of current information. March further explains that "knowledge makes performance more reliable" (1991: 83) in that as techniques are learned and processes become more familiar, time required to accomplish tasks is reduced and the quality is increased. This suggests that with more exploitation and exploration of information in the organization, responsiveness should be enhanced. Thus, increased sharing of information may contribute to the responsiveness component of operational flexibility.

Moorman and Miner also discussed organizational learning theory and stated that "learning generates change in some fashion" (2001: 305) such that it may generate new behavior or knowledge. Learning or the acquisition of information can thus lead to change in behaviors or new behaviors that members of the organization can rely on in times of uncertainty. More organizational learning occurs when there is a change in the range of potential behaviors (Huber, 1991). Information processing theory and group and organizational learning theory suggest that not only will increased information sharing potentially improve organizational efficiency, learning, innovation, and understanding of

organizational goals, but it may also improve flexibility (e.g. Malone & Rockart, 1991; Nickerson, 1992; Sproull & Kiesler, 1991; Walton, 1989). Information sharing may therefore be an important contributor to enhancing the subunits' ability to build operational flexibility.

In addition, Moorman and Miner (1998b) examined real-time information flows in new product development. These authors suggested that real-time organizational information flows are likely to influence the incidence of improvisation. As operational flexibility has some characteristics in common with organizational improvisation, such as the ability to recombine activities, I also expect that the sharing of real time information will also be associated with dimensions of operational flexibility.

Timeliness and Accessibility. Based on the above review, information sharing may be an important contributor to operational flexibility. Yet, shared information may only be useful if the information is shared in a timely manner and if subunit members have access to this information. First, information cannot be utilized when desired if it is shared within the subunit a long time after it is needed. For example, a tax accountant may be working on a specific account preparing tax forms. While working on these forms, additional paperwork may be dropped off for that account. If the members in the unit do not let the accountant know that there are additional papers for the account until a week after tax forms are due, the information is not useful. Thus, untimely information sharing will not be beneficial.

Research in group decision-making suggests that timeliness of shared information is important (Van Zandt, 1999). In fact, many studies indicate that not sharing unique information is associated with suboptimal decisions (e.g. Stasser, Taylor & Hanna, 1989;

Stasser & Titus, 1985, 1987; Winquist & Larson, 1998; Wittenbaum, 2000). For example, Eisenhardt (1989) found that real time information was a necessary part of successful and fast decision making among top management teams in a high velocity environment. She suggested that the timeliness of information sharing speeds issue identification among the members and allows them the ability to spot problems and opportunities sooner. Through the timeliness of shared information, Eisenhardt (1989) suggested that people might develop intuition and react quickly as they gain experience. This implies that with timely information, they will be able to better utilize their available options through their human and physical resources and confront the uncertainty in their environment responsively.

Yet, lack of access to this timely information may make the information useless. For instance, Moorman and Miner (1998b) define real time information flows as those that occur during or immediately prior to an action (Eisenhardt, 1989). They say that these flows are likely to occur in face-to-face interaction and electronic communication, in which there are few time delays and great opportunities for feedback (Eisenhardt, 1989; Sproull & Keisler, 1991). If subunit members miss these interactions and communications, timely information cannot contribute to operational flexibility. Members may miss this timely information because they do not have access to information in the form of little face-to-face interaction or lack of access to electronic communication. The lack of timely and accessible information can decrease the possibilities for the subunit to utilize when facing uncertainty. Members may need this information so they know what human resources and physical resources they need in order to deal with the changes that they face. Thus, these options are critical for the

subunit to increase its human resource and physical resource flexibility. Reduced timeliness and access will reduce options that will negatively impact human resource and physical resource flexibility.

In the communication literature, past research suggests that too much information is problematic (Daft & Lengel, 1986; Farace, Mong, & Russell, 1977; O'Reilly, 1980). These scholars suggest that there is a relationship such that information overload can be detrimental to individuals, groups, and organizations. It is important to note that I am not addressing the amount of information present, but just the ability to access this information and its timeliness. Thus, I do not expect there to be a curvilinear relationship but rather a linear relationship.

Additionally, there should be more accessibility to information if it is widely dispersed throughout the subunit, thereby allowing more timely access to information. Dispersion is "the extent to which organizational members share an understanding of organizational beliefs, behavioral routines, and physical artifacts" (Moorman & Miner, 1997: 95). It is the actual distribution of information throughout the members and subunit, and their common shared understandings of specific beliefs, routines, and resources. Literature on information sharing mechanisms, such as total quality management, suggests that information enhances cross-functional understanding and cooperation (Day, 1994; Griffin & Hauser, 1993; Hauser & Clausing, 1988). Thus, having timely and accessible information dispersed throughout the subunit may be a valuable tool to subunit members and may make them more efficient as they may understand other job roles in their subunit. If they understand the other job roles in the subunit better, they may be better able to utilize their human resources in the face of

uncertainty because they will know who can do what task and the number of staff needed to confront an operational issue.

In their study on new product performance and creativity, Moorman and Miner (1997) found a positive linear relationship between memory dispersion and creativity as well as new product short-term financial performance. In other words, increased memory dispersion led to more creativity in new product development. This finding implies that information distributed to subunit members may contribute to acquisition of breadth of knowledge and skills. In turn, timely and accessible information may enable members to understand one another and improve their ability to cooperate and be more creative. They may come to learn new ways to redeploy their physical resources, utilize their human resources in different situations and ultimately respond quickly to uncertainty in their environment. This research indicates that in the subunit, breadth of knowledge and skills attained through dispersed information that is accessible and timely may provide members with options that they rely on when facing uncertainty. Based on the above logic, I expect that increased information timeliness and accessibility will be associated with greater HR flexibility, physical resource flexibility and responsiveness.

*Hypothesis 7a: Greater information timeliness and accessibility is associated with greater HR flexibility.*

*Hypothesis 7b: Greater information timeliness and accessibility is associated with greater physical resource flexibility.*

*Hypothesis 7c: Greater information timeliness and accessibility is associated with greater responsiveness.*

Moderating effects. As stated above, research in group decision-making indicates that not sharing unique information is associated with suboptimal decisions (e.g. Stasser, Taylor & Hanna, 1989; Stasser & Titus, 1985, 1987; Winquist & Larson, 1998; Wittenbaum, 2000). Eisenhardt (1989) even found that real time information was a necessary part of successful and fast decision making among top management teams in a high velocity environment. Further, information processing theory (Galbraith, 1973; Van De Ven, Delbecq, & Koenig, 1976), and group and organizational learning theory (Argote, 1999; Levitt & March, 1988; March, 1991, Moorman & Miner, 1998a) imply that information sharing is key for members in an organization to process tasks as well as learn new behaviors. This timely and accessible information may inform what members in an organization can do and therefore may influence their decisions. With a lack of timely and accessible information, members may not be able to make good decisions in the face of uncertainty. Thus, I expect that increased information timeliness and accessibility will enhance the decentralized decision making-operational flexibility relationship.

Further, timely and accessible information is an important influence on the technology-operational flexibility relationship. As technology has been found to increase problem identification and decision making speed (Leidner & Elam, 1995) and increase problem solving efficiency (Lawler & Elliot, 1996), it is important that subunit members are able to use this technology when necessary. Although AMT has been found to enhance efficiency in production (Barley, 1986) and allow users the capacity to efficiently and quickly produce any range of parts or products (Zammuto & O'Connor, 1992), this advanced technology is actually useless if subunit members cannot operate it.

Thus, as subunit members provide timely and accessible information, their fellow workers will know how to use more advanced technology. They will be able to utilize more advanced technology with this timely and accessible information as needed when confronting uncertainty. Therefore, I expect that increased information timeliness and accessibility will enhance the technology-operational flexibility relationship.

*Hypothesis 8a: Information timeliness and accessibility moderates the decentralized decision making-HR flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.*

*Hypothesis 8b: Information timeliness and accessibility moderates the decentralized decision making-physical resource flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.*

*Hypothesis 8c: Information timeliness and accessibility moderates the decentralized decision making-responsiveness relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.*

*Hypothesis 8d: Information timeliness and accessibility moderates the technology-physical resource flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.*

*Hypothesis 8e: Information timeliness and accessibility moderates the technology-responsiveness relationship such that a positive relationship is*

*stronger for the subunits that have higher levels of information timeliness and accessibility present.*

Outcomes of Operational Flexibility

In the above sections, review of various streams of research has indicated that increased forms of flexibility may lead to better firm performance. Specifically, the operations literature suggests that flexible manufacturing will result in increased performance. In the area of strategic management, literature suggests that strategic flexibility is key for a firm in an uncertain environment. Evans (1991) even suggests that strategic flexibility helps firms manage environmental uncertainty and tends to enhance firm performance. Further, past and present general management and organization theory suggest the need for flexibility for organizational performance (Burns & Stalker, 1961; Hall, 1991; Thompson, 1967). Essentially, these authors argue that organizations with a higher level of flexibility can adapt to changes in the environment and this ability leads to more success. Yet, it is unclear why most research has neglected to link flexibility with performance (Volberda, 1998). A more complete examination of the flexibility and performance relationship should consider the type of flexibility and level of performance. In this study, I specifically focus on a logical link between operational flexibility and subunit performance, both at the subunit level of analysis. Based on the logic above, I expect to find that increased operational flexibility will be associated with increased subunit performance.

*Hypothesis 9a: Increased HR flexibility is positively related to subunit performance.*

*Hypothesis 9b: Increased physical resource flexibility is positively related to subunit performance.*

*Hypothesis 9c: Increased responsiveness is positively related to subunit performance.*

## Boundary Conditions

As described above, different streams of literature argue that organizations should build their ability to be flexible in order to adapt to changing conditions of the environment. Yet, according to this literature, a high level of this organizational capability is not desirable in all settings. For instance, in the operations literature, Skinner (1996) argues that there are investments, costs, and benefits associated with flexibility and thus the organization must examine these potential tradeoffs. For example, being flexible to produce many different products requires different procedures than to be flexible with changing demands in product volume. A firm must evaluate its policies and procedures it has to see if flexibility may create detrimental costs to another set of policies and procedures.

Additionally, high levels of flexibility may be undesirable in a static setting. In an environment where stable and consistent routines are the norm, flexibility has been shown not to contribute to firm performance (Lawrence & Lorsch, 1967). Market researchers argue that in an environment where the firm does not need to respond to environment changes, strategic flexibility can have an adverse influence on firm performance (Grewal & Tansuhaj, 2001; Levitt, 1983; McKee, Varadarajan, & Pride, 1989), perhaps due to overinvestment in this ability which produces detrimental costs to

the firm. It is important to note that this capability may be present in a stable setting, but it may not be as critical or even problematic as the firm invests in an unused ability.

On the other hand, in a more dynamic setting in which the organization must adjust to changes in the environment, flexibility will be a needed attribute to rely upon to be more effective. Higher levels of this organizational construct will allow a subunit or organization to respond more quickly than organizations with lower levels of this capability; higher levels may allow the organization more options in which to more effectively confront dynamism. In one study, practitioners even went so far as to describe flexibility as "a reserve, an asset, something which is possessed by the system but is not used all the time" (Correa, 1994). Thus, it is important to note that higher levels of operational flexibility may be key in a dynamic setting, but unwanted in a static setting. It may be that firms should not build this capability in a static setting and only have low levels of flexibility, whereas they should enhance their operational flexibility as the setting becomes more dynamic. This implies that to detect this concept, it is important to examine it in a dynamic setting, one in which higher levels of operational flexibility may be present. Examination of operational flexibility in a static setting may lead to a false conclusion that operational flexibility is not useful or not even present at all.

Summary

This chapter presented a literature review and accompanying hypotheses on the antecedents of operational flexibility and its link to performance. A summary table listing all of the hypotheses for this dissertation appears in Table 1. A conceptual model showing the hypothesized linkages between variables appears in Figure 2. The following chapter outlines the proposed methodology for the study. Specifically, I will discuss the

sample and research procedures, levels of analysis issues, and proposed measures for all variables.

TABLE 1
SUMMARY OF HYPOTHESES

Hypothesis 1a: Innovative climate is associated with greater HR flexibility than conservative climate.

Hypothesis 1b: Higher levels of psychological safety are associated with greater HR flexibility.

Hypothesis 2a: Innovative climate is associated with greater physical resource flexibility than conservative climate.

Hypothesis 2b: Higher levels of psychological safety are associated with greater physical resource flexibility.

Hypothesis 3a: Less formalized subunit structures are associated with greater HR flexibility than more formalized subunit structures.

Hypothesis 3b: Decentralized decision making is associated with greater HR flexibility than centralized decision making.

Hypothesis 4a: Less formalized subunit structures are associated with greater physical resource flexibility than more formalized subunit structures.

Hypothesis 4b: Decentralized decision making is associated with greater physical resource flexibility than centralized decision making.

Hypothesis 5a: Less formalized subunit structures are associated with greater responsiveness than more formalized subunit structures.

Hypothesis 5b: Decentralized decision making is associated with greater responsiveness than centralized decision making.

Hypothesis 6a: More advanced technology is associated with greater physical resource flexibility than less advanced technology.

Hypothesis 6b: More advanced technology is associated with greater responsiveness than will advanced technology.

Hypothesis 7a: Greater information timeliness and accessibility is associated with greater HR flexibility.

Hypothesis 7b: Greater information timeliness and accessibility is associated with greater physical resource flexibility.

Hypothesis 7c: Greater information timeliness and accessibility is associated with greater responsiveness.

Hypothesis 8a: Information timeliness and accessibility moderates the decentralized decision making-HR flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.

Hypothesis 8b: Information timeliness and accessibility moderates the decentralized decision making-physical resource flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.

Hypothesis 8c: Information timeliness and accessibility moderates the decentralized decision making-responsiveness relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.

Hypothesis 8d: Information timeliness and accessibility moderates the technology-physical resource flexibility relationship such that a positive relationship is stronger

for the subunits that have higher levels of information timeliness and accessibility present.

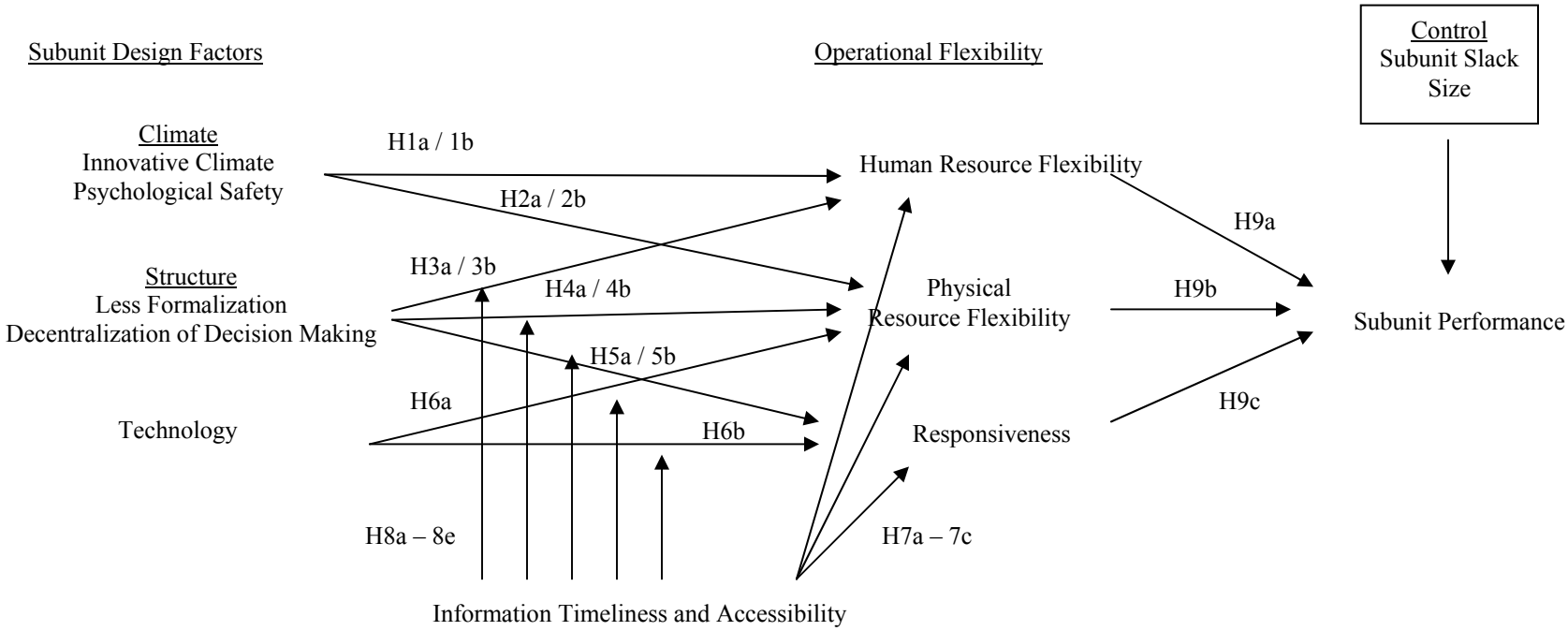
Hypothesis 8e: Information timeliness and accessibility moderates the technology-responsiveness relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present.

Hypothesis 9a: Increased HR flexibility is positively related to subunit performance.

Hypothesis 9b: Increased physical resource flexibility is positively related to subunit performance.

Hypothesis 9c: Increased responsiveness is positively related to subunit performance.

FIGURE 2
PROPOSED MODEL AND HYPOTHESES:
ANTECEDENTS OF OPERATIONAL FLEXIBILITY IN THE ORGANIZATIONAL SUBUNIT



# CHAPTER 3

# RESEARCH METHODOLOGY

This chapter describes the methodology, design and procedures in which the hypotheses were tested. Specifically, this chapter highlights the research setting, participants, data collection procedures, measures, power considerations, and analytic strategies.

## Overview of the Research Setting and Process

This research was conducted as part of a larger project involving a research team of doctoral students and faculty from the University of Maryland at College Park and Baltimore. The project provided a unique opportunity to administer a national survey to emergency departments (ED) in hospital trauma centers, a setting in which members face a dynamic, uncertain, and changing environment. Trauma centers must always be ready for any number and kind of patient admitted to the ED, the number of residents on staff, and other uncertainties. This trauma unit setting is also similar to an HRO, which has been an excellent choice for investigation of dynamic phenomena in the past. Within each trauma center, data were collected through a detailed questionnaire in a cross-sectional design. The sources of data were from respondents from multiple functional orientations (surgeons, nurses, anesthesiologists, and the like) in order to minimize same sample bias.

## Sample and Research Procedures

### Emergency Departments in Trauma Centers

To ensure that the organizational units in the sample were similar across a number of basic characteristics, the sample had to conform to a definition of level I and level II trauma centers as designated by the American College of Surgeons (ACS), as well as

some state designations. Generally, a level I trauma center has the most comprehensive resources with 1,200 or more trauma admissions a year. It is required to have specialties and medical services available at all times, and usually is home to a university residential program. A level II trauma center has similar services and although it is not *required* to have these services round the clock, it usually does. The model under investigation was expected to be useful in this type of highly dynamic and uncertain environment.

The ACS does not publicize ACS accredited trauma centers, and thus I needed to develop my sample of level I and II trauma centers from state information. I created the sample list by searching the Health Department and Emergency Medical System (EMS) web pages for each of the fifty United States and Washington, D.C. If I could not locate the list of level I and II trauma centers for a state online, I contacted individual state EMS directors or state trauma system directors by email or phone for the information. Through this process, I identified a total of 207 ACS verified, state designated, and self-designated level I trauma centers and a total of 250 ACS verified, state designated, and self-designated level II trauma centers for a total of 457 potential respondent centers.

Contact Protocol

Typically, cross-sectional survey research collects data from one source in each organization. One of the strengths of this study is the collection of data from multiple sources at each location. First, each trauma center in the sample was phoned to verify contact information for the Trauma Director and Trauma Coordinator. To encourage participation, potential respondents (Trauma Directors and Coordinators) were then contacted by letter to request their participation in a national survey. The survey process was described to them so that they understood what was expected of them and their staff

and complete cooperation was solicited. This contact served as an effort to prime the Trauma Directors and Coordinators ahead of time so that they were prepared for the package of survey materials to arrive. As an additional incentive, both Directors and Coordinators were informed that with their participation they would receive a feedback report of their organization, benchmarked against the entire group of respondents, summarizing key points of the data collection at the completion of the analysis in aggregated form (so no one organization could be identified).

Survey packages were mailed to all of the potential respondents (Trauma Directors, Coordinators and their staff) for completion. Two and a half weeks later, a reminder postcard was mailed out. Two and a half weeks after this mailing, a follow up mailing was sent to respondents that had not yet replied to the survey. This was an attempt to obtain as many responses as possible. Each package and follow up mailing to the Trauma Director contained one survey only for the Trauma Director. The package for the Trauma Coordinator contained one survey for the Coordinator and fourteen Clinician surveys to be handed out to each of the following positions: attending anesthesiologist, attending trauma physician / surgeon, trauma fellow / chief resident, trauma nurse, trauma surgical resident, and medical student. Typically, there is only one Trauma Director and one Trauma Coordinator at each center, but there are multiple workers in each subgroup. Multiple surveys to the other functions in the ED were surveyed in an effort to obtain a representative sample of the subunit which may have well over 100 workers combined from all job classes. These employees do not work at the same time, but fill the schedule to keep the ED staffed at all times. Each survey had a return

addressed business reply envelope attached to it in which the participant used to return the survey directly to the research team. This insured confidentiality to all participants.

Respondents. Of the possible 457 trauma centers, 7 centers stated that they were not trauma centers anymore, leaving a possible 450 centers in the sample. Of the remaining 450 centers, 8 centers declined to participate, 143 centers did not respond, and 299 centers sent in at least one survey (Trauma Director, Trauma Coordinator, or Clinician) for a response rate of 66.44%. Of these 299 centers, 155 centers did not have complete data sets to be included in the analysis, and thus analyses focused on 144 centers that sent in complete data (the Trauma Director survey, the Trauma Coordinator survey and two or more Clinician surveys for a 32% response rate). Further, of these 144 centers, complete usable data for all variables of interest and the two control variables subunit size and subunit slack (described below), left a total final sample of 110 centers for analyses (24.44% response rate). The final sample of 110 centers consisted of 55 level I, 50 level II, and five level III trauma centers. Table 2 presents the demographic characteristics.

TABLE 2:
DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS OF 110 CENTERS

| Variable | Statistic |
|---|---|
| Experience in health care (clinician only): | Mean: 16.6 years (s.d. 5.2) |
| Experience with current trauma center (clinician only): | Mean: 10.3 years (s.d. 4.8) |
| Functional position (clinicians only): | Nurse: 32%<br>Attending surgeon: 20.4%<br>Attending emergency medicine physician: 14.7%<br>Resident: 9.6%<br>Attending anesthesiologist: 6.9%<br>Technician: 6.5%<br>Nurse practitioner: 3.3%<br>Case manager: 1.4%<br>ED coordinator: 1%<br>Other: 4.4% (Fellow, medical student, etc.) |
| Trauma center # of trauma bays: | Mean: 3.1 (s.d. 1.9) |
| Trauma center # of utilized hospital beds: | Mean: 396.8 (s.d. 195.8) |
| Mean # of respondents per center: | Mean: 6.6 (s.d. 2.3); Minimum: 4 |

I further examined the possibility of nonresponse bias statistically, comparing the number of level I and level II centers of the respondents to the nonrespondents. Of the 110 centers that had usable responses, 55 reported that they were a level I center, 50 reported that they were a level II center, and the remaining 5 reported that they were level III. The remaining 152 nonrespondents were composed of 71 level I centers and 81 level II centers. A chi square test revealed that there were no significant differences between the groups on the basis of trauma center level. In additional analyses, I used the data from

the 189 respondents with incomplete information in a one way ANOVA comparing all variables of interest with the 110 respondents in my final analyses. I was able to compare all variables and found no significant differences between the two groups on any of the variables with the exception of one of the control variables "natural log of utilized beds". From this analysis, I have concluded that the no discernible nonresponse bias between the two groups. However, it is interesting to note that the centers included in my analyses did have a significantly higher mean of utilized beds in their centers than those without complete data not included in my analyses. Yet, the other variables were not significantly different. This suggests that even though size is an important consideration in much of the management literature as a possible influence on relationships, it may not be an influential factor here on the variables of interest.

**Variable Definition and Measurement**

Survey items were developed from a review of the literature as well as interviews conducted with a separate group of Trauma Directors and staff from 12 hospitals. I used both sets of information to construct measures that investigate subunit design factors and information timeliness and accessibility as well as operational flexibility and performance, while using established measures where possible. The original instrument was pilot tested with a small sample of five clinicians from local trauma units as well as eight experts in the field of business (professors and Ph.D. students) and was then refined further. Results from the pilot sample enabled me to clarify the measures and thus finalize the survey for distribution. Unless noted below, all survey items utilize a five-point response format to indicate the respondent's level of agreement with the statement,

where 1 = Not at All and 5 = To a Great Extent. (See Appendix 1 for all scale items and descriptions).

Operational Flexibility

Operational flexibility was measured using three scales representing HR flexibility, physical resource flexibility and responsiveness. These variables were chosen based on the definition of operational level flexibility reasoned in earlier sections of this manuscript. *HR flexibility* was measured to assess the degree of flexibility found in the human resources in the subunit, such as in the number of staff and employees' ability to do different functions. The three items in this scale were created for this study. *Physical resource flexibility* gauged the level of flexibility found in the physical resources in the subunit, specifically the extent of use of a resource as well as the ability to move the resource where needed in the subunit. The three items in this scale were created for this study based on the definitions of physical resource flexibility of Sanchez (1995) and Volberda (1996). The third dimension, *responsiveness,* indicates how quickly the subunit reacts in response to changes and uncertainty. The four items in this scale were created for this study based on definitions of responsiveness from Volberda (1998) and Golden and Powell (2000).

Subunit Design Variables

Subunit Climate. This investigation focused on two subunit climate variables (hereinafter referred to as climate) in the organization expected to contribute to operational flexibility mentioned earlier on page twenty-five: innovative climate and psychological safety. *Innovative climate*, measured by four items adapted from the Team Climate Inventory scale (Kivimaki, Kuk, Elovainio, Thomson, Kalliomaki-Levanto, &

Heikkila, 1997), is intended to measure the degree of support for innovation in the subunit. The items were phrased to measure this at the subunit level of analysis and not the team level. *Psychological safety* items reflect an assessment of the shared belief that the subunit is safe for interpersonal risk taking, expression, and dissent of ideas. These three items were adapted from Edmundson (1999).

Structure. This investigation focused on two structural variables in the subunit expected to contribute to operational flexibility: level of formalization and decentralization of decision-making. *Formalization* captures the degree to which procedures and rules are documented and followed. The three items are taken from Lee and Grover (2000) and were originally adapted from measures developed by Aiken and Hage (1971). *Decentralization of decision-making* was measured by four items adapted from Richardson, Vandenberg, Blum, and Roman (2002) (originally adapted from the Aiken & Hage's, 1966 scale). This scale is intended to measure the level of delegation of decision-making in the subunit. A higher number on both of these scales indicates a higher level of formalization and centralization, respectively.

Technology. The formative scale measuring *technology* created for this study is intended to gauge the level of complexity and specialization of the computer machinery and equipment in the subunit and how advanced it is. From prior interviews with over 45 trauma personnel including directors, coordinators, and clinicians, key pieces of technology needed in the trauma area were determined. This list was further refined based on interviews of three experts with extensive experience in the field of trauma and emergency medicine. The scale was refined to include seven advanced pieces of equipment or technology areas that may or may not be in a trauma center ED. Examples

include filmless digital X-ray and a magnetic resonance imaging machine (MRI). Trauma Coordinator respondents checked all pieces that were present in their trauma center ED and items checked were summed to indicate the level of technology in each subunit. A higher number on this measure indicates the presence of more advanced technology.

Information Timeliness and Accessibility

This investigation focused on an index composed of timeliness and accessibility of shared information. This index was measured by three items designed to assess how timely information is acquired by subunit members when needed or *timeliness of shared information,* and four items designed to evaluate the level of access that members of the subunit have to information or a*ccess to shared information.* As described below, all information index items were entered into the factor analysis along with all other variable items and, after dropping one item because of cross loading, the seven remaining items loaded on one factor to compose the information and timeliness index. Further, using all individual level data, I examined just the information timeliness and accessibility index. The measure broke out on two factors, but not as predicted. It appears that one factor included the reverse coded items and the other factor included the other items. When I did the same factor analysis on the aggregated data (subunit level), the items loaded as a single factor. Together, these results suggest that the information timeliness and accessibility index may consist of one factor and not two (please see Table 3). All items from this index were created for this study and were combined to form an average value. This composite index is an efficient measure of the overall level of information timeliness and accessibility in the subunit.

TABLE 3: FACTOR ANALYSIS FOR INFORMATION TIMELINESS AND ACCESSIBILITY ITEMS

| | Individual Level | | Aggregated Subunit Level |
|---|---|---|---|
| **Item** | **Loadings** | | **Loadings** |
| | **1** | **2** | **1** |
| Info Time and Access 1 | .88 | | .79 |
| Info Time and Access 2 | .85 | | .78 |
| Info Time and Access 3 | | .69 | .73 |
| Info Time and Access 4 | .69 | | .71 |
| Info Time and Access 5 | | .83 | .76 |
| Info Time and Access 6 | | .85 | .82 |
| Info Time and Access 7 | | | .57 |
| **Eigenvalue** | 3.17 | 1.02 | 3.82 |

Outcome Variable

Performance was measured through five items created for this study that measure the subjective perceptions of performance of the subunit. These items were collected from the Trauma Director, Trauma Coordinator, and Clinicians. In order to try and avoid same source bias, responses from the Trauma Director and Trauma Coordinator (not the Clinicians) were combined and aggregated to the subunit level to get a more comprehensive view of the performance of the subunit without Clinician responses included. Further, the use of a perceptual measure was necessary due to the extreme difficulty in obtaining reliable objective measures in the health field. Data on outcomes such as mortality rates and number of days of hospitalization are incredibly difficult to obtain. This difficulty is primarily due to anonymity and confidentiality issues in the trauma industry. To this day, primary investigators on the larger project and I have not been able to obtain reliable data that can be matched with our sample. Moreover, such measures may suffer from criterion contamination and deficiency problems (e.g. sicker

patients, who have a higher mortality rate, may gravitate for other reasons toward certain hospitals), making their use here of questionable value even if they were available.

Control Variables

In any study, it is important to control for variables that may affect the relationships in the model in order to avoid any extraneous noise in the relationships. Further, I wanted to control for any variables that might otherwise explain the predicted relationship between my independent variables and dependent variables. Specifically, large organizations and subunits are likely to have a greater amount of resources and research indicates that large organizations exhibit better performance than smaller ones (Keats & Hitt, 1988). I have thus controlled for *subunit size* by collecting the data on the number of utilized hospital beds (and not the number of licensed hospital beds) from the Trauma Coordinator for each center. This number is an indicator of the size of the overall hospital. I then transformed each number by taking the natural log because the values of the total number were highly skewed. This transformation normalizes the data and the relationships with other variables are less likely to be affected by acute differences in values.

Additionally, research in the organization theory literature shows that organizational slack is a necessary component for organizations trying to adapt, change and act in an environment characterized by turbulence (Cyert & March, 1963; Thompson, 1967). Further, HROs have also been found to have intentional redundancy built into their systems in order to make sure that they can operate error free in a complex environment (LaPorte, 1996). I therefore expected that subunits with higher levels of organizational slack may have more advantage to develop operational flexibility than

those subunits that do not have high levels of organizational slack due to available resources and time at their disposal. In order to control for *subunit slack* in the trauma subunit, I calculated the ratio of number of designated trauma patient bays in the ED to number of admitted trauma patients for the year to indicate the potential slack in each subunit. This score was created from data collected from the Trauma Coordinator.

In order to demonstrate discriminant validity, all items were analyzed using an exploratory factor analysis with varimax rotation. Because of cross-loadings, four individual items were dropped from the analysis. These items included two items from the original 5-item psychological safety measure, one item from the original 8-item information timeliness and accessibility index, and one item from the original 4-item HR flexibility measure. Visual inspection of the scree plot after these items were dropped suggested an eight factor solution. As shown in Table 4, when all items were entered, the eight variables showed discriminant validity and resulted in findings consistent with the theoretical model. These eight factors account for 63.74% of the total variance and had Eigenvalues of 8.35, 2.58, 2.16, 1.67, 1.40, 1.32, 1.22, and 1.06, respectively.

TABLE 4: FACTOR ANALYSIS FOR ITEMS (individual level of analysis)

| **Items** | **Component** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| HR flexibility 1 | | | | | | | .64 | |
| HR flexibility 2 | | | | | | | .80 | |
| HR flexibility 3 | | | | | | | .77 | |
| Physical resource flexibility 1 | | | | | | | | .72 |
| Physical resource flexibility 2 | | | | | | | | .73 |
| Physical resource flexibility 3 | | | | .45 | | | | .57 |
| Responsiveness 1 | | | | .76 | | | | |
| Responsiveness 2 | | | | .78 | | | | |
| Responsiveness 3 | | | | .76 | | | | |
| Responsiveness 4 | | | | .48 | | | | |
| Innovative Climate 1 | | .77 | | | | | | |
| Innovative Climate 2 | | .80 | | | | | | |
| Innovative Climate 3 | | .82 | | | | | | |
| Innovative Climate 4 | | .78 | | | | | | |
| Psych Safety 1 | | | | | .71 | | | |
| Psych Safety 2 | | | | | .72 | | | |
| Psych Safety 3 | | | | | .63 | | | |
| Formalization 1 | | | | | | .68 | | |
| Formalization 2 | | | | | | .81 | | |
| Formalization 3 | | | | | | .66 | | |
| Decentralization 1 | | | .72 | | | | | |
| Decentralization 2 | | | .64 | | -.40 | | | |
| Decentralization 3 | | | .84 | | | | | |
| Decentralization 4 | | | .86 | | | | | |
| Info Time and Access 1 | .72 | | | | | | | |
| Info Time and Access 2 | .73 | | | | | | | |
| Info Time and Access 3 | .59 | | | | | | | |
| Info Time and Access 4 | .71 | | | | | | | |
| Info Time and Access 5 | .68 | | | | | | | |
| Info Time and Access 6 | .70 | | | | | | | |
| Info Time and Access 7 | .38 | | | | | | | |
| **Eigenvalue** | 8.35 | 2.58 | 2.16 | 1.67 | 1.40 | 1.32 | 1.22 | 1.06 |

Principle component analysis with varimax rotation; Loadings less than .30 not shown
Items listed here correspond to items listed in appendix
N = 695

Further, items that are part of a construct need to demonstrate internal consistency to show that there is homogeneity of the indicators that are part of the construct. I relied on Cronbach's coefficient Alpha (Cronbach, 1951) as the measure of internal consistency of all measures. Acceptable values of perceptual measures are usually recommended to exceed .70 (Nunnally, 1978). When the value is much lower than this minimum, there is the implication that the items measuring the construct may be unrelated or measuring more than one construct. Additionally, there is also a concern for internal consistency when aggregating data. For scales that were aggregated from the individual level to the subunit level, two alpha reliabilities are reported: the alpha reliabilities for raw scores (N=695), or individual scores across all subunit members; and for the complete subunit level scores (N=110), once item responses were aggregated to the subunit level. Any major change in alpha between the individual level and subunit level would indicate a problem with the construct. Table 5 summarizes the scales, means, standard deviations, and alpha reliabilities (at both levels) for each measure. The alpha levels reported show consistency when going from individual level to subunit level aggregation. Additionally, there are two measures HR flexibility and physical resource flexibility that are slightly lower than the minimum recommended level of .70 alpha, at .64 and .68 respectively. Although they are slightly lower, they are new measures that were created for this study, and are very near the suggested levels.

TABLE 5: SCALES, MEANS, STANDARD DEVIATIONS, ALPHA RELIABILITIES, AGGREGATION RESULTS, $R_{WG}$, AND ANOVA STATISTICS

| | | | Subunit level | | Individual level | Subunit level | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Source of Data | # Items | Mean | S.D. | Cronbach α | Cronbach α | Median Rwg | ANOVA F-statistic |
| HR Flexibility | Clinicians | 3 | 3.18 | .56 | .66 | .64 | .62 | $F_{(109, 395)} = 1.55$** |
| Physical Resource Flexibility | Clinicians | 3 | 3.50 | .40 | .68 | .68 | .80 | $F_{(109, 395)} = 1.37$* |
| Responsiveness | Clinicians | 4 | 3.67 | .42 | .81 | .83 | .81 | $F_{(109, 395)} = 1.33$* |
| Innovation Climate | Clinicians | 4 | 3.63 | .44 | .90 | .91 | .82 | $F_{(109, 395)} = 1.43$** |
| Psychological Safety | Clinicians | 3 | 3.85 | .49 | .66 | .76 | .73 | $F_{(109, 395)} = 1.73$** |
| Formalization | Clinicians | 3 | 3.39 | .45 | .68 | .70 | .77 | $F_{(109, 395)} = 1.62$** |
| Decentralization of Decision Making | Clinicians | 4 | 2.41 | .50 | .83 | .86 | .70 | $F_{(109, 395)} = 1.23$† |
| Technology: sum of 7 indicators | Trauma Coordinator | 1 | 3.96 | 2.01 | NA | NA | NA | NA |
| Information Timeliness and Accessibility Index | Clinicians | 8 | 3.60 | .39 | .81 | .86 | .87 | $F_{(109, 395)} = 1.67$** |
| Performance | TD/TC | 5 | 4.30 | .53 | .96 | .91 | .91 | $F_{(109,110)} = 1.75$** |
| Performance Index | TD/TC/ Clinician | 5 | 4.20 | .43 | .98 | .90 | .94 | $F_{(109,110)} = 2.30$** |
| Size: number of utilized beds (natural log) | Trauma Coordinator | 1 | 5.83 | .63 | NA | NA | NA | NA |
| Slack Resources: ratio of number of trauma beds in trauma center to number of trauma admissions | Trauma Coordinator | 2 | .004 | .007 | NA | NA | NA | NA |

**p < .01, *p < .05, †p < .10; N = 110 centers at the subunit level; TD = Trauma Director; TC = Trauma Coordinator

## Analysis

In order to minimize same source bias, I collected my independent and dependent variables from different respondents. For example, control variables and the measure of technology were collected from the Trauma Coordinator. Climate, structure, operational flexibility and information timeliness and accessibility variables were collected from the Clinicians and the performance outcome measure was collected from both the Trauma Director and Trauma Coordinator.

### Level of Analysis Issues

Researchers argue that the levels of theory, measurement, and statistical analysis should be consistent and congruent (Klein, Dansereau, & Hall, 1994). The unit of theory for this study is the subunit level and all relationships among variables are hypothesized at the subunit level of analysis. However, the measures collected from the subunit members were gathered at the individual level. In order to justify aggregating individual clinician member scores to the subunit level, items were intentionally worded at the subunit level, thus helping to assure that aggregation of individual level responses was meaningful at the subunit level.

Additionally, showing that aggregation is statistically appropriate helps to support the notion that aggregation of clinician responses to the subunit level is justified. I used Rwg to test whether there was high within-subunit agreement (James, Demaree, & Wolf, 1984). Using the Rwg index, aggregation is generally considered appropriate when the median Rwg values for each scale is .70 or greater (George, 1990; George & Bettenhausen, 1990). All of the scales in this study had median Rwg values greater than

.70 except the HR Flexibility scale (value of .64), which may indicate a concern for aggregation for this scale.

To further support aggregation of the clinician data to the subunit level, I also used a one-way ANOVA to determine how variance in the measures due to between subunit effects compares with variance due to within subunit effects. There must be significant differences across subunits, or a between subunit effect based on a significant F statistic, to justify aggregation. The F statistic for all measures was significant at the $p < .05$ level, except decentralization of decision making which was significant at the $p < .10$ level. These scores indicate that between subunit effects do differ significantly from within subunit effects. Thus, this significant difference indicates there is agreement within subunits on all measures, and the measure of HR flexibility can be aggregated to the subunit level for analyses. Median Rwg values and one-way ANOVA results are given in Table 5.

Statistical Power

The power of a statistical procedure is the probability that it will yield statistically significant results (Cohen, Cohen, West, & Aiken, 2003), or the probability of rejecting $H_0$ given that $H_0$ is false. Power analysis is necessary in order to determine the level of confidence that can be placed in the study's findings. Using a power level of .8 and an alpha value of .05, I derived the required sample size that matches a pre-determined effect size. Assuming that my theoretical model will generate an $R^2$ level of .2 (a reasonable effect size for organizational and social psychological studies (Cohen, 1988: 414), and my power level is .8 and alpha level is .05, with a maximum of nine

independent variables the required samples size is 89 centers. Since my response set contains 110 centers, the appropriate sample size requirement has been exceeded.

Hypothesis testing. I tested the hypotheses using hierarchical regression analysis as this procedure allowed me to control for subunit size and subunit slack resources. For Hypotheses 1a — 7c, the two climate, two structure, and technology variables, the information timeliness and accessibility index, and two control variables were regressed onto each of the three dimensions of operational flexibility. First, I regressed all onto HR flexibility to test the predictions in Hypotheses 1a, 1b, 3a, 3b, and 7a. Similarly, I used the same process for Hypotheses 2a, 2b, 4a, 4b, 6a, and 7b. Finally, I regressed the same variables to test the predictions in Hypotheses 5a, 5b, 6b, and 7c. These tests provided results that will be described in the next chapter.

For each of the interaction hypotheses 8a-8e, I entered the moderating variable, the information timeliness and accessibility index, in the regression to test for potential direct effects after entering the control variables and the subunit variables. In the final step, I added the interaction terms to assess the significance of the index of information timeliness and accessibility on the subunit factor—operational flexibility relationship. Finally, for Hypotheses 9a-9c, the three dimensions of operational flexibility and the two control variables were regressed on the measures of subunit performance.

# CHAPTER 4

# RESULTS

This chapter summarizes the results of the data analyses. Correlations for all study variables are reported in Table 6. As described in the previous chapter, I used hierarchical regression analysis to test the hypotheses because this procedure allowed me to control for trauma center size and subunit slack resources.

Overall, there was support for the hypothesized relationships between the innovative climate characteristic and operational flexibility dimensions. There was also support for the proposed relationships between the two subunit structure variables and the dimensions of operational flexibility. Further, information timeliness and accessibility did appear to moderate the relationship between decentralized decision making and HR flexibility. Finally, there was no support for the relationships between operational flexibility and performance. In the following sections I will explain the regression results of the tests for hypotheses 1 – 9 and additional post hoc exploratory analyses.

TABLE 6: CORRELATIONS

| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Size (natural log of utilized beds) | | | | | | | | | | | |
| 2. Slack Resources | -.55*** | | | | | | | | | | |
| 3. HR Flexibility | -.11 | .08 | | | | | | | | | |
| 4. Physical Resource Flex | -.11 | .06 | .36*** | | | | | | | | |
| 5. Responsiveness | -.16† | .07 | .22* | .50*** | | | | | | | |
| 6. Innovative Climate | .06 | .01 | .31** | .50*** | .57*** | | | | | | |
| 7. Psychological Safety | -.16 | .11 | .25** | .38*** | .54*** | .53*** | | | | | |
| 8. Formalization | .05 | -.06 | .06 | .27** | .45*** | .46*** | .34*** | | | | |
| 9. Decentralization | .09 | .03 | -.09 | -.40*** | -.39*** | -.36*** | -.49*** | -.04 | | | |
| 10. Technology | -.02 | -.12 | .06 | .06 | .11 | .10 | -.07 | .01 | .02 | | |
| 11. Information Timeliness and Accessibility Index | -.07 | .09 | .00 | .45*** | .49*** | .42*** | .51*** | .45*** | .35*** | -.02 | |
| 12. Performance | .11 | -.12 | .07 | .12 | .06 | .29** | -.11 | -.05 | .01 | .14 | .06 |

***p < .001; **p < .01; *p < .05, † p < .10
N = 110 trauma centers

## Hypotheses 1 – 7: Relationships Between Subunit Design Factors / Information Timeliness and Accessibility and Operational Flexibility

Hypotheses 1 – 7 predicted that different subunit design factors as well as information timeliness and accessibility would be related to three key dimensions of operational flexibility: HR flexibility, physical resource flexibility, and responsiveness.

### HR Flexibility

First, hypothesis 1a and 1b predicted that the climate factors, a climate for innovation and a psychologically safe climate, would be significantly associated with greater HR flexibility. Further, hypothesis 3a and 3b predicted that the subunit structure factors, less formalization and more decentralization of decision making, would also be associated with greater HR flexibility. Finally, hypothesis 7a predicted that information timeliness and accessibility would be associated with greater HR flexibility.

As shown in Table 7, after entering the control variables subunit size and slack resources in step 1, I entered the subunit design variables in step 2 and the model was significant ($\Delta R^2 = .12$, $p < .05$). Although the overall model was significant, regression analysis shows that only a climate for innovation was significant and explained the majority of the variance. Thus, data showed support for hypothesis 1a but no support for 1b, 3a, and 3b. Specifically, a climate for innovation was significantly related to higher levels of HR flexibility ($\beta = .31$, $p < .05$), but psychological safety ($\beta = .18$, ns), less formalized structures ($\beta = -.14$, ns), and more decentralized decision making ($\beta = .11$, ns) were not significantly related to HR flexibility.

Further, in step 3 I entered the information timeliness and accessibility index and the model remained significant (Overall $F = 2.37$, $p < .05$) and the change in $R^2$ was

marginally significant ($\Delta R^2 = .03$, $p < .10$). Upon assessment of each individual variable entered into the regression, it was clear that a climate for innovation remained significant ($\beta = .32$, $p < .05$). Interestingly, the beta weight for the variable psychological safety not only increased, but was now marginally significant ($\beta = .23$, $p < .10$). Further, there was marginal significance in which information timeliness and accessibility was negatively associated with HR flexibility and not positively associated as predicted ($\beta = -.20$, $p < .10$). This provides weak support for the opposite of hypothesis 7a.

TABLE 7: REGRESSION RESULTS,
TESTS OF HYPOTHESES 1a, 1b, 3a, 3b, AND 7a PREDICTING HR FLEXIBILITY

| | HR Flexibility | | |
|---|---|---|---|
| | Step 1 | Step 2 | Step 3 |
| Size | -.09 | -.05 | -.04 |
| Subunit slack | .03 | .02 | .05 |
| Innovation | | .31* | .32** |
| Psych. Safety | | .18 | .23† |
| Formalization | | -.14 | -.07 |
| Decentralization | | .11 | .07 |
| Technology | | .04 | .04 |
| Information Timeliness and Accessibility Index | | | -.20† |
| Overall F | .67 | 2.23* | 2.37* |
| $R^2$ | .01 | .13* | .16† |
| Adj. $R^2$ | -.01 | .07* | .10† |
| $\Delta R^2$ | .01 | .12* | .03† |
| $\Delta F$ | .67 | 2.84* | 3.03† |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Physical Resource Flexibility**

Next, hypothesis 2a and 2b predicted that the climate factors, a climate for innovation and a psychologically safe climate, would be associated with greater physical

resource flexibility. Additionally, hypotheses 4a and 4b predicted that the two structural factors, less formalized structures and more decentralized decision making, would also be associated with greater physical resource flexibility. Hypothesis 6a predicted that more advanced technology would be associated with greater physical resource flexibility. Finally, hypothesis 7b predicted that information timeliness and accessibility would also be associated with greater physical resource flexibility. As with the hypotheses tested above, there were mixed results.

Table 8 presents the results of the hierarchical regression analysis. After entering the control variables subunit size and slack resources in step 1, I then entered the subunit design variables in step 2 and the model was significant ($\Delta R^2 = .31$, $p < .001$). As with the previous tests above, regression analysis shows that only specific variables significantly contributed to the model. Specifically, a climate for innovation ($\beta = .34$, $p < .01$) and decentralized decision making ($\beta = -.25$, $p < .05$) were significantly related to higher levels of physical resource flexibility, but psychological safety ($\beta = .04$, ns), less formalized structures ($\beta = .10$, ns), and more advanced technology ($\beta = .04$, ns) were not significantly related to physical resource flexibility. Thus, data showed support for hypotheses 2a and 4b, but no support for 2b, 4a, and 6a.

Further, in step 3 I entered the information timeliness and accessibility index and the model remained significant ($\Delta R^2 = .03$, $p < .05$). Upon assessment of each individual variable entered into the regression, it was clear that a climate for innovation remained significant ($\beta = .32$, $p < .01$) and also decentralized decision making remained significant ($\beta = -.20$, $p < .05$). Additionally, information timeliness and accessibility also was significant ($\beta = .24$, $p < .05$) indicating that it was associated with higher levels of

physical resource flexibility, and significantly explained some of the variance of this model. This provides support for hypothesis 7b.

TABLE 8: REGRESSION RESULTS,
TESTS OF HYPOTHESES 2a, 2b, 4a, 4b, 6a, AND 7b
PREDICTING PHYSICAL RESOURCE FLEXIBILITY

| | Physical Resource Flexibility | | |
|---|---|---|---|
| | Step 1 | Step 2 | Step 3 |
| Size | -.10 | -.03 | -.04 |
| Subunit slack | .01 | .06 | .03 |
| Innovation | | .34** | .32** |
| Psych. Safety | | .04 | -.02 |
| Formalization | | .10 | .02 |
| Decentralization | | -.25* | -.20* |
| Technology | | .04 | .04 |
| Information Timeliness and Accessibility Index | | | .24* |
| Overall F | .61 | 6.84*** | 6.89*** |
| $R^2$ | .01 | .32*** | .35* |
| Adj. $R^2$ | -.01 | .27*** | .30* |
| $\Delta R^2$ | .01 | .31*** | .03* |
| $\Delta F$ | .61 | 9.23*** | 5.28* |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Responsiveness**

Finally, hypotheses 5a and 5b predicted that subunit structural variables, less formalized subunit structures and more decentralized decision making, would be associated with greater responsiveness. Also, hypothesis 6b predicted that more advanced technology would be associated with greater responsiveness and hypothesis 7c predicted

that information timeliness and accessibility would be associated with greater responsiveness.

Table 9 presents the results of the hierarchical regression analysis. After entering the control variables subunit size and slack resources in step 1, I then entered the subunit design variables in step 2 and the model was significant ($\Delta R^2 = .45$, $p < .001$). As with the previous tests above, regression analysis showed that only specific variables significantly contributed to the model. Specifically, decentralized decision making ($\beta = -.17$, $p < .10$) was marginally significant, indicating it was related to higher levels of responsiveness and thus supported hypothesis 5b. Interestingly, more formalized structures were significantly associated with higher levels of responsiveness ($\beta = .26$, $p < .01$), the opposite of what was predicted in hypothesis 5a. Also, more advanced technology ($\beta = .04$, ns) was not significantly related to responsiveness, indicating a lack of support for hypothesis 6b. Although not hypothesized, the regression results indicated that psychological safety ($\beta = .23$, $p < .05$) and a climate for innovation ($\beta = .25$, $p < .01$) were also associated with higher levels of responsiveness, and thus significantly contributed to this model.

Further, in step 3 I entered the information timeliness and accessibility index and the model did remain significant (Overall $F = 12.03$, $p < .001$) but the change in $R^2$ was not significant ($\Delta R^2 = .01$, ns), indicating that information timeliness and accessibility did not contribute any explanation over the other variables. Upon assessment of each individual variable entered into the regression, it was clear that the unpredicted relationships remained significant. Specifically, a climate for innovation ($\beta = .20$, $p < .01$) and psychological safety ($\beta = .32$, $p < .01$) were significantly associated with greater

subunit responsiveness. Further, as found in the previous test, the opposite of hypothesis 5a also remained significant; more formalized structures were associated with greater subunit responsiveness ($\beta = .21$, $p < .05$). Interestingly, with information timeliness and accessibility entered into the third step, decentralized decision making was no longer significant ($\beta = -.14$, ns) although the magnitude of the beta and sign remained in the same direction. Finally, information timeliness and accessibility was also not significant ($\beta = .14$, ns) indicating that it was not associated with higher levels of responsiveness. This finding fails to provide support for hypothesis 7c.

TABLE 9: REGRESSION RESULTS,
TESTS OF HYPOTHESES 5a, 5b, 6b, AND 7c PREDICTING RESPONSIVENESS

| | Responsiveness | | |
|---|---|---|---|
| | Step 1 | Step 2 | Step 3 |
| Size | -.18 | -.10 | -.10 |
| Subunit slack | -.03 | .02 | .01 |
| Innovation | | .23* | .20* |
| Psych. Safety | | .25** | .24* |
| Formalization | | .26** | .21* |
| Decentralization | | -.17† | -.14 |
| Technology | | .10 | .10 |
| Information Timeliness and Accessibility Index | | | .14 |
| Overall F | 1.52 | 13.22*** | 12.03*** |
| $R^2$ | .03 | .48*** | .49 |
| Adj. $R^2$ | .01 | .44*** | .45 |
| $\Delta R^2$ | .03 | .45*** | .01 |
| $\Delta F$ | 1.52 | 17.44*** | 2.42 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

## Hypotheses 8a - 8e: Moderating Effects of Information Timeliness and Accessibility on the Subunit Design Factor and Operational Flexibility Relationships

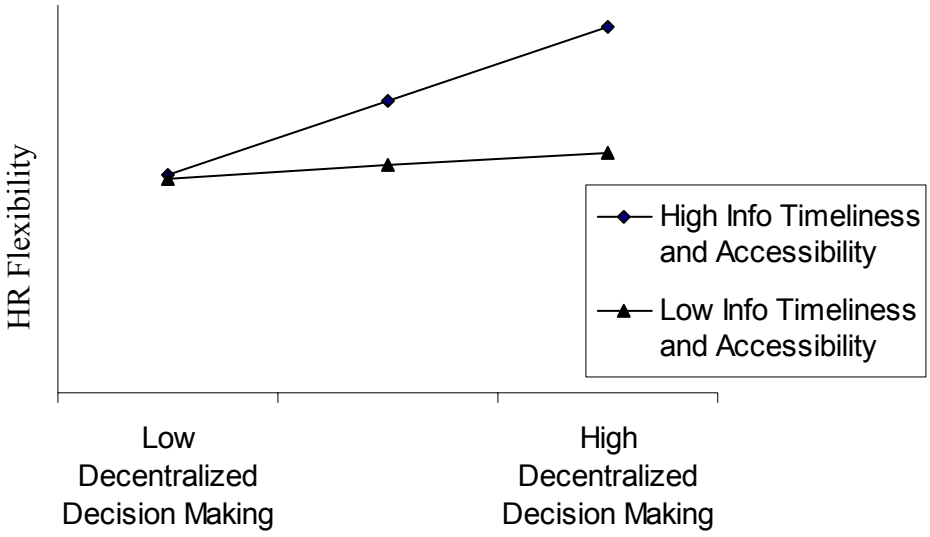
### Moderation of Decision Making Relationships

Hypothesis 8a, 8b, and 8c predicted that information timeliness and accessibility moderates the decentralized decision making-operational flexibility relationships (HR flexibility, physical resource flexibility, and responsiveness, respectively) such that a positive relationship would be stronger for the subunits that had higher levels of information timeliness and accessibility present. For these moderating analyses, I performed a 3-step hierarchical regression, with controls (size and subunit slack) and independent variables (psychological safety, climate for innovation, formalization, decentralized decision making, and advanced technology) entered in the first step, information timeliness and accessibility in the second step, and the interaction term (product of decentralization and information timeliness and accessibility) as the third step. The variables were mean centered for analysis to reduce the effect of multicollinearity among variables (Aiken & West, 1991).

As shown in Table 10, although the models were significant for physical resource flexibility (Overall $F = 6.09$, $p < .001$) and responsiveness (Overall $F = 10.63$, $p < .001$), the change in $R^2$ was not significant for both models (physical resource flexibility $\Delta R^2 = .00$, ns; interaction term $\beta = .03$, ns and responsiveness $\Delta R^2 = .00$, ns; interaction term $\beta = .03$, ns), indicating no support for hypotheses 8b and 8c. On the other hand, the model and change in $R^2$ was significant for HR flexibility ($\Delta R^2 = .03$, $p < .05$; interaction term $\beta = .19$, $p < .05$) indicating support for hypothesis 8a. Specifically, subunits with more information timeliness and accessibility did not show a significant difference in their

decentralized decision making-physical resource flexibility relationship or the decentralized decision making-responsiveness relationship. On the other hand, subunits with higher levels of information timeliness and accessibility did show a significant difference in the decentralized decision making-HR flexibility relationship. A graph of this interaction reveals that when information timeliness and accessibility is low, HR flexibility is at its lowest, regardless of whether there is more decentralized decision making or not in the subunit. HR flexibility is highest when information timeliness and accessibility is high and also when decentralized decision making is high. A graph of the moderating effect of information timeliness and accessibility on the decentralized decision making-HR flexibility relationship appears in Figure 3.

FIGURE 3: GRAPH OF INTERACTION:
DECENTRALIZATION OF DECISION MAKING X INFORMATION TIMELINESS AND ACCESSIBILITY




N = 110 trauma centers

TABLE 10:
REGRESSION RESULTS, TESTS OF HYPOTHESES 8A – 8C, MODERATING EFFECTS OF INFORMATION TIMELINESS AND ACCESSIBILITY ON THE DECENTRALIZED DECISION MAKING AND OPERATIONAL FLEXIBILITY RELATIONSHIPS

| | HR Flexibility | | | Physical Resource Flexibility | | | Responsiveness | | |
|---|---|---|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | -.05 | -.04 | -.05 | -.03 | -.04 | -.04 | -.10 | -.10 | -.10 |
| Subunit slack | .02 | .05 | .03 | .06 | .03 | .03 | .02 | .01 | .00 |
| Psychological Safety | .18 | .23† | .20 | .04 | -.02 | -.02 | .23* | .20* | .19† |
| Innovation | .31* | .32** | .35** | .34** | .32** | .33** | .25** | .24* | .25* |
| Formalization | -.14 | -.07 | -.09 | .10 | .02 | .01 | .25** | .21* | .20* |
| Decentralization | .11 | .07 | .11 | -.25* | -.20* | -.20† | -.17† | -.14 | -.13 |
| Technology | .04 | .04 | .02 | .04 | .04 | .04 | .10 | .10 | .09 |
| Information Timeliness and Accessibility | | -.20† | -.16 | | .24* | .24* | | .14 | .15 |
| Decentralization X Information Timeliness and Accessibility | | | .19* | | | .03 | | | .03 |
| Overall F | 2.23* | 2.37* | 2.61** | 6.84*** | 6.89*** | 6.09*** | 13.22*** | 12.03*** | 10.63*** |
| $R^2$ | .13* | .16† | .19* | .32*** | .35* | .35 | .48*** | .49 | .49 |
| Adj. $R^2$ | .07* | .10† | .12* | .27*** | .30* | .30 | .44*** | .45 | .45 |
| $\Delta R^2$ | .12* | .03† | .03* | .31*** | .03* | .00 | .45*** | .01 | .00 |
| $\Delta F$ | 2.84* | 3.03† | 3.96* | 9.23*** | 5.28* | .13 | 17.44*** | 2.42 | .20 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Moderation of Advanced Technology Relationships**

Hypothesis 8d and 8e predicted that information timeliness and accessibility moderates the technology-physical resource flexibility and technology-responsiveness relationship such that a positive relationship would be stronger for the subunits that had higher levels of information timeliness and accessibility present. For these moderating analyses, I performed the same 3-step hierarchical regression, with controls (size and subunit slack) and independent variables (psychological safety, climate for innovation, formalization, decentralized decision making, advanced technology) entered in the first step, information timeliness and accessibility entered in the second step, and the interaction term (product of technology and information timeliness and accessibility) as the third step. As shown in Table 11, the models in both regressions were significant (physical resource flexibility Overall $F = 6.10$, $p < .001$ and responsiveness Overall $F = 10.59$, $p < .001$) but the change in $R^2$ was not, indicating no support for hypotheses 8d ($\Delta R^2 = .01$, ns; interaction term $\beta = -.04$, ns) and 8e ($\Delta R^2 = .00$, ns, interaction term $\beta = .00$, ns).

TABLE 11:
REGRESSION RESULTS, TESTS OF HYPOTHESES 8D AND 8E, MODERATING EFFECTS OF INFORMATION TIMELINESS AND ACCESSIBILITY ON THE TECHNOLOGY AND OPERATIONAL FLEXIBILITY RELATIONSHIPS

| | Physical Resource Flexibility | | | Responsiveness | | |
|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | -.03 | -.04 | -.03 | -.10 | -.10 | -.10 |
| Subunit slack | .06 | .03 | .03 | .02 | .01 | .01 |
| Psychological Safety | .04 | -.02 | -.01 | .23* | .20* | .20† |
| Innovation | .34** | .32** | .32** | .25** | .24* | .24* |
| Formalization | .10 | .02 | .00 | .26** | .21* | .20* |
| Decentralization | -.25* | -.20* | -.19† | -.17† | -.14 | -.14 |
| Technology | .04 | .04 | .04 | .10 | .10 | .10 |
| Information Timeliness and Accessibility | | .24* | .25* | | .14 | .14 |
| Technology X Information Timeliness and Accessibility | | | -.04 | | | .00 |
| Overall F | 6.84*** | 6.89*** | 6.10*** | 13.22*** | 12.03*** | 10.59*** |
| $R^2$ | .32*** | .35* | .36 | .48*** | .49 | .49 |
| Adj. $R^2$ | .27*** | .30* | .30 | .44*** | .45 | .45 |
| $\Delta R^2$ | .31*** | .03* | .01 | .45*** | .01 | .00 |
| $\Delta F$ | 9.23*** | 5.28*** | .21 | 17.44*** | 2.42 | .00 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

### Hypotheses 9a, 9b, and 9c: Relationships Between Operational Flexibility and Performance

Hypothesis 9a, 9b, and 9c predicted that increased operational flexibility (HR flexibility, physical resource flexibility, and responsiveness, respectively) would be positively related to subunit performance. The data showed no support for these hypotheses. As shown in Table 12, after entering the control variables hospital size and subunit slack, the model was not significant ($\Delta R^2 = .02$, ns). HR flexibility, physical resource flexibility, and responsiveness were not significantly related to higher levels of subunit performance (HR flexibility $\beta = .04$, ns; physical resource flexibility $\beta = .11$, ns; responsiveness $\beta = .01$, ns). Thus, subunits with higher levels of all three dimensions of operational flexibility did not show significantly higher levels of subunit performance.

TABLE 12:
REGRESSION RESULTS, TESTS OF HYPOTHESES 9A – 9C,
PREDICTING SUBUNIT PERFORMANCE

| | Subunit Performance | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .06 | .08 |
| Subunit slack | -.09 | -.09 |
| HR Flexibility | | .04 |
| Physical Resource Flexibility | | .11 |
| Responsiveness | | .01 |
| Overall F | .92 | .76 |
| $R^2$ | .02 | .04 |
| Adj. $R^2$ | .00 | -.01 |
| $\Delta R^2$ | .02 | .02 |
| $\Delta F$ | .92 | .65 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

A summary of all hypotheses are presented in Table 13 and also a model is presented in Figure 4. Overall, the path model in Figure 4 shows that a climate for innovation, decentralized decision making, and formalized structures were significantly related to at least one of the operational flexibility dimensions: HR flexibility, physical resource flexibility, and responsiveness. Additionally, information timeliness and accessibility also was significantly related to human resource flexibility and physical resource flexibility. Finally, as shown earlier in Figure 3, information timeliness and accessibility did moderate the decentralized decision making—HR flexibility relationship.

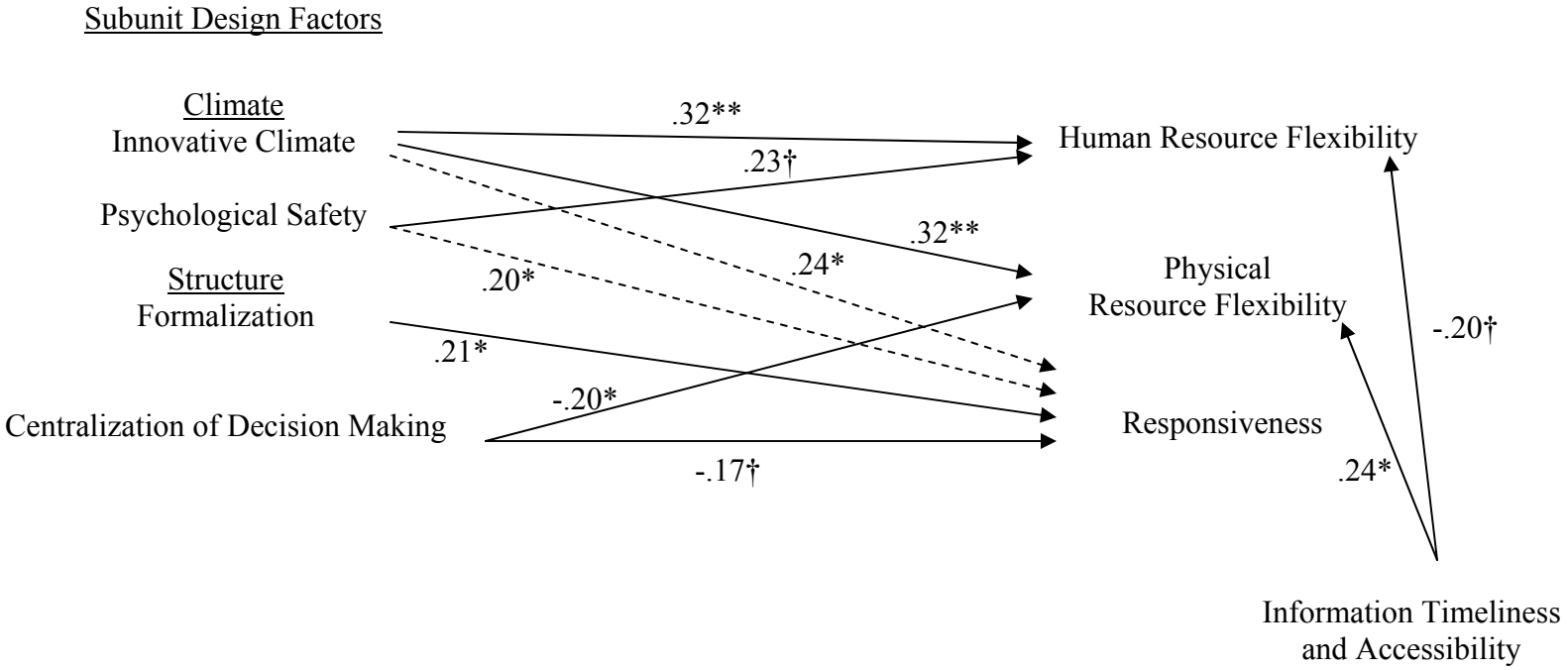
TABLE 13: SUMMARY OF FINDINGS

| **Hypothesis** | **Supported?** |
|---|---|
| H1a: Innovative climate associated with greater HR flexibility | + |
| H1b: Higher levels of psychological safety associated with greater HR flexibility | n.s. |
| H2a: Innovative climate associated with greater physical resource flexibility | + |
| H2b: Higher levels of psychological safety associated with greater physical resource flexibility | n.s. |
| H3a: Less formalized subunit structures associated with greater HR flexibility | n.s. |
| H3b: More decentralized decision making associated with greater HR flexibility | n.s. |
| H4a: Less formalized subunit structures associated with greater physical resource flexibility | n.s. |
| H4b: More decentralized decision making associated with greater physical resource flexibility | + |
| H5a: Less formalized subunit structures associated with greater responsiveness | - (opposite of prediction) |
| H5b: More decentralized decision making associated with greater responsiveness | + |

TABLE 13: SUMMARY OF FINDINGS CONTINUED

| Hypothesis | Supported? |
|---|---|
| H6a: More advanced technology associated with greater physical resource flexibility | n.s. |
| H6b: More advanced technology associated with greater responsiveness | n.s. |
| H7a: Greater information timeliness and accessibility associated with greater HR flexibility | - (opposite of prediction) |
| H7b: Greater information timeliness and accessibility associated with greater physical resource flexibility | + |
| H7c: Greater information timeliness and accessibility associated with greater responsiveness | n.s. |
| H8a: Information timeliness and accessibility moderates the decentralized decision making-HR flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present | + |
| H8b: Information timeliness and accessibility moderates the decentralized decision making-physical resource flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present | n.s. |
| H8c: Information timeliness and accessibility moderates the decentralized decision making-responsiveness relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present | n.s. |
| H8d: Information timeliness and accessibility moderates the technology-physical resource flexibility relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present | n.s. |
| H8e: Information timeliness and accessibility moderates the technology-responsiveness relationship such that a positive relationship is stronger for the subunits that have higher levels of information timeliness and accessibility present | n.s. |
| H9a: Increased HR flexibility positively related to subunit performance | n.s. |
| H9b: Increased physical resource flexibility positively related to subunit performance | n.s. |
| H9c: Increased responsiveness positively related to subunit performance | n.s. |

FIGURE 4: PATH MODEL OF DIRECT RELATIONSHIPS



## Additional Analyses

One of the objectives of this dissertation was to determine constructs that are positively associated with operational flexibility and to investigate the link between operational flexibility and subunit performance. In the previous sections, I reported that there was significant support for a relationship between subunit design factors and operational flexibility. On the other hand, I also reported that the dimensions of operational flexibility were not significantly related to subunit performance and thus, the mediating model, where the subunit design factor—subunit performance relationship is mediated by operational flexibility, was also not supported. Because of these findings, I explored other plausible models within the data. Certain key issues needed to be addressed in order to better understand the role of operational flexibility in the subunit, such as issues of multicollinearity, a possible combined index of flexibility, the subjective measure of performance, and the subject of unreliable measures.

### Issues of Multicollinearity

The first issue that needed attention was the possibility of the presence of multicollinearity in the data. Looking at the correlations presented in Table 6, it is clear that there are some significant and large values between predictor variables. These values indicate that it may be difficult to find relationships between the variables because they are highly collinear and this may be the reason that some hypotheses were not supported in earlier analyses. Thus, I utilized the variance inflation factor (VIF) in my regression analyses in order to assess the magnitude of multicollinearity. This statistic is a formal method that "measures how much the variances of the estimated regression coefficients

are inflated as compared to when the predictor variables are not linearly related" (Neter, Kutner, Nachtsheim, & Wasserman, 1996: 385).

As shown in Table 14, the VIF factors for the variables in each regression are all well below the critical cut-point of ten as suggested by researchers (Cohen et al, 2003; Hair, Anderson, Tatham, & Black, 1995). Specifically, the values range from the lowest at 1.055 to the highest value at 1.967. It appears that there is evidence of slight multicollinearity because the values are over 1, but there is not a high magnitude as a value over ten would indicate. Even though there did not seem to be a great magnitude of multicollinearity according to the VIF scores, I explored the notion that operational flexibility might actually be combined into an index as described in the next section.

TABLE 14: VARIANCE INFLATION FACTORS (VIF) FOR ALL REGRESSIONS

| Regression | Independent Variable | VIF |
|---|---|---|
| Impact on all dimensions of flexibility | | |
| | Psychological safety | 1.868 |
| | Climate for innovation | 1.710 |
| | Formalization | 1.561 |
| | Decentralized decision making | 1.487 |
| | Advanced technology | 1.055 |
| | Information timeliness and accessibility index | 1.627 |
| Moderating relationship of info. Sharing index on decision making-flexibility relationship | | |
| | Psychological safety | 1.903 |
| | Climate for innovation | 1.732 |
| | Formalization | 1.574 |
| | Decentralized decision making | 1.548 |
| | Advanced technology | 1.078 |
| | Information timeliness and accessibility index | 1.692 |
| | Info timeliness and accessibility index X decentralized decision making | 1.117 |
| Moderating relationship of info. Sharing index on technology-flexibility relationship | | |
| | Psychological safety | 1.967 |
| | Climate for innovation | 1.725 |
| | Formalization | 1.658 |
| | Decentralized decision making | 1.626 |
| | Advanced technology | 1.066 |
| | Information timeliness and accessibility index | 1.790 |
| | Info timeliness and accessibility index X advanced technology | 1.279 |
| Impact of flexibility on performance | | |
| | HR flexibility | 1.158 |
| | Physical resource flexibility | 1.453 |
| | Responsiveness | 1.354 |

**A Combined Index of Operational Flexibility**

As mentioned above, I was concerned that the correlation between the three dimensions of operational flexibility (see Table 6) could be one problem that might be affecting the predicted relationships. This possible multicollinearity issue could be the reason that I was not finding support for some of my predicted relationships. I was interested to find out if results would change after combining the three measures of operational flexibility into one. Thus, I created an operational flexibility index and reran my regression analyses with this new variable.

To create the operational flexibility index I went back to the original data and took the mean of all items used in the three dimensions. As a precaution, I also created an alternate index in which I first standardized the three dimensions of operational flexibility and then took the mean of these three standardized variables. This allowed me to examine the relationships from a slightly different perspective. Results with both versions of the index were the same and thus only the results with the first index described (the mean of the original items) are reported below.

In the first regression, I entered the control variables trauma center size and subunit slack resources in the first step, then the subunit design variables in the second step and finally the information timeliness and accessibility index in the third step. This process would indicate if there were direct effects of the subunit design variables and the information timeliness and accessibility index on the new combined operational flexibility index. As shown in Table 15, after entering the control variables in step 1, I entered the subunit design variables in step 2 and the model was significant ($\Delta R^2 = .42$, $p < .001$). Although the overall model was significant, regression analysis showed that only

a climate for innovation and psychological safety explained the significant variance. Thus, data did show support that a climate for innovation was significantly related to higher levels of the operational flexibility index ($\beta = .31$, $p < .05$) as well as psychological safety ($\beta = .22$, $p < .05$). But, less formalized structures ($\beta = .09$, ns), more decentralized decision making ($\beta = -.11$, ns), and advanced technology ($\beta = .08$, ns) were not significantly related to the new operational flexibility index.

TABLE 15: REGRESSION RESULTS, TESTS OF SUBUNIT DESIGN FACTORS AND INFORMATION TIMELINESS AND ACCESSIBILITY RELATIONSHIPS WITH OPERATIONAL FLEXIBILITY INDEX

| | Operational Flexibility Index | | |
|---|---|---|---|
| | Step 1 | Step 2 | Step 3 |
| Size | -.17 | -.08 | -.09 |
| Subunit slack | .00 | .04 | .04 |
| Innovation | | .39*** | .39*** |
| Psych. Safety | | .22* | .20* |
| Formalization | | .09 | .07 |
| Decentralization | | -.11 | -.11 |
| Technology | | .08 | .08 |
| Information Timeliness and Accessibility | | | .05 |
| Overall F | 1.60 | 11.94*** | 10.41*** |
| $R^2$ | .03 | .45*** | .45 |
| Adj. $R^2$ | .01 | .41*** | .41 |
| $\Delta R^2$ | .03 | .42*** | .00 |
| $\Delta F$ | 1.60 | 15.64*** | 10.41 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

These findings are somewhat consistent with the findings of the tests of hypotheses 1 – 7, yet there are also differences. Like the tests above, a climate for

innovation was positively associated with all three dimensions of operational flexibility as well as the new index. Psychological safety was positively associated with the responsiveness dimension, and was also positively associated with the operational flexibility index. In contrast, decentralization of decision making was not significantly associated with the new operational flexibility index even though it was significantly associated with the physical resource flexibility and responsiveness dimension in tests above.

Further, in step 3 I entered the information timeliness and accessibility index and although the model did remain significant (Overall $F = 10.41$, $p < .001$) the change in $R^2$ was not significant ($\Delta R^2 = .00$, ns), indicating that the information timeliness and accessibility index was not significantly related to higher levels of the operational flexibility index over and above the subunit design variables ($\beta = .05$, ns). Upon assessment of each individual variable entered into the regression, it was clear that a climate for innovation remained significant ($\beta = .39$, $p < .001$) as well as psychological safety ($\beta = .20$, $p < .05$). Further, the insignificant relationships of formalization, decentralization of decision making, and advanced technology with the operational flexibility index remained insignificant (see table 15). These findings are in contrast to earlier analyses, where information timeliness and accessibility was found to be significantly associated with the human resource and physical resource flexibility dimensions.

I also conducted additional analyses to investigate the impact of this index variable on the relationship between operational flexibility and performance. Recall that hypotheses 9a-9c predicted relationships between the three separate dimensions of

operational flexibility and subunit performance. I thus ran a regression examining the relationship between the operational flexibility index and subunit performance.

As shown in Table 16, after entering the control variables hospital size and subunit slack resources in step 1, I entered the operational flexibility index in step 2 and the model was not significant ($\Delta R^2 = .01$, ns). Data thus showed that, like the tests of hypotheses 9a – 9c, the operational flexibility index was not significantly related to subunit performance as indicated by the trauma directors and trauma coordinators.

TABLE 16:
REGRESSION RESULTS, TESTS OF OPERATIONAL FLEXIBILITY INDEX PREDICTING SUBUNIT PERFORMANCE

| | Subunit Performance | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .06 | .08 |
| Subunit slack | -.09 | -.09 |
| Operational Flexibility Index | | .12 |
| Overall F | .92 | 1.15 |
| $R^2$ | .02 | .03 |
| Adj. $R^2$ | .00 | .00 |
| $\Delta R^2$ | .02 | .01 |
| $\Delta F$ | .92 | 1.60 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**A Combined Measure of Performance**

Another key issue worthy of investigation was the measure of subunit performance used in this study, created from both the Trauma Coordinator and Trauma Director data and not assessments from the clinicians. This performance measure was utilized due to two issues. First, it is very difficult to obtain an objective measure of

performance as mentioned in the previous chapter. Available data were all anonymous and there was no chance of matching anonymous data with the data collected. Other avenues of objective data were exhausted and a perceptual measure was necessary. Second, the subjective performance measure created from the directors and coordinators was utilized in analyses in order to reduce issues with same source bias; taking the measure only from the clinicians might increase this bias. Interestingly, it is the clinician that is working everyday in the subunit dealing with team and organizational issues, and not the coordinator and director. I thus considered that clinicians might also be able to contribute a valid assessment of subunit performance, even though the director and coordinator may be a good source of perceived overall effectiveness.

Further, indications from analysis of the histograms from the performance measure from the director and coordinator indicated that there might be a ceiling effect. It may have been that these participants wanted to project a more positive assessment of their center and thus scored their respective centers highly on performance. As shown in Figure 5, the performance measure taken from the directors and coordinators showed a clear indication of this possibility. This ceiling effect may be an issue when trying to detect significant relationships and a more objective measure in which the clinician responses are included in the performance measure may actually help show a direct link between the variables. As shown in Figure 6, with the clinician data regarding performance included in the new performance index, the measure was more normal in its kurtosis.

FIGURE 5: HISTOGRAM OF PERFORMANCE
(TRAUMA DIRECTOR AND TRAUMA COORDINATOR)

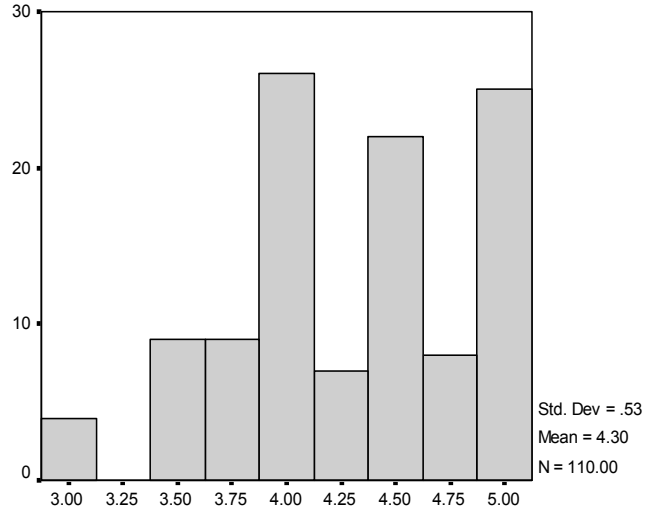
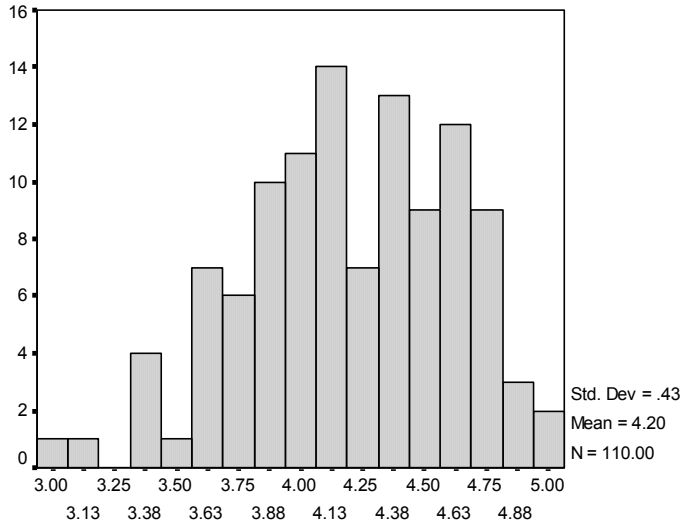



FIGURE 6: HISTOGRAM OF PERFORMANCE
(TRAUMA DIRECTOR, TRAUMA COORDINATOR, AND CLINICIAN)




After creating the combined measure of perceived performance from the ratings of the Trauma Director, Trauma Coordinator, and clinicians from each center, I also made sure that there was support for aggregation and examined the descriptive data

results. As I had done with other variables of interest, I calculated the median Rwg and ANOVA F-statistic and other descriptive data for this measure. I found that the Rwg (.94) and F-statistic (2.30, $p < .01$), as well as the descriptive results (mean = 4.2; SD = .43; Cronbach's alpha = .98 individual and .90 group level), were similar to the statistics associated with the performance measure created from the director and coordinator perceptions of performance (see Table 5). These findings supported justification for aggregation and further investigation with this new measure of performance. Based on these results, there seems to be significant overlap of these two measures of performance. I thus investigated how the performance index (from directors, coordinators, and clinicians) related to operational flexibility.

First, I examined the relationships between the separate dimensions of operational flexibility and the new subunit performance index. As shown in Table 17, after entering the control variables hospital size and subunit slack resources in step 1, I then entered HR flexibility, physical resource flexibility, and responsiveness in the second step and the model was significant ($\Delta R^2 = .12$, $p < .01$). Upon assessment of each individual variable entered into the regression, it was clear that only responsiveness was positively related to higher subunit performance index ($\beta = .24$, $p < .05$) and significantly explained the variance. On the other hand, HR flexibility and physical resource flexibility were not significantly related to higher levels of subunit performance index (HR flexibility $\beta = .05$, ns; physical resource flexibility $\beta = .13$, ns). These results varied from the findings of hypotheses 9a – 9c where there were no significant results. Here, with the combined measure of subunit performance (from directors, coordinators, and clinicians) it appears that responsiveness is positively associated with subunit performance index.

TABLE 17:
REGRESSION RESULTS, TESTS OF OPERATIONAL FLEXIBILITY
PREDICTING SUBUNIT PERFORMANCE INDEX

| | Directors / Coordinators / Clinicians Subunit Performance Index | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .06 | .12 |
| Subunit slack | -.09 | -.09 |
| HR Flexibility | | .05 |
| Physical Resource Flexibility | | .13 |
| Responsiveness | | .24* |
| Overall F | 1.01 | 3.22* |
| $R^2$ | .02 | .13** |
| Adj. $R^2$ | .00 | .09** |
| $\Delta R^2$ | .02 | .11** |
| $\Delta F$ | 1.01 | 4.62** |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

Next, I examined the relationship between the combined operational flexibility index and the subunit performance index. As shown in Table 18, after entering the control variables hospital size and subunit slack resources in step 1, I then entered the operational flexibility index in the second step and the model was significant ($\Delta R^2 = .10$, $p < .01$). Specifically, the operational flexibility index was positively related to higher subunit performance index ($\beta = .32$, $p < .01$). Here, with the combined measures of the operational flexibility index and the subunit performance index, the data indicate there is a positive relationship.

TABLE 18:
REGRESSION RESULTS, TESTS OF OPERATIONAL FLEXIBILITY INDEX PREDICTING SUBUNIT PERFORMANCE INDEX

| | Directors / Coordinators / Clinicians Subunit Performance Index | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .06 | .12 |
| Subunit slack | -.09 | -.09 |
| Operational Flexibility Index | | .32** |
| Overall F | 1.01 | 4.73** |
| $R^2$ | .02 | .12** |
| Adj. $R^2$ | .00 | .09** |
| $\Delta R^2$ | .02 | .10** |
| $\Delta F$ | 1.01 | 11.96*** |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

Although these findings indicate that the operational flexibility index is positively associated with the new subunit performance index, I was concerned that there were still issues of same source bias as both measures included responses from the clinicians. Thus, in order to control this issue in addition to the possible ceiling effect from the director and coordinator combined measure of performance described above, I used a split sample design to reanalyze the relationships between operational flexibility and subunit performance. In this split sample design, for each center half the clinicians contributed data for the measures of operational flexibility and the other half contributed to the performance index measure composed of the Trauma Director, Trauma Coordinator, and Clinicians. This design allowed me to include the clinician performance data while safeguarding for common method variance.

As shown in Table 19, results were not significant. This is unlike tests above where the same clinician data were included in both the operational flexibility and performance index. Specifically, after entering the control variables hospital size and subunit slack resources in step 1, I then entered HR flexibility, physical resource flexibility, and responsiveness in the second step and the model was not significant ($\Delta R^2$ = .04, ns). Upon assessment of each individual variable entered into the regression, it was clear that HR flexibility, physical resource flexibility, and responsiveness were not significantly related to higher levels of subunit performance index (HR flexibility $\beta$ = -.06, ns; physical resource flexibility $\beta$ = .12, ns; responsiveness $\beta$ = .11, ns). These results were similar to the original findings of hypotheses 9a – 9c where there were no significant results.

TABLE 19: SPLIT SAMPLE DESIGN REGRESSION RESULTS,
TESTS OF OPERATIONAL FLEXIBILITY
PREDICTING SUBUNIT PERFORMANCE INDEX

| | Directors / Coordinators / Clinicians Subunit Performance Index | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .09 | .10 |
| Subunit slack | .01 | .01 |
| HR Flexibility | | -.06 |
| Physical Resource Flexibility | | .12 |
| Responsiveness | | .11 |
| Overall F | .37 | .85 |
| $R^2$ | .01 | .04 |
| Adj. $R^2$ | -.01 | -.01 |
| $\Delta R^2$ | .01 | .02 |
| $\Delta F$ | .37 | 1.16 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

Next, I examined the relationship between the combined operational flexibility index and the subunit performance index in this split sample design. As shown in Table 20, after entering the control variables hospital size and subunit slack resources in step 1, I then entered the operational flexibility index in the second step and the model was not significant ($\Delta R^2 = .03$, ns). Specifically, the operational flexibility index was not significantly related to higher subunit performance index ($\beta = .14$, ns). Here, unlike in the earlier exploratory analyses where the relationship was significant, with the combined measures of the operational flexibility index and the subunit performance index using a split sample design the data indicate there is not a significant relationship.

TABLE 20: SPLIT SAMPLE DESIGN REGRESSION RESULTS,
TESTS OF OPERATIONAL FLEXIBILITY INDEX
PREDICTING SUBUNIT PERFORMANCE INDEX

| | Directors / Coordinators / Clinicians Subunit Performance Index | |
|---|---|---|
| | Step 1 | Step 2 |
| Size | .09 | .09 |
| Subunit slack | .01 | .01 |
| Operational Flexibility Index | | .14 |
| Overall F | .37 | .92 |
| $R^2$ | .01 | .03 |
| Adj. $R^2$ | -.01 | .00 |
| $\Delta R^2$ | .01 | .02 |
| $\Delta F$ | .37 | 2.01 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Subunit Design Factors as Indicators of Performance**

The results stated earlier show that the hypothesized mediation model, where operational flexibility mediates the subunit design factor—subunit performance relationship, was not significant. I thus investigated the possibility that the subunit design variables and information timeliness and accessibility index might be directly linked to performance and not mediated by operational flexibility.

It might be possible that both decentralized decision making and less formalization were positively associated with subunit performance. As mentioned earlier, research indicates that in stable and homogenous environments, more formalized, hierarchical and centralized firms were more effective. Yet, in more diverse and changing environments, decentralization and less formalization seemed to be more appropriate.

The organization essentially needed to be able to change with the dynamic environment through such structural design factors as decentralization and less formalization in order to produce effective performance (Galbraith, 1978, 1993; LaPorte, 1996; Lawrence & Lorsch, 1967).

Further, research also shows that climate factors and more advanced technology might be linked to performance. Specifically, psychological safety or an atmosphere safe for interpersonal risk taking is critical for group performance (Edmondson, 1999). Edmondson's research found that groups with higher levels of psychological safety felt that they could violate rules, deviate from the norm, take risks, or make mistakes in order to contribute to their performance. Further, research examining technology tries to link advanced technology to performance. Huber suggests that technology can be used to enhance the quality and timeliness of organizational processes (1990), while other researchers indicate that more advanced technology increases problem identification and decision making speed (Leidner & Elam, 1995), increases problem solving efficiency (Lawler & Elliot, 1996), and advanced manufacturing technologies (AMT) enhances efficiency in production (Barley, 1986).

Finally, I also thought that information timeliness and accessibility could also be positively associated with subunit performance. As mentioned in previous sections, group learning theory (Argote, 1999) states that involving group members in sharing, generating, evaluating, and combining knowledge is important for group performance. Other studies indicate that not sharing unique information is associated with suboptimal decisions (e.g. Stasser, Taylor & Hanna, 1989; Stasser & Titus, 1985, 1987; Winquist & Larson, 1998; Wittenbaum, 2000) thus indicating that information timeliness and

accessibility is also important for performance. Thus, based on previous research, I explored the possibility that there were direct effects between these variables and subunit performance, first examining the relationships with the original subunit performance measure (combined measure of directors and coordinators) and then with the new subunit performance index (combined measure of directors, coordinators, and clinicians).

Subunit performance measure (combined measure of directors and coordinators). As shown in Table 21, after entering the control variables hospital size and subunit slack resources in step 1, I then entered the subunit design factors in the second step and the model was significant ($\Delta R^2 = .21$, $p < .001$). Upon assessment of each individual variable entered into the regression, it was apparent that psychological safety, a climate for innovation, and formalization were significantly related to subunit performance (psychological safety $\beta = -.28$, $p < .05$; climate for innovation $\beta = .56$, $p < .001$; formalization $\beta = -.22$, $p < .05$), but decentralized decision making ($\beta = .06$, ns) and advanced technology were not ($\beta = .07$, ns). Additionally, psychological safety was negatively correlated with subunit performance, indicating that less psychological safety was associated with higher levels of subunit performance. This finding is contrary to the literature and will be discussed in more detail in the discussion chapter.

Further, I entered the information timeliness and accessibility index in the third step and, although the model remained significant (Overall $F = 4.02$, $p < .001$), the change in $R^2$ did not ($\Delta R^2 = .01$, ns). However, upon assessment of the individual variables, it was clear that the relationships in the second step remained significant and in the same direction. Thus, the information timeliness and accessibility index did not explain any variance over and above the subunit design variables ($\beta = .16$, ns).

TABLE 21: DIRECT EFFECTS OF SUBUNIT DESIGN FACTORS, INFORMATION TIMELINESS AND ACCESSIBILITY INDEX AND SUBUNIT PERFORMANCE

| | Directors / Coordinators Subunit Performance | | | Directors / Coordinators / Clinicians Subunit Performance Index | | |
|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | .06 | .07 | .07 | .06 | .10 | .09 |
| Subunit slack | -.09 | -.06 | -.08 | -.09 | -.05 | -.07 |
| Psych. Safety | | -.28* | -.31* | | -.19 | -.25* |
| Innovation | | .56*** | .55*** | | .56*** | .55*** |
| Formalization | | -.22* | -.27* | | -.06 | -.14 |
| Decentralization | | .06 | .09 | | -.03 | .02 |
| Technology | | .07 | .07 | | .10 | .10 |
| Information Timeliness and Accessibility Index | | | .16 | | | .24* |
| Overall F | .92 | 4.26*** | 4.02*** | 1.01 | 5.34*** | 5.53*** |
| $R^2$ | .02 | .23*** | .24 | .02 | .27*** | .31 |
| Adj. $R^2$ | .00 | .17*** | .18 | .00 | .22*** | .25 |
| $\Delta R^2$ | .02 | .21*** | .01 | .02 | .25*** | .04 |
| $\Delta F$ | .92 | 5.52*** | 2.06 | 1.01 | 6.96*** | 5.29* |

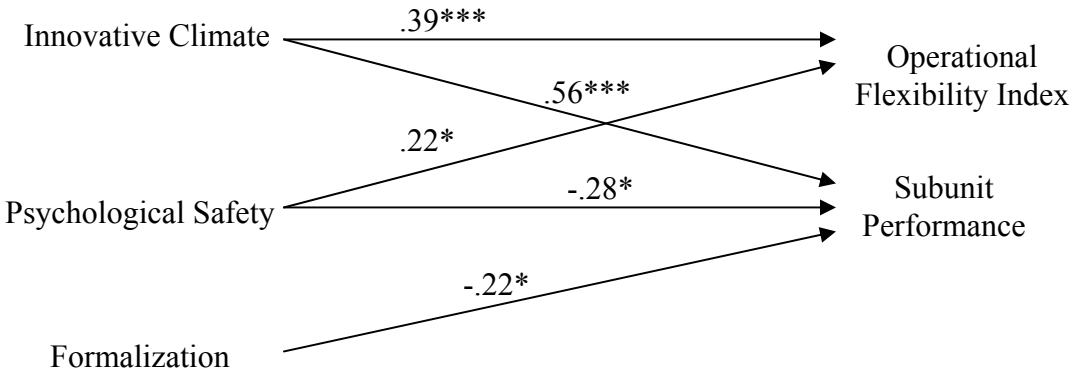
***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

Subunit performance index (combined measure of directors, coordinators, and clinicians). I then tested the same relationships with the subunit performance index (combined directors, coordinators, and clinicians) as shown in Table 21. In this regression, after entering the control variables hospital size and subunit slack resources in step 1, I then entered the subunit design factors in the second step and the model was significant ($\Delta R^2 = .25$, $p < .001$). Upon assessment of each individual variable entered into the regression, it was apparent that a climate for innovation was significantly related

to the subunit performance index ($\beta = .56$, $p < .001$), but the other subunit design variables were not significantly related (psychological safety $\beta = -.19$, ns; formalization $\beta = -.06$, ns; decentralization $\beta = -.03$, ns; technology $\beta = .10$, ns).

I also entered the information timeliness and accessibility index in the third step and, although the model remained significant (Overall $F = 5.53$, $p < .001$), the change in $R^2$ did not remain significant ($\Delta R^2 = .04$, ns). Even so, upon assessment of the individual variables, the data indicated that a climate for innovation ($\beta = .55$, $p < .001$) was still significantly associated with the subunit performance index and now psychological safety was significantly related to the subunit performance index ($\beta = -.25$, $p < .05$). Further, the information timeliness and accessibility index was positively associated with the subunit performance index ($\beta = .24$, $p < .05$). Thus, there may be some significant relationships with the subunit performance index. Figure 7 provides a summary of the major findings from the exploratory analyses described above.

FIGURE 7: EXPLORATORY PATH MODEL




***p < .001; **p < .01; *p < .05, † p < .10
N = 110 trauma centers

**Correction for Unreliability**

According to Schmidt and Hunter (1996), most currently published studies "still make no mention of either error of measurement or of reliability" although "the methodological literature since 1910 has been virtually universal in stating that correction is not only desirable but critical to both accurate estimation of scientific quantities and to the assessment of scientific theories." (199) Thus, it appeared that a final step investigating the issue of unreliability was warranted. Specifically, both HR flexibility and physical resource flexibility had a Cronbach alpha below the normally accepted .70 level (see Table 5).

In order to correct for unreliability, I used a widely accepted formula (Cohen et. al, 2003; Schmidt & Hunter, 1996). The correction formula is derived from the general formula for the observed correlation between any two measures and is $r_{xy}' = r_{xy} / (r_{xx}r_{yy})^{½}$, where $r_{xy}$ is the observed correlation between two variables, $r_{xx}$ is the observed reliability of x, and $r_{yy}$ is the observed reliability of y. The formula is applied to each pair of variables in the uncorrected correlation matrix to produce a corrected correlation matrix. This corrected correlation matrix is then used as the input matrix for standard statistical packages.

After correcting for unreliability using this formula, I used the corrected correlation matrix to rerun the regressions examining the original proposed relationships. Specifically, I retested the relationships predicting the antecedents to operational flexibility and the relationships between the dimensions of operational flexibility and performance to examine if reliability influenced my ability to estimate relationship magnitudes.

**HR Flexibility.** Both the uncorrected findings from prior sections and corrected findings are shown in Table 22. After entering the control variables subunit size and slack resources in step 1, I entered the subunit design variables in step 2 and the model was significant ($\Delta R^2 = .25$, $p < .001$). The regression analysis shows that a climate for innovation, psychological safety, decentralized decision making, and formalization were significant and explained the majority of the variance. Thus, unlike tests on the uncorrected correlation matrix, data showed support for hypothesis 1a *and* for 1b and 3a, *and* for the opposite of 3b. Specifically, a climate for innovation ($\beta = .46$, $p < .001$), psychological safety ($\beta = .40$, $p < .01$), less formalized structures ($\beta = -.35$, $p < .001$), and less decentralized decision making ($\beta = .30$, $p < .01$) were significantly related to higher levels of HR flexibility.

Further, in step 3 I entered the information timeliness and accessibility index and the model remained significant (Overall $F = 6.05$, $p < .001$) and the change in $R^2$ was significant ($\Delta R^2 = .05$, $p < .01$) and not marginally significant as in the uncorrected tests. Upon assessment of each individual variable entered into the regression, it was clear that a climate for innovation ($\beta = .42$, $p < .01$) and psychological safety ($\beta = .50$, $p < .001$) remained significant, yet formalization ($\beta = -.19$, ns) did not remain significant and decentralized decision making ($\beta = .22$, $p < .10$) was now marginally significant. Further, information timeliness and accessibility was negatively associated with HR flexibility and not positively associated as predicted ($\beta = -.32$, $p < .01$). This provides support for the opposite of hypothesis 7a and not marginal support as indicated in the uncorrected tests.

Further, as indicated in Table 22, results differ such that standardized beta coefficients and also the change in $R^2$ were larger in the corrected findings (e.g. step 2 uncorrected matrix $\Delta R^2 = .12$, $p < .05$; step 2 corrected matrix $\Delta R^2 = .25$, $p < .001$). Finally, where the uncorrected model was only marginally significant in step 3, the corrected model was significant at the .01 level in step 3, indicating a larger magnitude in the relationships.

TABLE 22: REGRESSIONS RESULTS, TESTS PREDICTING HR FLEXIBILITY WITH CORRECTION FOR UNRELIABILITY

| | HR Flexibility Corrected for Unreliability | | | HR Flexibility Uncorrected | | |
|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | -.12 | -.04 | -.03 | -.09 | -.05 | -.04 |
| Subunit slack | .04 | .00 | .04 | .03 | .02 | .05 |
| Innovation | | .46*** | .42** | | .31* | .32** |
| Psych. Safety | | .40** | .50*** | | .18 | .23† |
| Formalization | | -.35*** | -.19 | | -.14 | -.07 |
| Decentralization | | .30** | .22† | | .11 | .07 |
| Technology | | .06 | .06 | | .04 | .04 |
| Information Timeliness and Accessibility Index | | | -.32** | | | -.20† |
| Overall F | 1.05 | 5.58*** | 6.05*** | .67 | 2.23* | 2.37* |
| $R^2$ | .02 | .27*** | .32** | .01 | .13* | .16† |
| Adj. $R^2$ | .00 | .22*** | .27** | -.01 | .07* | .10† |
| $\Delta R^2$ | .02 | .25*** | .05** | .01 | .12* | .03† |
| $\Delta F$ | 1.05 | 7.27*** | 7.06** | .67 | 2.84* | 3.03† |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Physical Resource Flexibility.** Table 23 presents the results of the hierarchical regression analysis tests of physical resource flexibility before and after correcting for unreliability. After entering the control variables subunit size and slack resources in step 1, I then entered the subunit design variables in step 2 and the model was significant ($\Delta R^2$ = .49, $p < .001$). As with the previous tests above with the uncorrected correlation matrix, regression analysis shows that the data showed support for hypotheses 2a and 4b, but no support for 2b, 4a, and 6a. Specifically, a climate for innovation ($\beta$ = .41, $p < .001$) and decentralized decision making ($\beta$ = -.36, $p < .001$) were significantly related to higher levels of physical resource flexibility, but psychological safety ($\beta$ = -.04, ns), less formalized structures ($\beta$ = .16, ns), and more advanced technology ($\beta$ = .04, ns) were not significantly related to physical resource flexibility.

Further, in step 3 I entered the information timeliness and accessibility index and the model remained significant ($\Delta R^2$ = .05, $p < .01$). Upon assessment of each individual variable entered into the regression, it was clear that a climate for innovation remained significant ($\beta$ = .45, $p < .001$) and also decentralized decision making remained significant ($\beta$ = -.28, $p < .01$). Additionally, information timeliness and accessibility also was significant ($\beta$ = .34, $p < .01$) indicating that it was associated with higher levels of physical resource flexibility, and significantly explained some of the variance of this model. This provides support for hypothesis 7b similar to the uncorrected findings. Finally, as indicated in Table 23, results differed such that standardized beta coefficients and also the change in $R^2$ were larger in the corrected findings (e.g. step 2 uncorrected matrix $\Delta R^2$ = .31, $p < .001$; step 2 corrected matrix $\Delta R^2$ = .49, $p < .001$).

TABLE 23: REGRESSIONS RESULTS, TESTS PREDICTING PHYSICAL RESOURCE FLEXIBILITY WITH CORRECTION FOR UNRELIABILITY

| | Physical Resource Flexibility Corrected for Unreliability | | | Physical Resource Flexibility Uncorrected Findings | | |
|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | -.12 | -.04 | -.05 | -.10 | -.03 | -.04 |
| Subunit slack | .01 | .09 | .04 | .01 | .06 | .03 |
| Innovation | | .41*** | .45*** | | .34** | .32** |
| Psych. Safety | | -.04 | -.14 | | .04 | -.02 |
| Formalization | | .16 | -.01 | | .10 | .02 |
| Decentralization | | -.36*** | -.28** | | -.25* | -.20* |
| Technology | | .04 | .03 | | .04 | .04 |
| Information Timeliness and Accessibility | | | .34** | | | .24* |
| Overall F | .90 | 15.03*** | 16.16*** | .61 | 6.84*** | 6.89*** |
| $R^2$ | .02 | .51*** | .56** | .01 | .32*** | .35* |
| Adj. $R^2$ | .00 | .47*** | .53** | -.01 | .27*** | .30* |
| $\Delta R^2$ | .02 | .49*** | .05** | .01 | .31*** | .03* |
| $\Delta F$ | .90 | 20.36*** | 12.34** | .61 | 9.23*** | 5.28* |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Responsiveness.** Table 24 presents the results of the hierarchical regression analysis of the relationships with responsiveness before and after correcting for unreliability. After entering the control variables subunit size and slack resources in step 1, I then entered the subunit design variables in step 2 and the model was significant ($\Delta R^2$ = .61, p < .001). As with the previous tests above on the uncorrected matrix, regression analysis showed that only specific variables significantly contributed to the model. Specifically, decentralized decision making ($\beta$ = -.20, p < .05) was significant, indicating it was related to higher levels of responsiveness and thus supported hypothesis 5b. More

formalized structures were significantly associated with higher levels of responsiveness ($\beta = .36$, $p < .001$), the opposite of what was predicted in hypothesis 5a, just as in the uncorrected analyses. Unlike tests above, more advanced technology ($\beta = .12$, $p < .10$) was marginally significantly related to responsiveness, indicating marginal support for hypothesis 6b. Although not hypothesized, the regression results indicated that psychological safety ($\beta = .28$, $p < .01$) and a climate for innovation ($\beta = .16$, $p < .10$) were also associated with higher levels of responsiveness, and thus significantly contributed to this model. These findings are similar to the uncorrected model, yet a climate for innovation was only marginally significant in the corrected analyses.

Further, in step 3 I entered the information timeliness and accessibility index and the model did remain significant (Overall $F = 22.48$, $p < .001$) but the change in $R^2$ was not significant ($\Delta R^2 = .00$, ns), indicating that information timeliness and accessibility did not contribute any explanation over the other variables just as in the uncorrected matrix analyses. Upon assessment of each individual variable entered into the regression, it was clear that the unpredicted relationships remained significant. Specifically, a climate for innovation ($\beta = .17$, $p < .10$) and psychological safety ($\beta = .26$, $p < .05$) were significantly associated with greater subunit responsiveness. Further, as found in the previous test, the opposite of hypothesis 5a also remained significant; more formalized structures were associated with greater subunit responsiveness ($\beta = .33$, $p < .001$). Unlike in the uncorrected analyses, with information timeliness and accessibility entered into the third step, decentralized decision making was still significant ($\beta = -.18$, $p < .05$) and technology was still marginally significant ($\beta = .12$, $p < .10$). Finally, information timeliness and accessibility was also not significant ($\beta = .06$, ns) indicating that it was not

associated with higher levels of responsiveness. This finding fails to provide support for hypothesis 7c similar to earlier analyses. Finally, as indicated in Table 24, results differed such that standardized beta coefficients and also the change in $R^2$ were larger in the corrected findings (e.g. step 2 uncorrected matrix $\Delta R^2 = .45$, $p < .001$; step 2 corrected matrix $\Delta R^2 = .61$, $p < .001$).

TABLE 24: REGRESSIONS RESULTS, TESTS PREDICTING RESPONSIVENESS WITH CORRECTION FOR UNRELIABILITY

| | Responsiveness Corrected for Unreliability | | | Responsiveness Uncorrected Findings | | |
|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 |
| Size | -.20 | -.10 | -.11 | -.18 | -.10 | -.10 |
| Subunit slack | -.03 | .03 | .02 | -.03 | .02 | .01 |
| Innovation | | .16† | .17† | | .23* | .20* |
| Psych. Safety | | .28** | .26* | | .25** | .24* |
| Formalization | | .36*** | .33*** | | .26** | .21* |
| Decentralization | | -.20* | -.18* | | -.17† | -.14 |
| Technology | | .12† | .12† | | .10 | .10 |
| Information Timeliness and Accessibility | | | .06 | | | .14 |
| Overall F | 1.83 | 25.78*** | 22.48*** | 1.52 | 13.22*** | 12.03*** |
| $R^2$ | .03 | .64*** | .64 | .03 | .48*** | .49 |
| Adj. $R^2$ | .02 | .61*** | .61 | .01 | .44*** | .45 |
| $\Delta R^2$ | .03 | .61*** | .00 | .03 | .45*** | .01 |
| $\Delta F$ | 1.83 | 34.22*** | .43 | 1.52 | 17.44*** | 2.42 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

**Relationships Between Operational Flexibility and Performance.** Finally, hypothesis 9a, 9b, and 9c predicted that increased operational flexibility (HR flexibility, physical resource flexibility, and responsiveness, respectively) would be positively

related to subunit performance. Similar to the findings on the uncorrected data, the results showed no support for these hypotheses. As shown in Table 25, after entering the control variables hospital size and subunit slack, the model was not significant ($\Delta R^2$ = .02, ns). HR flexibility, physical resource flexibility, and responsiveness were not significantly related to higher levels of subunit performance (HR flexibility β = .02, ns; physical resource flexibility (β = .18, ns; responsiveness β = -.04, ns). Thus, subunits with higher levels of all three dimensions of operational flexibility did not show significantly higher levels of subunit performance.

TABLE 25: REGRESSIONS RESULTS, TESTS PREDICTING SUBUNIT PERFORMANCE WITH CORRECTION FOR UNRELIABILITY

| | Subunit Performance | | | |
|---|---|---|---|---|
| | Corrected for Unreliability | | Uncorrected Findings | |
| | Step 1 | Step 2 | Step 1 | Step 2 |
| Size | .07 | .08 | .06 | .08 |
| Subunit slack | -.09 | -.09 | -.09 | -.09 |
| HR Flexibility | | .02 | | .04 |
| Physical Resource Flexibility | | .18 | | .11 |
| Responsiveness | | -.04 | | .01 |
| Overall F | 1.01 | 1.02 | .92 | .76 |
| $R^2$ | .02 | .05 | .02 | .04 |
| Adj. $R^2$ | .00 | .00 | .00 | -.01 |
| $\Delta R^2$ | .02 | .03 | .02 | .02 |
| $\Delta F$ | 1.01 | 1.03 | .92 | .65 |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

# CHAPTER 5

# DISCUSSION

This chapter discusses and interprets the results described in the previous chapter that answer the study's main research questions. Specifically, I summarize the major findings and describe the theoretical and practical implications of the findings, explain some possible limitations of the study, briefly point out the study's strengths, and finally present some suggestions for future research. Essentially, this dissertation examined the use of operational flexibility and information timeliness and accessibility in trauma units in an effort to determine the answers to the following three research questions:

(1) What is operational flexibility?

(2) What are the antecedents of operational flexibility? and

(3) Is increased operational flexibility related to increased performance?

These research questions were investigated by testing hypothesized relationships between subunit design factors, operational flexibility, information timeliness and accessibility, and subunit performance. Overall, it appears a climate for innovation, psychological safety, decentralized decision making, and formalized structures, as well as information timeliness and accessibility are significantly related to operational flexibility (HR flexibility, physical resource flexibility, and responsiveness). Additionally, information timeliness and accessibility does enhance the decentralized decision making—HR flexibility relationship. Further, the findings did not unambiguously support the notion that operational flexibility is related to subunit performance. Yet, exploratory investigation indicated subunit design factors were significantly related to subunit

performance as well as operational flexibility. The following section summarizes the major findings.

## Major Findings

### Building Operational Flexibility

While theoretical research suggests that flexibility is indeed advantageous for organizations (Avison, et. al, 1995; Burns & Stalker, 1961; Hall, 1991; Sanchez, 1993; Thompson, 1967), much of this research has yet to suggest how to build this greatly needed capability. Findings from this study help to inform this research.

As predicted, subunit design factors were shown to be related to operational flexibility. Specifically, a climate for innovation was shown to be related to higher levels of HR flexibility and physical resource flexibility. Additionally, more decentralized decision making was shown to be related to greater levels of physical resource flexibility and also greater responsiveness. Interestingly, more formalization was shown to be related to higher levels of responsiveness and although not hypothesized, climates high in innovation and those high in levels of psychological safety were also shown to be related to higher levels of responsiveness. Contrary to predictions, increased psychological safety was not related to HR and physical resource flexibility and more advanced technology was not significantly related to physical resource flexibility and responsiveness, indicating that both are not critical components for these capabilities. Further, the data also showed that subunits with more information timeliness and accessibility present showed significantly higher levels of physical resource flexibility, yet contrary to predictions it was also related to lower levels of HR flexibility.

Subunit design factors. Thus, the data do support the notion that configuring a subunit in terms of its climate, structure, and information timeliness and accessibility is related to the level of operational flexibility in the subunit. As research suggests, a more innovative climate is indeed related to operational flexibility (Volberda; 1998). It appears that managers may be able to increase their HR flexibility by building an innovative climate within the subunit. Further, enhancing psychological safety in the subunit is also associated with increased HR flexibility. These findings support the idea that with a more innovative climate, employees may feel supported and encouraged to deviate from regular patterns and the norm. They may use creative solutions to everyday problems and thus, the innovative climate allows members in the subunit to create adaptive ways out of sticky situations, utilizing their human resources in different ways.

In order to build physical resource flexibility in the subunit, managers should be advised to build not only an innovative climate, but also more decentralized decision making among their subunit members. As stated above, these innovative climates seem to enable members of the subunit to seek relevant responses in the face of change and not just focus on standard operating procedures, thereby enhancing the movement of physical resources to where they are needed. Further, as the organization theory and HRO literature suggests, decentralized decision making is linked with flexibility (LaPorte, 1996; Thompson, 1967), such that members of the subunit are better able to make decisions in the face of change without having to consult supervisors for approval and thus utilize their physical resources in different situations without consultation.

Another important finding indicates that in order to build responsiveness in the subunit, a characteristic critical in times of change and uncertainty, managers should

build a climate for innovation where members also feel that it is safe for interpersonal risk taking and decision making is more decentralized. As suggested by the HRO literature, decision making within the HRO can shift and is usually decentralized (LaPorte, 1996) as members may rely on decentralized decision making in order to avoid errors and provide reliable service. Thus, in order to provide quick response, managers should make sure to build a system where subunit members can make decisions without relying on a cumbersome hierarchical system. In addition, innovative climates where members feel safe to violate rules, deviate from the norm, take risks, or make mistakes (Edmondson, 1999) will help subunit members make changes and respond quickly in a dynamic environment.

Interestingly, the data showed that managers should also be encouraged to create a more formalized structure to build responsiveness in the subunit, which was opposite of what was originally hypothesized. This is an interesting finding. Burns and Stalker (1961) suggest that less formalization in organizational design contributes to flexibility, yet the data in this study indicated the opposite. Perhaps more formalized structures enable members to rely on specifically codified jobs, rules, procedures and instructions (Hage & Aiken, 1967) in order to respond quickly in the face of uncertainty. It may be that allowing members in a less formalized structure to break old rules and ways of working and allow them to utilize other subunit members and physical resources within the subunit in response to operational issues actually takes more time, and thus interferes with being responsive. Following specific guidelines may create fewer questions for the subunit member as what it is he / she needs to do. Future research should indeed investigate this contradictory finding to explain why the notion that a more organic

organization that is less formal is more effective in a dynamic setting. Perhaps in a dynamic setting where time is critical, there needs to be formalized rules and procedures for people to follow in order to respond quickly to change.

Surprisingly, the hypothesized relationships between advanced technology and physical resource flexibility and responsiveness were not supported. Although, the HRO literature reports that complex and sophisticated technologies help to contribute to operational flexibility (LaPorte, 1998), and other research suggests that technology should focus on speed and flexibility (Venkatraman, 1994), my data did not support this claim. Even though the measure was created with experts in the trauma medical field, it may be that there was a misunderstanding and miscalculation in the creation of the measure. It appears that the more advanced pieces of technology measured in this medical setting are actually very specialized and dedicated to specific issues and thus are never used for more than one use. Thus, because they are not easily used for different purposes, the assumption that more pieces of technology will be positively associated with physical resource flexibility is a difficult hypothesis to support. Further, a more advanced piece of technology may even be more difficult to use and learn, thus requiring more time when utilized. In other words, more advanced technology as it is measured here may not contribute to quick responses in times of change. Future research should incorporate another technology measure to assess these issues, as well as examine the characteristics of the technology to assess whether or not they can be exploited for other uses.

These findings are interesting because not all factors were associated with all of the dimensions of operational flexibility as anticipated, yet most seemed to be related to

responsiveness. This may indicate that responsiveness is the key component in the measurement of operational flexibility. Although HR and physical resource flexibility may be present, it may be that being able to respond in a quick manner in a dynamic environment is the key to being operationally flexible. This notion may suggest that operational flexibility is better measured by this one dimension. As this is a new construct adapted from research in the organization, strategic, and operations management literature, future research may need to refine these measures in order to get a more accurate reading of operational flexibility. Expanding the responsiveness dimension as well as investigating other possible aspects of HR and physical resource flexibility may be advantageous in explaining this concept.

Further, it appears that findings indicate that having an innovative climate in the subunit is also a key component in the model. In most of the results, a climate for innovation accounted for the majority of the variance and was also the only variable positively associated with all three dimensions of operational flexibility. Further, it was also positively associated with the combined measure of operational flexibility. It seems that if subunits have a climate for innovation, they will likely have higher levels of operational flexibility. This relationship, where an innovative climate is the overwhelming factor associated with operational flexibility, seems to be possible even if the other indicators are present or not. It appears to be logical because innovative climates bring forth many different options, ideas, and possibilities that may inherently be associated with responsive behavior, and thus other factors may be overpowered by this climate.

Finally, as indicated by the analyses with the correction for unreliability above, it seems that there may be an issue where my ability to estimate relationships was hampered. It appears that after correction, hypothesized relationships that were previously undetected were significant. Specifically, psychological safety and less formalization were significantly related to HR flexibility. In addition, information timeliness and accessibility was found to be significantly negatively related to HR flexibility and not marginally significant. Moreover, the magnitude of the majority of the relationships seemed to be larger where not only beta weights, but also change in $R^2$ was greater. These findings indicate that there may be issues with the reliability of the operational flexibility dimensions. The lower reliability of two of the dimensions may have been the reason that I was unable to detect some of the expected relationships and their magnitude. Further refining these measures is necessary in order to increase the reliability of my measures and also increase the probability of finding relationships where they do exist.

Information timeliness and accessibility. The study findings also support the arguments of theorists that information timeliness and accessibility helps an organization respond to task uncertainty (e.g. information-processing theory - Galbraith, 1973; Van De Ven, Delbecq, & Koenig, 1976) as well as increase their flexibility (e.g. information processing theory and group and organizational learning theory - Malone & Rockart, 1991; Nickerson, 1992; Sproull & Kiesler, 1991; Walton, 1989). According to the results, a higher level of information timeliness and accessibility was related to a higher level of physical resource flexibility in the subunit, confirming the notion that having timely and available information is important at lower levels of the organization. It seems that timely

and accessible information shared at the subunit level helps subunit members use physical resources in rare as well as common circumstances and they can also move equipment from one area of the trauma service to another as needed. Managers need to focus on enhancing the timeliness and accessibility of information so that subunit members are aware of the uses of their physical resources. They can then effectively confront uncertainty and change through this physical resource flexibility. Enhanced information timeliness and accessibility will allow them to share with fellow subunit members alternative uses for their equipment and resources.

On the other hand, it appears that more timely and available information may be detrimental to HR flexibility in the subunit because findings showed that increased information timeliness and accessibility was marginally associated with lower levels of HR flexibility. It is very interesting that there was a positive linear relationship between information timeliness and accessibility and physical resource flexibility, yet there was a negative linear relationship between information timeliness and accessibility and HR flexibility. As subunit members have increased levels of timely information and have more access to information that they need, they appear to be less able to work in different areas and help out, and may not be trained to work in different areas. It may be that this timely and available information requires more specialization of the subunit members to interpret. They may only be able to comprehend some of the information, focus only on a small percentage of the information that is shared, and thus cannot move and work in other areas of the subunit; they may give attention to only shared information that is relevant to their specialization and thus there is a negative relationship with HR

flexibility where more timely and accessible information may actually impede their flexibility.

It may also be possible that there are other variables not measured in this study that are influencing the relationships. Specifically, as information sharing is more timely and accessible, it seems that this may increase the exchanges between subunit members as they access this information. As members are compelled to interact more, interpersonal interaction will thus increase. With this increase in interpersonal exchange, the chance for increased conflict is a definite possibility. Research indicates that conflict can impact processes in organizations such as reduce group effectiveness, reduce cohesion, and increase infighting between members (Thomas, 1992). Thus, there may be no desire to help out another subunit member in a different area because cohesion and trust in the subunit may drop. Subunit members may neglect providing these behaviors and thus there will be less HR flexibility associated with higher levels of information timeliness and accessibility. Future research measuring these possible issues would help clarify the relationships.

Because there also seemed that there might be a possibility that information timeliness and accessibility may in fact slow members down, I also investigated the possibility of a curvilinear relationship between information timeliness and accessibility and operational flexibility. As stated earlier, past research suggests that too much information is problematic (Daft & Lengel, 1986; Farace, Mong, & Russell, 1977; O'Reilly, 1980). With the significant direct relationships that show that more information timeliness and accessibility is negatively associated with HR flexibility and positively

associated with physical resource flexibility, there was reason to investigate this possibility.

I thus tested the data for a possible curvilinear relationship between information timeliness and accessibility and the three dimensions of operational flexibility. After mean centering the information timeliness and accessibility index and squaring the mean centered variable to create a quadratic term, I regressed the mean centered term in the first step and the quadratic term in the second step on each of the dimensions of flexibility. Of these three tests, data indicated that there was a significant relationship with the responsiveness dimension only, and thus I reran the regression on responsiveness including all control and independent variables included in previous regressions. The results from step 3 show that information timeliness and accessibility had a positive beta coefficient of .15 ($p < .05$) and had a significant U-shaped curvilinear relationship with responsiveness (Please see Table 26).

TABLE 26: CURVILINEAR RELATIONSHIP BETWEEN INFORMATION TIMELINESS AND ACCESSIBILITY AND RESPONSIVENESS

| | Responsiveness | | |
|---|---|---|---|
| | Step 1 | Step 2 | Step 3 |
| Size | -.18 | -.10 | -.11 |
| Subunit slack | -.03 | .01 | .00 |
| Psych. Safety | | .20* | .21* |
| Innovation | | .24* | .22* |
| Formalization | | .21* | .18* |
| Decentralization | | -.14 | -.13 |
| Technology | | .10 | .08 |
| Information Timeliness and Accessibility Index | | .14 | .18* |
| Information Timeliness and Accessibility Index Quadratic term | | | .15* |
| Overall F | 1.52 | 12.03*** | 11.46*** |
| $R^2$ | .03 | .49*** | .51* |
| Adj. $R^2$ | .01 | .45*** | .46* |
| $\Delta R^2$ | .03 | .46*** | .02* |
| $\Delta F$ | 1.52 | 15.14*** | 4.01* |

***p < .001; **p < .01; *p < .05, † p < .10
All Beta coefficients reported are standardized
N = 110 trauma centers

Specifically, data indicated that when there is lack of timely and accessible information sharing or very timely and accessible information sharing, responsiveness is the best in the subunit. Yet, when there is a medium level of timely and accessible information sharing, responsiveness is at its lowest point. These findings indicate that with lack of timely and available information, members are quick to respond. It may be that when members know they do not have timely and accessible information available to them, they do not take the time to search for this information and thus can react to uncertainty and change quickly. They may be responsive as needed without utilizing

precious time in a turbulent environment. Further, when information is very timely and accessible in the subunit, members can respond quickly because the information needed is readily available at their fingertips. They can confront issues that arise and respond quickly.

Yet, when timeliness and accessibility is at a medium or mid-level, there is a different process occurring. Members know that information is available and they may use precious time to retrieve this information as needed to respond to uncertainty. It may be that although not extremely timely and accessible, the information is available for the subunit members. But, due to the medium levels of timeliness and availability, it takes more time to respond because members are searching for the needed information. There may be unrelated bits of information which are haphazardly organized and may force the subunit member to use time to sort through it all in order to identify needed information. There also may be more obstacles to retrieving the needed information, as members need to search through available outlets for this information. Thus, the time that it takes for members to retrieve this information makes this medium level of information timeliness and accessibility associated with lower levels of responsiveness.

This finding contradicts the notion that too much information is problematic (Daft & Lengel, 1986; Farace, Mong, & Russell, 1977; O'Reilly, 1980) and information overload can be problematic. It seems that increasing amounts of timely and accessible information is associated with poor HR flexibility and thus supports this notion, yet the curvilinear relationship indicates that at the same time the subunit is more responsive with increased information timeliness and accessibility. Yet, these findings may be a result of the limitation of this measure. Specifically, the information timeliness and

accessibility index in this manuscript focused only on the timeliness and availability of information as an indication of the level of information sharing, but it did not confirm that the information was actually shared between the subunit members. Further, it also did not examine the types of information that members share and the amount of information shared between them. This limitation may have influenced my ability to confirm past research and may have led to the contradictory findings. Future research will need to focus on different dimensions of information sharing by examining the different types of information that members share, the amount of information shared, and if the information was actually shared to see if there is a different phenomenon at work. It may be that a specific type of information is negatively associated with HR flexibility and thus not all information is valuable, although it seems that timely and accessible information is definitely associated with a responsive subunit.

Moderating Effects of Information Timeliness and Accessibility

In addition to adding to research on flexibility, this study also contributes to research in decision making. The data support the claim that sharing timely and accessible information is important to optimal, successful and fast decision making (e.g. Eisenhardt,1989; Stasser, Taylor & Hanna, 1989; Stasser & Titus, 1985, 1987; Winquist & Larson, 1998; Wittenbaum, 2000) because subunits with higher levels of information timeliness and accessibility did show a significant difference in the decentralized decision making-HR flexibility relationship. When information timeliness and accessibility was low, HR flexibility was at its lowest, regardless of whether there was more decentralized decision making or not in the subunit. HR flexibility was highest when information timeliness and accessibility was high and also when decentralized decision making was

high. Thus, managers should encourage more timely information sharing in the subunit and make information readily available as they create a more decentralized decision making structure. Interestingly, a more decentralized decision making structure was not directly related to higher levels of HR flexibility, but the relationship was significant when there were high levels of information timeliness and accessibility in the subunit. It seems that decentralized decision making alone is not related to higher levels of HR flexibility, but must be encouraged in conjunction with increased access and timeliness of shared information among subunit members. In order to be able to utilize staff in other areas or have members help out when they are overwhelmed with work, the information must be widely available to all members.

On the other hand, information timeliness and accessibility did not moderate any of the other predicted relationships. Subunits with more information timeliness and accessibility did not show a significant difference in their decentralized decision making-physical resource flexibility or -responsiveness relationship. This is quite intriguing as I would have expected that information timeliness and accessibility would have a similar effect on the two decision making relationships as above. Based on theory described in previous chapters, it seems that information timeliness and accessibility should be important in all relationships and would help to enhance the associations. Yet it may be that the other design factors that are positively associated with physical resource flexibility and responsiveness, namely an innovative climate and psychological safety, may facilitate information timeliness and accessibility in the subunit and thus measuring the information timeliness and accessibility index does not explain any additional variance. Specifically, it may be that this type of climate supports sharing timely and

accessible information in the subunit as members are encouraged to suggest innovative ideas in an atmosphere safe for risk taking. This climate may actually be a substitute for information sharing and provide positive effects toward that end. Future research may be able to tap this possibility by expanding measures of climate to determine if this issue is evident.

Additionally, information timeliness and accessibility did not have any impact on the advanced technology-physical resource and -responsiveness relationships as well. Based on the data, it is interesting to note that advanced technology was not significantly related to any of the other variables in the model. This is out of the ordinary as the literature suggests that more advanced technology is useful in many situations (e.g. Huber, 1990; Venkatraman, 1994). Because there were no significant relationships with this variable, it may be that this was not a reliable indicator of technology in this setting and this may account for the lack of findings. On the other hand, this may be a new finding that indicates that in dynamic settings more advanced technology does not contribute to operational flexibility because it may actually be too specialized and focused on specific uses. It may be that pieces of equipment are not focused on many different uses and thus are not beneficial to physical resource flexibility. Additionally, it may also be that advanced technology requires more time to learn how to use and utilize in certain situations and thus does not contribute to the subunit's responsiveness. Future investigations should consider multiple measures of technology in order to examine these relationships again.

Using Operational Flexibility to Build Performance

This study also adds to the theoretical literature that purports that organizations with a higher level of flexibility can adapt to changes in the environment and this ability leads to more success (Burns & Stalker, 1961; Hall, 1991; Sanchez, 1997; Thompson, 1967). Results showed that although there was not a significant relationship between the separate dimensions of operational flexibility and performance when measured by the Trauma Directors and Trauma Coordinators alone, there was a significant relationship when using the operational flexibility index and the performance index including the directors, coordinators, and clinicians.

Specifically, a more general measure of flexibility (the index) and a more inclusive measure of subunit performance showed a positive significant relationship. Yet, this measure of performance as an index also brings up another concern. Same source bias may play a part because the measure of operational flexibility came from the clinicians and part of the subunit performance index also was from these participants. But, aggregation statistics indicate that this measure shows agreement within each trauma center and is significantly different across centers just as in the director and coordinator performance indicator. These statistics seem to indicate a definite similarity in how all respondents saw center performance and thus using a combined measure may not be biased.

Yet, analysis using the split sample technique indicated that there were no significant results between operational flexibility and performance (using indices or separate dimensions). This data thus suggest that there may be a same source bias at play and that it is indeed necessary to measure the variables using data from different sources.

These ambiguous findings indicate that it may be possible to claim that operational flexibility is indeed empirically linked to subunit performance, but further research does need to investigate other options in which to measure subunit performance. This research is step in the right direction in trying to empirically link flexibility with performance, a fact that is currently lacking in the literature (Volberda, 1998).

It was satisfying to find that there were significant direct relationships between a climate for innovation, psychological safety, formalization and subunit performance. These findings support research showing that in more diverse and changing environments, less formalization is more appropriate (Galbraith, 1978, 1993; LaPorte, 1996; Lawrence & Lorsch, 1967). Yet, findings did not indicate that decentralization of decision making is also important in this setting. Although these prior studies suggest that the subunit essentially needs to be able to change with the dynamic environment through such structural design factors as decentralization and less formalization, in this setting decentralization was not important. This finding may be unique to this setting because in a trauma setting the ultimate legal responsibility for patient life rests with the attending surgeon. The residents in trauma centers are not licensed physicians and work under the license of the attending and thus if there are any mistakes, the attending is legally at fault. Thus, it may be that all critical decisions must be made with the attending's approval.

Further, these findings support the notion that a climate for innovation contributes to subunit performance. This innovative climate, in which subunit members search for new ways of looking at problems and cooperate in order to help develop and apply new ideas, was associated with higher subunit performance. Managers should be encouraged to build a climate that emphasizes these characteristics so that subunit members are

supported in developing new ideas and they are encouraged to develop new solutions and new ways of looking at problems.

Surprisingly, findings showed that less psychological safety was associated with higher levels of subunit performance. This is contrary to research that purports that psychological safety or an atmosphere safe for interpersonal risk taking is critical for group performance (Edmondson, 1999). It seems that subunit members should not be encouraged to feel that they can violate rules, deviate from the norm, take risks, or make mistakes in order to contribute to their subunit performance in this setting. This seems logical considering that this trauma setting deals with human life and it is not acceptable to make mistakes or deviate from the norm when taking care of patients. Yet, the measure specifically focused on interpersonal risk taking and not patient risk taking. It could be possible that participants did not fully understand the survey items or these items had a double meaning when dealing with patients in this setting.

It is interesting to note that psychological safety was positively associated with HR flexibility and responsiveness, indicating that although the safe atmosphere is associated with a flexible subunit, it is negatively associated with subunit performance. It may be that when members are encouraged to feel safe about taking risks, they make quick changes as needed and respond quickly in times of change. But, these risks may not always be positive risks to take and may in fact directly impact subunit performance negatively. Thus, although subunit members may feel more comfortable taking risks, they may need some guidance to make sure that their risks are helpful for the subunit. It may be that encouraging this safety and risk taking behavior among peers comes with a price of training and focus for subunit performance. Future investigation into these

contradictory findings, perhaps using an alternative measure of psychological safety, would help shed light on this issue.

Unfortunately, exploratory analyses did not support the notion that information timeliness and accessibility is positively associated with subunit performance. Even though group research shows that not sharing unique information is associated with suboptimal decisions (e.g. Stasser, Taylor & Hanna, 1989; Stasser & Titus, 1985, 1987; Winquist & Larson, 1998; Wittenbaum, 2000) and poorer group performance (Argote, 1999), findings here did not support these views. This lack of findings may be remedied with a more objective measure of performance as mentioned above.

Operational Flexibility and Dynamic Capabilities

The findings from this study contribute to the literature on dynamic capabilities showing how operational flexibility is a vehicle that allows the subunit to integrate and recombine resources, key tasks of dynamic capabilities (Eisenhardt & Martin, 2000). Dynamic capabilities is primarily focused on seeking a better understanding of the relationship between resources and performance. In this study, I specifically focused on operational flexibility, a measure of the flexibility of a subunits' human resources, physical resources and responsiveness in the face of change and uncertainty. This study shows how to build this specific capability in a dynamic environment, and further shows a link between the operational flexibility index and a comprehensive subunit performance index. It may be possible that although this is a step forward in trying to establish dynamic capabilities at the lower levels of the firm, there needs to be further examination of variables that are critical in linking dynamic capabilities closely with subunit performance.

Specifically, current research in dynamic capabilities examines search, entrepreneurial action, and learning of the dynamic capabilities process (Smith, Cao, & Lofstsrom, 2004) as well as the experience accumulation, knowledge articulation, and knowledge codification of the dynamic capabilities process (Zollo & Winter, 2003). This recent literature suggests that other mechanisms, such as learning, experience, and knowledge codification, may be critical in building dynamic capabilities. These other variables may help contribute to better performance along with operational flexibility in the subunit. It may be important to examine if subunit members accumulate experience and knowledge in order to build operational flexibility in order to enhance performance. If they only build operational flexibility and do not accumulate experience and knowledge, they may not incorporate this knowledge as new routines (Zollo & Winter, 2003) and thus may not contribute to effective performance. Further, Smith et. al (2004) suggest that managers need to search, act, and learn in order to build and enhance the dynamic capability process. It may be that these actions are necessary components to build operational flexibility and thereby enhance subunit performance. Thus, incorporating variables such as exploration, experience accumulation, learning, and knowledge codification may help to shed light on how to not only build operational flexibility completely, but also how to further link operational flexibility to performance.

## Limitations

Although the findings of this study are relevant and important, there are a few limitations that need to be acknowledged. First, the study involved a field sample of trauma centers across the country in which data were collected simultaneously from all respondents. This cross-sectional design makes it impossible to prove causality, which is

detrimental when making predictions on how to build operational flexibility within the subunit. One method to remedy this issue may be to collect data longitudinally to test the predictive validity of the independent and mediating variables. Or, using a laboratory experiment testing a causal hypothesis might provide a greater degree of control. For example, a business simulation in which a problem in a dynamic environment is created could provide a setting for investigation. Participants would need to solve the problem within the simulations context. Manipulation of design factors and the information factor would help link them with operational flexibility and performance.

Using a laboratory experiment as well as testing this model in other settings may also address possible limitations on generalizability. Although a strength of this study is its setting in trauma centers, this sample choice may influence the generalizability of the findings. Specifically, the findings may be highly generalizable to subunits in these types of dynamic settings, where life is of utmost concern. It may be that other subunits within a hospital, in a nuclear power plant, or even an aircraft carrier may glean useful information from these findings. Yet, in more traditional organizations operating in an environment with limited uncertainty and change, there may be less application of the findings. It may be that other variables not measured here drive operational flexibility, or there may be a different type of flexibility at work.

Further, although it seemed logical that in trying to detect high levels of operational flexibility I required a dynamic setting for my tests, this setting may also be a drawback. All of the sites in my study were relatively high in environmental dynamism and thus, the findings do not shed light on factors associated with operational flexibility in a more stable environment. It may be that operational flexibility is present in stable

settings but only in very low levels. Or, it may be that operational flexibility is present but not utilized until the environment increases in dynamism. Thus, it would be beneficial for future research to examine the relationships in both a stable and dynamic setting as well as in a more traditional organization to determine the presence or absence of these constructs and their relationships.

Another potential limitation to this study is the use of subjective rather than objective performance measures. Trauma Directors, Coordinators, and clinicians were asked to assess the subunit's performance relative to other trauma units. I tried to avoid subjective bias by using a multi-item measure and by also asking directors, coordinators, and clinicians to provide data. Even though these steps were taken, using sources that might provide more realistic information over general clinicians might be beneficial and future researchers should consider a more subjective measure of performance. More objective measures might provide different results and a stronger link between operational flexibility and subunit performance. However, I would caution future researchers to use care when determining objective performance measures to use in studies in this industry. The medical field has wrestled with this dilemma, trying to determine the most appropriate system of measurement. Mortality rates, length of stay of the patient, and injury severity scores have all been considered and each has its pros and cons. Use of these measures must be considered, but also must be used with caution.

A final possible limitation is that some of the study variables were created for the purpose of this dissertation, most notably operational flexibility and the information timeliness and accessibility index. These measures have yet to be validated using other samples in other settings. In addition, these variables were measured using subunit

members' self-reports, which might create a possible bias to the results. Thus, validating these measures is highly recommended for future research, as well as possible exploration into using more objective measures to test their reliability.

## Study Strengths

Although there are limitations to this study, there are also strengths worth noting. First, I was able to study the phenomenon of interest, operational flexibility, in a very dynamic and uncertain environment, one where this component may be key for subunit effectiveness. If operational flexibility is really a necessary capability for organizations in this setting, then the study of this characteristic in a dynamic setting should yield the most robust results. It is thus interesting that the results showed a direct link between operational flexibility and subunit performance when both indices were created in the exploratory analyses.

Further, this study takes a step forward in trying to create reliable instruments in order to measure operational flexibility and information timeliness and accessibility. The concept of flexibility is consistently referred to in the literature (e.g. Golden & Powell, 2000; Sanchez, 1995; Volberda, 1998), but measures of this concept at the subunit level have yet to be established. Additionally, many attempts of measuring knowledge creation and integration are highlighted in the literature (e.g. Nonaka, 1994), but there does not seem to be an instrument specifically available to refer to basic information sharing. Thus, this study developed measures of operational flexibility and information timeliness and accessibility that may be validated and refined for use across a wide variety of samples in the future.

## Future Research

Future research of operational flexibility, information timeliness and accessibility, and subunit design factors is needed to fully understand the causal relationships between these concepts. Research and data should be collected longitudinally to help establish the direction of causality and further assess the complexity of interconnections. Does operational flexibility in fact lead to increased performance? Such research would add to the understanding of how operational flexibility can be built in a subunit and just how it can systematically increase subunit performance.

Further, including other variables of interest that maybe be related to the development of operational flexibility would increase our knowledge and understanding of these relationships. For example, some theoretical research has identified that using a capability more often may help the organization learn to operate in a familiar environment (King & Tucci, 2002). But, this research suggests that as these organizations are more familiar in their environment, it may discourage their use of the capability as the capability develops into a stable routine. Thus, if subunits learn to use operational flexibility in their dynamic settings, will these dynamic processes then evolve into everyday operating routines and thus the use of operational flexibility will then diminish? Exploring this notion of organizational learning and the development of operating routines in a longitudinal study may help shed light on how learning may impact use of dynamic capabilities.

Finally, it is important to look at more objective measures of subunit performance to examine if operational flexibility is important for other subunit outcomes other than perceptual measures. For example, operational flexibility may be critical for the subunit

in terms of coordination and timing of members in the subunit itself which may directly contribute to subunit performance. Additionally, more objective measures of subunit performance may be more suggestive of these relationships.

## Conclusion

This dissertation essentially has achieved the goal of defining, operationalizing, measuring, and determining the antecedents of operational flexibility at the subunit level. Specifically, the study provided evidence that subunit design factors and information timeliness and accessibility are indeed significantly related to operational flexibility. Although the study findings were not unambiguous in regards to the relationship between operational flexibility and subunit performance, it may be a beginning step at helping scholars determine how to link this critical capability to effective outcomes. This study also provides a prescriptive model for managers for building operational flexibility in their subunits. The findings show that more decentralized decision making design, a psychologically safe and innovative climate, and more formalization are likely associated with increased HR flexibility, physical resource flexibility, as well as more responsiveness. Because the business environment is increasingly dynamic and changing, it is critical for research to investigate and examine how to build these critically important capabilities.

Appendix A

**Human Resource Flexibility:** Defined as the extent that human resources provide the subunit with the ability to adapt to its dynamic environment through the number of staff and employees' ability to do different functions. *Items developed for this survey*

| | **To what extent do you agree with the following statements?**<br>**In my trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …our staff are trained to work in different areas. | 1 | 2 | 3 | 4 | 5 |
| 2 | …if we need to, we can use staff from other areas to help out. | 1 | 2 | 3 | 4 | 5 |
| 3 | …anyone can help out if we are overwhelmed with patients. | 1 | 2 | 3 | 4 | 5 |

**Resource Flexibility:** These items are based on definitions from Sanchez (1995) and Volberda (1996) and were developed for this survey. The scale is intended to measure the level of flexibility found in the resources in the subunit, specifically the extent of use of a resource as well as the ability to move the resource where needed in the subunit. *Items developed for this survey*

| | **To what extent do you agree with the following statements?**<br>**In my trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …there are alternative uses for our equipment and resources. | 1 | 2 | 3 | 4 | 5 |
| 2 | …our resources can be used for rare as well as common circumstances. | 1 | 2 | 3 | 4 | 5 |
| 3 | …we can move equipment from one area of the trauma service to another area as needed. | 1 | 2 | 3 | 4 | 5 |

**Responsiveness:** These items were created based on definitions of responsiveness: the speediness in which organizations can respond to change (Volberda, 1998) and the ability to respond to change in an appropriate timeframe (Golden & Powell, 2000). *Items developed for this survey*

| | **To what extent do you agree with the following statements?**<br>**In my trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …people make quick changes when needed. (Volberda p.94) | 1 | 2 | 3 | 4 | 5 |
| 2 | …we respond quickly when encountering new circumstances. (Golden & Powell p.379) | 1 | 2 | 3 | 4 | 5 |
| 3 | …we react rapidly if there is a change in processes. (Golden & Powell, p.379) | 1 | 2 | 3 | 4 | 5 |
| 4 | …people are slow to respond to needed changes. (reverse-coded) | 1 | 2 | 3 | 4 | 5 |

**Innovative Climate:** Items adapted from Team Climate Inventory from Kivimaki, Kuk, Elovainio, Thomson, Kalliomaki-Levanto, & Heikkila (1997)

| | **To what extent do you agree with the following statements?**<br>**In my trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …we move toward the development of new solutions. | 1 | 2 | 3 | 4 | 5 |
| 2 | …assistance in developing new ideas is available. | 1 | 2 | 3 | 4 | 5 |
| 3 | …we search for fresh, new ways of looking at problems. | 1 | 2 | 3 | 4 | 5 |
| 4 | …we cooperate in order to help develop and apply new ideas. | 1 | 2 | 3 | 4 | 5 |

**Psychological Safety:** Items adapted from Edmondson (1999: 354): A shared belief that the team is safe for interpersonal risk taking.

| | **To what extent do you agree with the following statements regarding your working relationships?** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | If you make a mistake in this trauma unit, it is often held against you. *(reverse-coded)* | 1 | 2 | 3 | 4 | 5 |
| 2 | People in this trauma unit typically reject others for having different ideas or approaches. *(reverse-coded)* | 1 | 2 | 3 | 4 | 5 |
| 3 | It is difficult to ask other members in this trauma unit for help. *(reverse-coded)* | 1 | 2 | 3 | 4 | 5 |

**Formalization:** Items from Lee & Grover (2000) Alpha = .71 adapted from measures developed by Aiken & Hage (1971) defined as the degree of codification of jobs, rules, procedures, and instructions

| | To what extent do you agree with the following statements? In my trauma unit… | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …rules and procedures are very clearly documented. | 1 | 2 | 3 | 4 | 5 |
| 2 | …there is always an extensive reliance on rules and procedures to meet emergencies. | 1 | 2 | 3 | 4 | 5 |
| 3 | …violation of the documented procedures is not tolerated. | 1 | 2 | 3 | 4 | 5 |

**(De)centralization of decision-making:** Przestrzelski (1987): the selective delegation of authority to the operational level; Aiken & Hage's (1966) scale found reliable at organizational level (Dewar, Whetten & Boje, 1980)—reasonable to adapt to unit level. Items adapted from Richardson, Vandenberg, Blum, & Roman (2002) (internal reliability coefficient = .87 of 5 item scale)

| | To what extent do you agree with the following statements? In my trauma unit… | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …there can be little action taken until a supervisor approves a decision. | 1 | 2 | 3 | 4 | 5 |
| 2 | …people who want to make their own decisions would be quickly discouraged. | 1 | 2 | 3 | 4 | 5 |
| 3 | …even small matters must be referred to someone higher up for approval. | 1 | 2 | 3 | 4 | 5 |
| 4 | …any decisions we make must get approval. | 1 | 2 | 3 | 4 | 5 |

**Technology:** *This formative scale was created for this study following consultation with three trauma technology experts.*

In our trauma center, we have immediate access to:

☐ Portable ultrasound scanner (FAST)
☐ Filmless digital X-ray
☐ High speed CAT scanner
☐ OR facilities
☐ MRI
☐ Waveforms capnography in all trauma resuscitation bays
☐ An angiography suite

**Information Timeliness and Accessibility Index:** *Items created for this study*

| | **Please indicate the extent that you agree with the following statements. In my trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …we get needed information in a timely manner. | 1 | 2 | 3 | 4 | 5 |
| 2 | …we can count on the information we need when we need it. | 1 | 2 | 3 | 4 | 5 |
| 3 | …we don't know what's going on until things have already happened. (reverse-coded). | 1 | 2 | 3 | 4 | 5 |
| 4 | …we are able to access information needed. | 1 | 2 | 3 | 4 | 5 |
| 5 | …we can never find the reports and charts that we need. (reverse-coded) | 1 | 2 | 3 | 4 | 5 |
| 6 | …it is hard to get information that we need even when we know it is there. (reverse-coded) | 1 | 2 | 3 | 4 | 5 |
| 7 | …everyone has similar information about how our processes are conducted. | 1 | 2 | 3 | 4 | 5 |

**Perceived Unit Performance:** *Items created for this study*

| | **To what extent do you agree with the following statements regarding your trauma unit's performance? Based on your knowledge of other trauma units, your trauma unit…** | Not at All | | | | To a great extent |
|---|---|---|---|---|---|---|
| 1 | …performs excellently as compared to other trauma units. | 1 | 2 | 3 | 4 | 5 |
| 2 | …provides excellent service to patients as compared to other trauma units. | 1 | 2 | 3 | 4 | 5 |
| 3 | …does an excellent job of meeting patient needs as compared to other trauma units. | 1 | 2 | 3 | 4 | 5 |
| 4 | …does an excellent job of helping patients get well as compared to other trauma units. | 1 | 2 | 3 | 4 | 5 |
| 5 | …has excellent overall quality of medical care as compared to other trauma units. | 1 | 2 | 3 | 4 | 5 |

**Organizational and unit size:** *Items created for this study*.

How many beds are in your hospital? Routinely utilized_____

**Organizational slack:** defined as the ratio of number of designated trauma patient bays in the ED to number of admitted trauma patients for the year; intended to indicate the potential slack in each subunit. *Items created for this study*.

How many resuscitation bays in the trauma center / ED are specifically designated for trauma? _____

How many trauma admissions in the last fiscal year? Total_____

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