# TECHNOLOGY USE, COOPERATION, AND ORGANIZATIONAL LEARNING IN PATIENT SAFETY REPORTING

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

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# DEDICATION

I dedicate this dissertation to my wonderful family, especially…a special gratitude to my loving parents, Chia-Chang Liu and Hsueh-Chin Tseng, who have always supported and believed in me; to my brother, Shing-Ren (Andy) Liu, who has been my role-model for hard work, persistence and personal sacrifices and who has provided the inspiration to set high goals and never never give up; to my sisters, Shin-Yi (Shane) Liu and Yueh-Hsuan (Celia) Liu, who inspired me to take chances and to stand for what I believe in. May you also be motivated and encouraged to reach your dreams. I love you all!

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ABSTRACT

Information technology has the potential to support cooperation and facilitate organizational learning. However, technology use, cooperation, and organizational learning are complex constructs that were often oversimplified and resulted in inconsistent findings in past studies. This study employed an innovative approach to building new knowledge about the use of technology in support of cooperative work and organizational learning in a health care setting. This study examined the use of the Patient Safety Network (PSN) within the University of Missouri Health Care (UMHC). The purpose of this study is to understand in what ways and to what extent health care practitioners at UMHC used the PSN and how it influenced cooperative work and contributed to organizational learning. Activity was used as the unit of analysis to examine members' actions and interactions surrounding a common patient safety activity that were recorded by the PSN. Follow-up surveys of perceived organizational learning were collected at the end of each patient safety activity. The findings of this study provide evidence that technology use and cooperation can be operationalized and examined in context and demonstrate how it can be done reliably. Three types of PSN technology use were found: Event Complexity, Appropriation of Reporting, and Appropriation of Resolution. The results show the importance of understanding the participation of different roles within a CSCW context and of considering task characteristics, such as event complexity. The degree of cooperation depended on how well the basic elements were met. The results indicate that at the time of the study, those using PSN show evidence of working cooperatively through the system, but in general are not scoring high on the indicators of cooperation. Additionally, the overall relationship between cooperation and organizational learning was found weak. Finally, the results show that factors of

technology use impact levels of cooperation and perceived organizational learning. The overall cooperation was influenced by the levels of Appropriation of Reporting as well as by the interaction between the level of Event Complexity and Appropriation of Reporting. More specifically, the higher the Appropriation of Reporting, the higher the overall cooperation was found. Event Complexity reduced the effect of Appropriation of Reporting on the overall cooperation. The overall perceived organizational learning was influenced by the levels of Event Complexity and Appropriation of Resolution. More specifically, the higher the Event Complexity, the lower the overall perception of organizational learning. Extremely high and extremely low overall scores on Appropriation of Resolution had higher perceptions of organizational learning.

# CHAPTER 1

# INTRODUCTION

# CHAPTER I

## INTRODUCTION

### *Overview*

In order to remain competitive in today's rapidly changing business environments, organizations have to continuously adapt and improve (Dodgson, 1993; Scott, 2003). Over the last several decades, organizations have increasingly used information technology, made efforts to support organizational learning, and sought to foster cooperation among employees as a means to improve performance and effectiveness (Dodgson, 1993; Templeton, Lewis, & Snyder, 2002; Tippins & Sohi, 2003; Tjosvold, Dean & Tsao, 1989).Although organizational learning has been defined in number of different ways (Argyris & Schön, 1978; Crossan, Lane, & White, 1999; Fiol & Lyles, 1985; Huber, 1991), most agree that it is a complex, multi-level, multidisciplinary, and dynamic means of creating collective knowledge and organizational memory. It is used for continuous development of knowledge and ability, both for individual members of the organization and the organization as a whole.

Six key aspects of organizational learning emerge from the literature:

1. Individuals are the learning agents within organizations. Although individual learning does not guarantee organizational learning, organizational learning cannot occur without individual learning (Argyris & Schön, 1978).
2. Organizational learning is greater than the sum of its parts (Senge, 1990).

3. Communication and information sharing are critical to organizational learning. If individuals do not want to or have a proper channel to share and communicate with each other, organizational learning simply cannot occur (Huber, 1991).
4. Organizational learning involves dynamic processes across individual, group, and organization levels. Organizations learn through the individuals, and individuals are also socialized by organizations through rules and routines (Crossan et al., 1999; Kim, 1993).
5. A collective form of knowledge is accumulated and stored as organizational memory for future use (Huber, 1991; Levitt & March, 1988).
6. The source of learning may vary over time according to the aims of the industry. For example, in the health care industry, adverse event reporting is one means of organizational learning that seeks to improve patient safety and health care quality (Carroll & Edmondson, 2002).

One of the most critical factors for organizational learning is communication. Individuals in the organization need resources and opportunities to communicate and share their knowledge with others in order to negotiate and build organizational knowledge. Putting people together to work in the same place and time does not guarantee that they will negotiate meaning and build knowledge. They can choose to compete with others, complete the task alone, or simply take advantage of others' efforts while contributing nothing to the organization. A key concept for achieving positive outcomes in social exchange is the notion of cooperation. Cooperation refers to the ways

that individuals work interdependently and contribute efforts to achieve mutual benefits through active participation and communication among one another. Cooperative work involves sharing individual expertise, experience and responsibilities in the pursuit of common goals. Johnson and Johnson (2002) outline five elements in cooperative work: positive interdependence, individual accountability, promotive interaction, social skills, and group processing. They argue that the value of cooperative work primarily depends on the manner in which it is implemented; it can only be maximized when all elements are in place. Thus, cooperation best contributes to organizational learning when individuals are positively interdependent, accountable and responsible for their actions, actively engaged and positively interacting with others, and coordinating and negotiating their work efficiently and effectively.

Even if individuals are willing and eager to work with others, poor mechanisms or lack of support for coordination, communication, and information sharing can cause problems. In a face-to-face context those working together on a task can easily tell what others are doing, where they are, and what is going on because they can see, listen, and talk to each other. However, this intuitive process becomes more complex and difficult to achieve when work is distributed and people no longer work at the same time or location, such as in an organization that runs 24/7 or in a global organization that manufactures and markets goods and services across the world. Under these circumstances, it is challenging to keep members aware of each other's actions and able to cooperate efficiently and effectively across physical and temporal boundaries.

Information technology is increasingly being used to bridge these boundaries for distributed work groups (Munkvold, 2002). Information systems can also reduce the costs of recording the knowledge and experiences of individuals and transforming them into organizational routines and memory. Information technology also provides members greater and quicker access to organizational memory (Dewett & Jones, 2001).

Computer Supported Cooperative Work (CSCW) is a framework often used to understand and develop technological support for activities and relationships in work groups. CSCW is defined as "an endeavor to understand the nature and requirements of cooperative work with the objective of designing computer-based technologies for cooperative work settings" (Bannon & Schmidt, 1989). Hutchins (1995) further suggests two characteristics of CSCW: the support of cognitive artifacts of a group and the support of member behaviors. A CSCW system facilitates effective cooperative processes and supports meaningful communication among members. Research in CSCW provides guidelines for system development and a range of analytic frameworks for articulating important social characteristics of work, which may be used to guide analysis and understanding of cooperative work (Crabtree, 2003).

Current technology for cooperation pales in comparison with the natural senses, instincts and habits people use in face-to-face settings. However, information technology has the potential of providing new affordances not easily available in face to face settings, such as automatic tracking of member's behavior and recording of all communication. Information technology can provide new means for communication, coordination, and cooperation and open the door to new opportunities for engaging members, teams,

workgroups, and organizations as a whole. However this potential is often difficult to realize (Huber, 1991; Maznevski & Chudoba, 2000). Understanding how information technology can address the needs for cooperative work in organizations is a substantial challenge (Driskell, Radtke, & Salas, 2003; Sarker & Sahay, 2002; Schmidt, K. & Simone, 1996; Thompson & Coovert, 2003).

### *Statement of the Problem*

The use of cooperative work to build organizational learning for continuous improvement is a goal of all organizations. Rapidly developing information technology has the potential to support cooperative work and improve organizational learning. Understanding how to develop and use these tools effectively is a major challenge facing organizations today. Applications that can support cooperative work for distributed organizations are the "killer applications" of today; major technology organizations are competing to create and market their solution. How does an organization determine which ones work best and work best for their organization? Past research has used surveys and interviews to demonstrate effects of various technologies in cooperative work settings. Further research is needed to examine the use of these tools in context so as to understand how and to what extent the use of technology influences each element of cooperation in the work setting and how it affects an organization's ability for learning.

### *Purpose of the Study*

This study employed an innovative approach to building new knowledge about the use of technology in support of cooperative work and organizational learning in a

health care setting. This study examined the use of the Patient Safety Network (PSN) within the University of Missouri Health Care (UMHC). Patient safety reports represented organizational members' actions and interactions. These reports were the primary artifacts of the study. Follow-up surveys of perceived organizational learning were collected at the end of each patient safety activity.

The overall goal of the study was to understand the relationships between and among technology use, cooperation, and organizational learning in this health care setting. The study had three objectives.

1. To examine how practitioners used the PSN to cooperate to ensure patient safety at UMHC.
2. To examine the effects of technology use on cooperation and organizational learning.
3. To test and verify new methods and analytics for examining computer supported cooperative work.

The study is based in the analytical techniques and theoretical insights from information systems research and social science research to assess artifacts and perceptions at the activity level. This combination of approaches is powerful, especially when the problem under study is one that both disciplines have explored extensively.

### *Significance of the Study*

Recent advances in technology and globalization have led to a distributed work force where individuals often interact via networked technology. It is likely this growth

will continue, with more and more people needing to interact and work in new and different ways mediated by technology. New knowledge about the how and to what extent the use of technology affects cooperation and organizational learning can inform the design and development of information technology to advance computer supported cooperative work and organizational development.

### *Statement of the Research Questions*

1. How do members use the PSN to report and resolve safety events?
2. In what ways and to what extent do members use the PSN to cooperate for patient safety?
3. In what ways and to what extent do staff members perceive that the organization learns through the use of the PSN?
4. In what ways and to what extent does the level of cooperation in the use of PSN influence members' perception of organizational learning?
5. In what ways and to what extent does the use of PSN help people work more cooperatively?
6. In what ways and to what extent does the use of PSN influence members' perception of organizational learning?

### *Definition of Constructs*

- *Activity*: In this study, an activity is defined as a set of work that incorporates tools, people, and resources needed to report and resolve a patient safety event

through the Patient Safety Network (PSN) at the University of Missouri Health Care (UMHC).

- *Computer-supported cooperative work (CSCW):* Computer applications or technology designed to support cooperative group work.
- *Cooperation*: Individuals work interdependently and contribute efforts to achieve mutual benefits through active participation and communication with one another.
- *Learning Organization*: An organization that focuses on constructing structure and strategies to enable and maximize learning in ways that facilitate organizational transformation.
- *Organizational Learning*: A dynamic process of continuous development in knowledge and capacity, both individually and collectively (Senge, 1990).
- *Technology Use*: The extent to which an information system is incorporated into the user's business processes (Cuellar, McLean, & Johnson, 2006).

### *Chapter Summary*

This chapter introduced the foundation and rationale for this study. Researchers have viewed organizational learning and cooperation as complex constructs and indicated that the use of information technology has the potential to support cooperation and facilitate organizational learning. The purpose of this study is to understand in what ways and to what extent health care practitioners at UMHC used the Patient Safety Network and how it influenced cooperative work and contributed to organizational learning.

# CHAPTER 2

# LITERATURE REVIEW

# CHAPTER II

Literature Review

## *Introduction*

This chapter begins with an overview of the theoretical foundations of organizational learning, including definitions, key concepts, strategies, and previous research. Given the importance and dynamic nature of organizational learning, cooperation is discussed because of its potential to encourage information sharing, negotiation of meanings, and building common understandings, all of which are essential for organizational learning. Cooperative work in organizations requires not only high interdependence but also efficient and effective coordination among individuals. Information technology is often seen as a key in supporting cooperative work and the organizational learning process. This study was an attempt to develop new knowledge to about the use of information technology to support cooperative work and organizational learning. It was carried out in the context of the healthcare industry.

## *Organizational Learning*

### *Definitions of Organizational Learning*

No matter how successful an organization has been in the past, it must continuously learn and adapt to survive and grow in today's challenging and changing environment. The process of moving forward and adapting to change is often referred to as "organizational learning." Organizational learning is a multidisciplinary and cross-

level phenomenon that has become the focus of organizational development in recent years. However, the meaning of this term varies widely by contexts and has been operationalized in a number of ways in past research (Table 2.1).

Table 2.1

Definitions of Organizational Learning in Past Research

| Researcher | Definition of Organizational Learning |
|---|---|
| Argyris and Schon (1978) | The process of detection and correction of errors (p.2). |
| Fiol and Lyles (1985) | The process of improving actions through better knowledge and understanding (p.803). |
| Levitt and March (1988) | Organizations are seen as learning by encoding inferences from history into routines that guide behaviors (p.320). |
| Dodgson (1993) | The ways firms build, supplement, and organize knowledge and routines around their activities and within their cultures, and adapt and develop organizational efficiency by improving the use of the broad skills of their workforces (p.377). |
| Kim (1993) | Increasing an organization's capacity to take effective action (p.43). |
| Robey, Boudreau, and Rose (2000): | An organizational process, both intentional and unintentional, enables the acquisition of, access to, and revision of organizational memory, thereby providing direction to organizational action (p.130). |
| Templeton, Lewis, and Snyder (2002) | The set of actions (knowledge acquisition, information distribution, information interpretation, and organizational memory) within the organization that intentionally and unintentionally influence positive organizational change (p.189) |
| Lines (2005) | The development or dissemination of work-based knowledge that is perceived to be useful for improving organizational performance (p.160). |
| Real, Leal, and Roldan (2006) | A dynamic process of knowledge creation generated at the heart of the organization via its individuals and groups, directed at the generation and development of distinctive competencies that enable the organization to improve its performance and results (p.506). |

Argyris and Schon (1978) defined organizational learning as a process of detection and correction of errors. They identified two types of learning processes: single-loop learning and double-loop learning. In single-loop learning, individuals improve their behaviors and make adjustments according to the outcomes of their actions. During single-loop learning, individuals continuously detect and correct their actions based on the deviations they perceive after comparing the results with the standard rules. Single loop learning corrects deviations in order to meet the standard rules without examining or challenging underlying assumptions. Double-loop learning requires individuals to reflect on themselves and their actions in ways that cause them to question the rules and assumptions they have brought to the problem at hand. Individuals must be active and reflective thinkers to achieve double-loop learning. Argyris and Schon argued that double-loop learning has the potential to lead to major changes and re-engineering in organizations. In double-loop learning, individuals are seen as the agents or instruments of learning for organizations. Indeed, organizations cannot learn without having individuals who are willing and able to learn and grow.

Argyris and Schon pointed out that, although individuals may be learning every day, special conditions are necessary to bring forth the kind of learning (double loop) needed for substantial organizational learning. These are the conditions needed to make members active and reflective learners. However, organizational learning is not simply the cumulative sum of the parts of individuals' learning (Fiol & Lyles, 1985). When individual members come and go, the knowledge and expertise they bring to the organization does not diminish because of turnover. Organizations can preserve and transmit their knowledge through developing an organizational memory of histories,

routines, and norms (Levitt & March, 1988). At the same time, individuals within an organization are socialized to those routines and norms (March, 1991).

*Development of Organizational Memory*

Levitt and March (1988) view organizational learning as routine-based, history-dependent, and target-oriented actions. Specifically, to reach a desired outcome, organizations learn and develop routines to guide behaviors, based on the interpretation of past history and experience. By doing so, knowledge and experience are recorded and accumulated within those routines, regardless of the turnover of personnel over time. These accumulated experiences and routines are conserved in a collective memory often referred to as ”organizational memory” that is available for future decision making and action taking.

Huber (1991) argues “An entity learns if, through its processing of information, the range of its potential behaviors is changed.” From Huber’s view, organizational memory is a repository of knowledge stored for future use. He also describes how organizational memory is formed through different forms of information processing within organizations. First, knowledge must be created by individuals through information acquisition, including several processes to acquire information or knowledge, such as congenital learning, experiential learning, vicarious learning, grafting, and searching and noticing. After knowledge is created, it can be shared among units and individuals to produce new knowledge and understanding. This information distribution process is a necessary precursor to organizational learning. Organizational learning cannot occur if individual members keep information and experience to themselves.

Individuals must be able to share and contribute their knowledge and information to others in some way. Once individuals share and receive information, they need to negotiate and interpret this new information to build common meanings and shared understandings. This information interpretation process develops common conceptual schema among individuals and across departments. The common understandings and conceptual schema are aggregated, stored and retrieved as collective information and understandings that form the basis for future decision making.

*Multilevel and Dynamic Process of Organizational Learning*

Organizational learning is not simply a one-way process to form organizational memory. Crossan, Lane, and White (1999) describe four main processes explicitly connecting the multiple levels (individual, group, and organization) involved in organizational learning. Figure 2.1 represents their schema of the multilevel and dynamic processes of organizational learning, as visualized by Crossan, Lane, and White (1999).

1. *Intuiting* is the most basic individual level of learning, which includes preconscious recognition of the patterns and possibilities inherent in a personal experience. It is highly subjective. Individuals use it to guide their own actions.
2. *Interpreting* is the explanation of an idea to oneself and to others through words or actions for building shared meanings and understandings. It connects the individual and group level.
3. *Integrating* is the developing of a mutual adjustment, negotiated action, and shared practice among individuals.

4. *Institutionalizing* is the process of formalizing actions and practices so that they become routine for individuals across the organization. The collective knowledge (organizational memory) is built through participation and negotiation of meaning among the individual members and becomes embedded in their practices and workplaces.

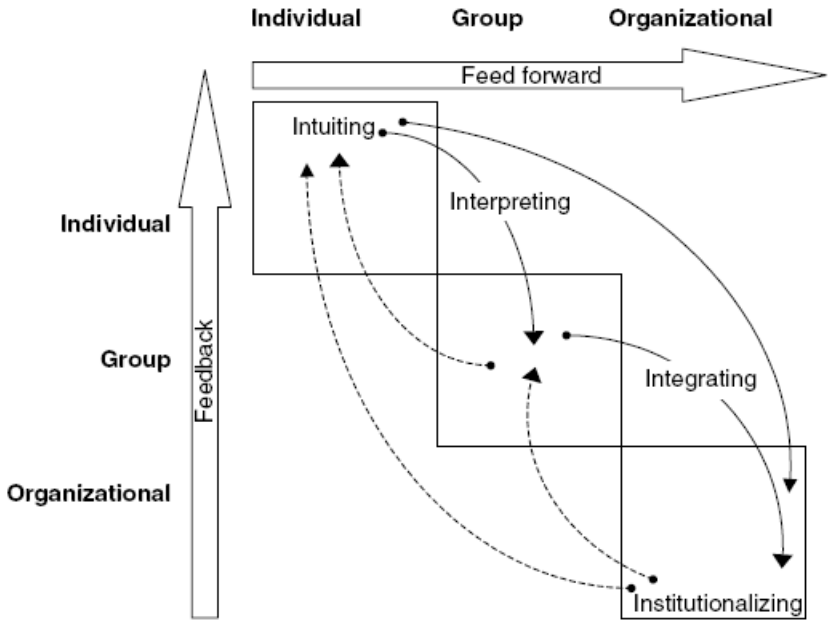



Figure 2.1 Organizational Learning Process (Crossan et al., 1999)

Kim (1993) developed a model to describe individual and organizational learning through mental models. He argues that organizational learning takes place through individuals whose actions are based on a set of shared models. However, individual learning also affects learning at the organizational level through their influence on the organizational shared mental models, such as culture, beliefs, artifacts, and behavioral rules. From his perspective, organizations can only learn when the learning cycle

interconnecting individuals with the organization is completed. Moreover, without shared mental models, an organization becomes incapable of learning. With an emphasis on the development of shared meanings in an organization, an organization's ability for effective coordination increases when mental models are made explicit and actively shared (Kim, 1993).

Holmberg (2000) focused on the process of interaction, conversation, and dialoguing within social contexts in organizations. He sees learning as a reciprocal process in which the establishing of a basis for action is a collaborative effort that necessarily has to develop in relation to all those who can be seen as stakeholders for a certain issue. Therefore, establishing a process of communication and dialog in a workplace that allows or encourages participation and engagement in communicative and productive work practices and activities is beneficial to organizational learning.

Organizations ultimately learn through their individual members. Nevertheless, organizational learning is a multi-level dynamic process of continuous knowledge transformation and improvement in organizations (Crossan et al., 1999; Jerez-Gomeza, Cespedes-Lorentea, & Valle-Cabrera, 2005; Kim, 1993). In this study, organizational learning is defined as a dynamic process of continuous development of the knowledge and capacities of individuals and the organization (Senge, 1990).

*The Need for a Learning Organization*

There are different strategies and tools employed to help achieve organizational learning, including top-down formal structures, employee incentives, and information

technology, and work design. An organization that focuses on constructing structures and strategies that enable and maximize learning in ways that facilitate organizational transformation is called a learning organization (Dodgson, 1993). Emphasis is placed on providing continuous learning opportunities, promoting a culture of learning, using learning to reach goals, linking individual performance with organizational performance, and ensuring that individual learning enriches and enhances the organization as a whole.

Senge (1990) identified five basic dimensions of a learning organization: personal mastery, mental models, shared vision, team learning, and systems thinking.

*Personal mastery* is an individual's ability to continually clarify and deepen his or her personal vision, focusing energies to develop patience and see reality objectively. Individuals are seen as the necessary learning agents within organizations. Individual learning is necessary, but not sufficient for organizational learning.

*Mental models* are "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action." Mental models are often in forms of structures, experiences, cultures, and belief systems within an organization that can guide individuals' actions and decision making.

*Shared vision* is "a shared picture of the future we seek to create." The core of shared vision is a mutual purpose that can build a sense of commitment among individuals working in an organization. More importantly, this common perception of vision spreads when there is a positive and reinforcing process.

*Team learning* is "the process of aligning and developing the capacities of a team to create the results its members truly desire." Individuals of a team act, think, and learn together through dialogue and discussion in ways that transform individual intelligence and ability into something greater than the sum of the parts. Teamwork encourages communication, cooperation and appreciation among members.

*Systems thinking* is a way of describing and reflecting all aspects and interrelationships that shape the overall operation of an organization. It sees work practice as a dynamic whole rather than a set of parts and examines the interrelationships among the parts. Feedback provides a way to see the system dynamics and the patterns of change as they occur over time. However, people do not easily see systems and interdependent relationships.

In addition to the five dimensions of a learning organization, another major contribution of Senge has been his emphasis on the importance of understanding individual's thinking and involving people within an organization in building models and visions that facilitate the ultimate growth of the organization.

*Recent Attempts at Organizational Learning Measurement*

Previous research on organizational learning has taken many approaches to studying how organizations learn and understanding the important attributes. Robey and his colleagues (2000) suggested two approaches: examining the outcomes of organizational actions and learning process descriptions. These two approaches both utilize qualitative methods, creating thick descriptions or organizational learning profiles

to illustrate the dynamic phenomena within organizations (Dorai, McMurray, & Pace, 2002; Janson, Cecez-Kecmanovic, & Zupancic, 2007). However, Bontis and his colleagues(2002) suggested that measures of perceptions are the best indicators of organizational learning. Organizational learning includes multi-level dynamic processes linking individual, group, and organizational level. They explained that if individuals do not feel like their ideas are utilized by the organization despite the facts, the learning process is not fully completed and that may cause negative effects such as a decrease in confidence or an increase in dissatisfaction. Viewing individuals are part of the overall organizational learning system and organizations have to learn through individuals, they argued individuals' perceptions ultimately govern the degree and types of learning that occur within organizations.

Goh and Richard (1997) developed the Organizational Learning Survey (OLS) systematically and quantitatively assessing how well organizations perform. They assessed five organizational characteristics and management practices (Figure 2.2) – clarity of mission and vision, leadership, experimentation, transfer of knowledge, and teamwork – with 21 items. The primary purpose of the OLS is to measure an organization's current learning capability, defined as "the ability of the organization to implement the appropriate management practices, structures and procedures that facilitate and encourage learning" (Goh, 2003, p. 217). Goh and Richard argued that the more prevalent these characteristics, the stronger the learning capability of the organization. The current status and levels of organizational learning within an organization are captured and represented by its learning capability. By using the capability for organizational learning as an indicator of organizational learning, we can identify and

assess the impact of organizational conditions and specific interventions (Goh, Swee C. & Richard, 1997).

| | |
|---|---|
| (1) | Clarity of mission and vision: The degree to which employees have a clear vision/mission of the organization and understand how they can contribute to its success and achievement. |
| (2) | Leadership: The role of leaders in the organization with respect to helping employees learn and elicit behaviors that are consistent with an experimenting and changing culture. |
| (3) | Experimentation: The degree of freedom employees enjoy in the pursuit of new ways of getting the job done and freedom to take risks. |
| (4) | Transfer of knowledge: The systems that enable employees to learn from others, from past failures and from other organizations. |
| (5) | Teamwork and group problem-solving: The degree of teamwork possible in the organization to solve problems and generate new and innovative ideas. |

Figure 2.2 Five Dimensions of Organizational Learning Survey (Goh, Swee C. & Richard, 1997)

After developing the OLS, they tested the scale for validity and reliability using four organizations The OLS was found to be reliable (Cronbach's alpha = .90, Goh, Swee C. & Richard, 1997). They also conducted two longitudinal case studies to understand the process two companies undertook to become learning organizations. These studies used pre- and post- OLS surveys, interviews, focus groups, and secondary information related to the activities of the organizations (Goh, Swee C., 2003). The case studies showed the larger company made greater improvements than the smaller company. The larger company seemed to take a more serious attitude about the challenge of changing and devoted significant resources to it. The results also showed that transforming a large organization into a learning organization is not an easy task, but it can be done.

These later studies showed the OLS scale to be reliable with a Cronbach's alpha = .94 (Goh, Swee C., 2003). Since then, the OLS has been used in several empirical studies of organizational learning (Chan, 2003; Chiva-Gomez, Camison-Zornoza, & Lapiedra-Clcami, 2003; Goh, Swee C. , Cousins, & Elliott, 2006; Goh, Swee C. & Ryan, 2002; Jerez-Gomeza et al., 2005; Stetler, Ritchie, Rycroft-Malone, Schultz, & Charns, 2007).

Several other instruments have been developed to attempt to assess organizational learning. Bontis, Crossan, and Hulland (2002) developed a questionnaire based on the organizational learning process conceptualized by Crossan and his colleagues (1999) to measure learning at the individual, group, and organizational levels and the flow (feed-forward and feed-back) among these levels. They argued that individuals' perceptions are what matter most. They showed that employees' beliefs that the company did not utilize their ideas resulted in negative consequences. They recommended using perceptual measures because such measures allow researchers to assess an individual's feelings and perceptions about organizational learning. Templeton, Lewis, and Snyder (2002) developed a measure for organizational learning based on Huber's taxonomy, including eight factors: awareness, communication, performance assessment, intellectual cultivation, environmental adaptability, social learning, intellectual capital management, and organizational grafting. They used this measure to describe organizational learning for those in different roles in organizations. Based on Goh and Richard's work, Jerez-Gomez, Cespedes-Lorente, and Valle-Cabrera (2005) developed a measurement of organizational capability that included four constructs: managerial commitment, systems perspective, openness and experimentation, and knowledge transfer and integration.

Various attempts to develop measures for organization learning suggest that organizational learning is a latent construct that cannot be measured directly but can only be measured indirectly through several subsets of observed variables. Today, Goh and Richard's OLS scale remains the only demonstrated reliable scale of organizational learning.

## *Cooperation*

### *Definitions of Cooperation*

Organizational learning cannot occur if individuals have no proper ways to share their knowledge with others. Group work has the potential to encourage organizational learning and contribute to the development of a learning organization though providing individuals opportunities and channels for information sharing, communication, cooperation, and negotiation of meaning. Working together in groups is valued because of the contributions made through cooperative efforts. The concept of cooperation is not new; there have been numerous definitions and conceptualizations of cooperation.

From a sociological perspective, Eaton (1948) proposed a conceptual scheme with seven attributes of cooperation processes: social values, contacts, activity involvements, time sequences, structural entities, culture patterns, and status relations. Eaton argued that cooperation differs by the degree of differences across these attributes. He defined the seven attributes and articulated how a cooperation process or activity can be characterized for each attribute as follows.

*Social value* refers to the objectives of a cooperative process, which can be divided into two types: common means and common ends. Although individuals work together, they may have different objectives. Individuals cooperate with each other using common means only to help achieve their individual objectives. A higher level of cooperation that yields a stronger organization occurs when individuals work for a common objective shared by all members. These two types of cooperation are often difficult to separate in the real world.

*Contact* refers to the ways individuals interact with each other, either directly or indirectly. Direct contact involves individuals acting jointly at the same time and place; indirect contact involves interaction at different times and places. Direct contact is the most common form of cooperation, but indirect cooperation is increasingly important due to the growing size and complexity of organizations today. There is a greater need for a common system to help individuals cooperate in activities that differ across time and place.

*Activity involvement* refers to the number and intensity of activities involved in cooperative actions. The more closely individuals work together, the greater the stability.

*Time sequence* refers to the sequence and duration of activities. Some cooperative processes are temporary, while others are more long-term.

The *structure entity* is related to the functional differences within an organization. A division of labor can help improve the effectiveness of cooperation.

*Cultural pattern* refers to the organizational culture in which cooperative actions take place. Cooperation cannot occur when the perception (or the reality) is that the organization does not support cooperation.

*Status relations* refer to the perceived or real differences in status of the members of an organization. There are three basic possibilities: equal and identical status of members, equitable but not identical status of members; and hierarchical status. Equal status relations are the most effective in supporting cooperation (Edmondson, 2002).

From a behavioral perspective, cooperation is seen as individuals' actions that maximize the interest of others. Reciprocity plays a significant role in the establishment of cooperative behaviors (Fehr, Fischbacher, & Gächter, 2002). Researchers often adapt the Prisoner's Dilemma to assess cooperation. In the Prisoner's Dilemma simulation, individuals are given two strategies to interact with others: cooperation or defection. Using observation, reciprocity has been shown to support cooperation in a long run (Axelrod & Dion, 1988). Getting cooperation started requires more than a single cooperative act; there is a need for a norm of cooperation.(Fehr et al., 2002). Tyler (2002) suggests two types of cooperative behaviors: those that stimulate desirable behavior and those that lessen the occurrence of undesirable behavior. Desirable behavior involves activities and actions that promote the effectiveness of a group, such as exchanging information and offering assistance. Undesirable behavior involves activities and action that inhibit the effectiveness of a group.

The cognitive approach to understanding cooperation focuses on a group of people working together to achieve a common goal. The relationship among their

individual goals affects the process and outcome of a group. Koffka (1935)and Lewin (1935; 1948) proposed the notion of social interdependence. Given that the outcomes of individuals' actions are affected by each other's actions, Koffka argued that groups are dynamic wholes in which the interdependence of members could vary. Lewin refined this notion by emphasizing the two "essences" of a group. The first essence is the "dynamic whole". Their interdependence can change the nature of a group as well as the state of the members within the group. The second essence is a shared common goal that motivates group members to work with joint efforts toward some accomplishment. Deutsch (1962) extended their work by focusing on the nature of relationships between the goals of individuals in a given social situation. He structured three types of social interdependence – positive, negative, and no interdependence – which largely determine how individuals interact with each other and the outcomes of those interactions. The belief that goals are positively interdependent tends to promote interactions, such as helping behaviors, challenging reasoning, encouraging, engaging, providing feedback, and exchanging resources. The belief of negative interdependence tends to produce competition rather than cooperation. No interdependence leads to an absence of interaction. Individuals interpret a situation or a task as cooperative when their goals are positively related to each other.

This study is built on Johnson and Johnson's (1996; 1998; 2005) understanding of cooperation. The basic elements of cooperation in this model are positive interdependence, promotive interaction, accountability, social skills, and group processing.

*Positive interdependence* refers to individuals linked with others so that one cannot succeed unless they all succeed. Everyone must coordinate efforts with one another to complete tasks. They understand that they sink or swim together through the interdependence of outcomes (goal and reward) and means (resource, task, and role).

*Accountability* is the sense of responsibility to contribute efforts to accomplish the common goals.

*Promotive interaction* is the effort to encourage each other to complete tasks and reach the common goal through providing help, exchanging information or resources, using other's opinion for decision making and achieving mutual benefits.

*Social skills* are needed for high quality cooperation. Members must trust each other, communicate accurately and unambiguously, accept and support each other, and resolve conflict constructively.

*Group processing* reflects group functions and supports the effectiveness of the members.

In summary, cooperation can be defined as individuals working interdependently and contributing efforts to achieve mutual benefit through active participation and communication.

### *Cooperative Work in Organizations*

Cooperation has benefits in both learning and working settings. Collaborative learning encourages learners to work together on academic activities and actively co-

construct knowledge through cooperation. In work environments, cooperative work involves sharing individual expertise, experience, and responsibilities in the pursuit of common goals. People often cooperate simply because of the limited capabilities of working individually (Schmidt, K., 1994). Cooperative work is seen as a design to achieve goals that cannot be accomplished individually, at least not as efficiently and effectively. There is evidence suggesting that cooperative performance is higher than individual performance when the work requires a broader scope of knowledge, judgments and opinions (Stewart & Barrick, 2000). Cooperation can lead to greater work satisfaction, higher productivity, more autonomy, positive attitudes towards the organization, and innovation (Griffin, Patterson, & West, 2001; Hoegl & Gemuenden, 2001; Tjosvold, Dean & Tsao, 1989). Importantly, cooperation contributes to the establishment of a continuous learning cycle (Hillebrand & Biemans, 2003). From Huber's (1991) information process view of organizational learning, cooperative work has great promise for organizational learning by providing more opportunities for information acquisition, information distribution, information interpretation, and collective information and understandings. Moreover, Un and Cuervo-Cazurra (2004) suggest that organizational knowledge is constructed through the interaction among individuals with different knowledge sets and expertise. They investigated the organization and team strategies for the creation of knowledge in organizations using surveys. They found that the project team strategy was as good as the organization strategy in facilitating the development of knowledge creation. They show that knowledge creating interaction occurs only when, first, individuals are willing to share their knowledge with others and, second, are able to understand one another. Both

conditions can be encouraged by using strategies. In other words, the possibility of knowledge exchange and for generating new knowledge is greater when individuals with diverse knowledge interact regularly. Their work provides support for the importance of interactions, and shows that cooperative work can facilitate knowledge creation and learning in organizations.

How do people work together in their everyday work practice? It is important to note that individuals who participate in common activities at the same time and place are not necessarily engaged in a cooperative process (Eaton, 1948). Putting people together to work does not guarantee they will cooperate, co-construct knowledge, create better performance, or produce superior outcomes. Individuals can choose various pathways to achieve the team goal: each individual could complete parts of the task or only few could finish the entire job for the group.

It can be argued that all work is cooperative, but in different degrees, based on interdependence with others to achieve success. The degree of cooperation varies, depending on how well individuals fulfill the five basic elements of cooperation.

First, cooperation cannot occur without interdependence. High interdependence occurs when members interact cooperatively and heavily depend on each other for information, materials, and reciprocal inputs and outcomes (Campoin et al., 1993). Bardram (1998) suggests three levels of cooperative activity based on the level of work interdependence: coordination, cooperation, and co-construction.

*Coordination* includes plans, procedures, and processes for managing tasks, activities, and resources. Although individuals may seem to be passively working together to achieve a common goal, coordination is necessary for all successful teamwork (Bardram, 1998).

*Cooperation* usually requires individuals to adjust their actions for the sake of the collective goal.

*Co-construction* is the highest level of interdependence, involving the negotiation and construction of meaning. It includes accepting divergent insights, reconstructing meanings and re-organizing new ways of working to achieve shared goals (Bardram, 1998).

The degree to which individuals work cooperatively can also vary by the levels and opportunities for interaction at work, including casual and loose interaction, unidirectional information sharing, and tightly coupled and well-structured teamwork. Neale, Carroll, and Rosson (2004) identified five levels of work coupling, based on the intensity of information sharing or level of communication required: light-weight interactions, information sharing, coordination, collaboration, and cooperation.

*Light-weight interaction* is casual social interaction at work, not necessarily related to any specific work tasks. For example, people meet in the hallway or stop by the coffee room at work for a chat.

*Information sharing* helps build and exchange contextual knowledge for developing understanding at work.

*Coordination* requires individuals to coordinate the processes of work.

*Collaboration* involves individuals working toward a common goal but doing so by completing separate tasks.

*Cooperation* demands a great amount of personal contact and quality of communication because many of the tasks are carried out concurrently as shared activities (Borghoff & Schlichter, 2000; Neale et al., 2004).

No matter what level the cooperative work, the central factors are the same – interdependence and interaction. Analyzing the communication, coordination, and cooperation needs in particular situations and generating alternative ways of fulfilling the interdependent needs provides useful insights for building cooperative work tools.

Cooperative work also requires adequate support so that people have a proper channel to interact efficiently and effectively in the pursuit of common goals. Information and communication technology can increase the ability to connect employees and enable functions within and across divisions, such as cross-functional workflow, horizontal coordination, and increased interdependence. Information technology does not guarantee a positive impact on communication processes due to individual variances and limitations of technology affordances (Driskell et al., 2003; Sarker & Sahay, 2002; Thompson & Coovert, 2003). The use of information and communication technology will contribute to employees' work if employees' work design supports communication across boundaries and information and communication technology aids in this communication (Stewart & Barrick, 2000).

*Recent Attempts at Measuring Cooperation*

Past research has sometimes over-simplified the concept of cooperation in operationalizing it, such as by using only a few items on survey measures. Tjosvold, Yu, and Hui (2004) investigated how groups learn from mistakes. They measured cooperation by asking participants to rate on a 7-point scale, ranging from strongly disagree to strongly agree, five statements about compatible and mutual goals. They reported that having a cooperative goal in a group promotes learning from mistakes because cooperation among group members can help them discuss their mistakes so that they have opportunities to develop new strategies to reduce the probability of reoccurrences. Tjosvold and Tsao (1989) conducted a study examining the relationships among cooperation, values, productivity, and organizational commitment using questionnaires. They measured cooperation by asking employees their perceptions of the extent they cooperated with co-workers and supervisors on five-point scales. Although the results showed positive relationships among those variables, we need to be wary about the conclusions and aware of the limitations of the study based on its simplified definition of cooperation. In a study of workplace change, Bacon and Blyton (2006) asked employees to rate cooperation between management and unions on a one-item five-point scale ranging from a high level of cooperation to a high level of conflict. They defined cooperation as a means to gain a degree of involvement in decision making. In this study, cooperation was narrowly defined as the opposite of conflict in decision making. The research conclusions drawn from these over-simplified definitions neglect the complex nature of cooperation.

Experimental research on cooperation primarily looks for behavioral indicators. In a study of cooperation under different conditions of tasks and reward interdependence, Wageman and Backer (1997) operationalized cooperation using observer ratings on the amount of cooperation within each experimental session on a scale from 0 (did not cooperate at all) to 4 (cooperated a great deal). Other observed behavioral indicators included the number of verbal interchanges and the time spent on a partner's article. Self-reported perceptions of cooperation on the task were also collected on the post-session questionnaire.

Sinclair (2003) also designed an experiment to study the mediation effect of cooperation between procedural justice and group effectiveness. Observers evaluated the cooperation of each group by viewing videotapes of group work, using a behavioral checklist, such as the frequency of offering suggestions to one another and asking for other's opinions. Observers also rated the cooperation level on a 10-item Likert scale on activities such as taking turns and discussing cooperative strategies. The sum of the frequencies of the behavioral checklist and the weights from the Likert-type scale items yielded an overall numerical rating for each team. The higher the score, the greater the cooperation. Their observation or rating approach looked at cooperation as an overall activity involving multiple people, actions, and interactions in different research contexts. This approach appears to have power in being able to capture the interactive and multiple aspects of cooperation and has greater face validity for representing cooperation than do the approaches that simply use surveys.

### *Information Technology*

Computer applications are becoming increasingly important for organizational functioning as technological improvements are being made and incorporated in to new information and communication systems. Research indicates information and communication technology has a significant moderating effect on several organizational factors, such as more flat and flexible structures, cultural impacts, and improving effectiveness (Dewett & Jones, 2001; Robey, D. & Boudreau, 1999). The influence of information and communication technology on organizations is expanding as the scope of these applications extends to new functions and departments. Several studies have shown a strong relationship between information and communication technology and vertical integration and horizontal diversification in organizations (Hitt, 1999). Information and communication technology significantly reduces the coordination cost in organizations (Argyres, 1999; Cordella & Simon, 1997; Dewett & Jones, 2001).

Fulk and DeSanctis (1995) argue that information and communication technology promotes vertical control for managerial practices of monitoring up-to-the-minute information from front-line workers to maintain centralized authority and control and enhance decision-making processes. Moreover, Hinds and Kiesler (1995) found that computer-mediated communication facilitates horizontal coordination and communication among different units of the organization by providing more awareness of the work and activities performed in other departments and giving decentralized authority without losing control.

Information and communication technology connects and supports individuals who have fewer chances to interact with others within an organization on a regular basis. Of course, different technologies have different affordances. Understanding how a technology is being used, we must take into account its affordances and constraints in supporting a certain task within a certain context (Fulk & DeSanctis, 1995).

*Information Technology and Cooperative Work*

Information technology connects individuals and supports cooperative work through a common space and computer-mediated communication (CMC) tools. The common space provides individuals virtual places to handle information, coordinate activities, share information, maintain an overview for planning and prioritizing, establish a common interpretation, and contribute expertise (Bardram, 1997; Bossen, 2002). Rafaeli and Ravid (2003) conducted an experimental study of information sharing via a CMC tool, email, in an organization and reported that sharing information through email within a team has a significantly positive impact on group performance. Suchman's ethnographic study (1995) and Prinz and Zaman's field study (2005) both pointed out the importance of making cooperative work visible to others through creating representations of work in shared work spaces. The high interdependence of group work requires more coordination among members, costing more in terms of capital cost, communication cost, and time. Research shows that the use of information and communication technologies can reduce coordination costs (Cordella & Simon, 1997). Hinds and Kiesler (1995) found that individuals who have relatively more interdependent work tend to use information

and communication technology more often. However, technology that is improperly utilized can also increase coordination costs (Hitt, 1999)

However, some studies show contradictory results, revealing some challenges in supporting cooperative work in computer-mediated environments. Some have found difficulties in maintaining positive social interdependence and supporting the process of negotiation of meanings among individuals.

Dirskell, Radtke & Salas (2003) studies of virtual group processes found that distance did matter and technological mediation had a strong impact on group processes and performance. They found that technological mediation had a negative effect on group cohesiveness; it affected interpersonal bonds, normative bonds, and instrumental bonds among the group members. Technological mediation also blocked status information and made it difficult for group members to communicate with each other (Driskell et al., 2003).

Thompson and Coovert (2003) found that computer mediated communication tools reduced the accuracy of decision recording and led to difficulty establishing and maintaining common ground. The results showed that when people engaged in computer conferences, they recorded their group decisions less accurately than in face-to-face situations. Sarker and Sahay (2002) also observed that unpredictable computer mediated communication is highly associated with group members' leaving for an extended period of time and their failing to communicate their absence beforehand. Computer-mediated communication adversely affects team outcome satisfaction. It seems to have an even larger negative effect on group process satisfaction. Current technologies, designed for

functional cooperation, often fail to support group dynamics and team formation in virtual environments (Thompson & Coovert, 2003).

*Research attempts at Computer-Supported Cooperative Work (CSCW)*

There is a growing body of research on computer-supported cooperative work (CSCW). Bannon & Schmidt (1989) define CSCW as an agenda to understand the requirements and the nature of cooperative work practice; its primary purpose is designing computer technologies to support cooperative work. From their perspective, CSCW is concerned with using technology to help people work together more effectively. Hutchins (1996) also suggests two characteristics of CSCW: the support of cognitive artifacts of a team and the support of member behaviors. For example, computer-based patient record systems can be considered cognitive artifacts because they are shaped by the way that healthcare professionals obtain, organize, and reason with their knowledge (Pratt, Reddy, McDonald, Tarczy-Hornoch, & Gennari, 2004).

Studies in CSCW are often qualitative case studies with thick descriptions in an effort to develop common themes and patterns. Some use quantitative surveys of subjective measures of individuals' perceptions about the use of technology. Vandenbosch & Ginzberg (1996/1997) used interviews and surveys in a study of the impact of a groupware technology, Lotus Notes, on cooperation. To measure the degree of cooperation, they used a scale that focused on the potential interdependencies and opportunities for cooperation found in the organization. They measured individual and organizational impacts using a survey. However, they found no significant change in the

degree of cooperation among individuals within the organization following the implementation of the Lotus Notes.

Downing and Clark (1999) used surveys and interviews to understand the effect groupware technologies have had on consulting firms. Their primary interest was in comparing the expected and realized benefits from implementation of groupware technologies. Their results showed a lack of enthusiasm for the new technology. The researchers attributed this low level of acceptance, in part, to the difference between expected and realized results. All the companies had high expectations for success in terms of increased communication, increased client or customer service, competitive advantage, cost savings, higher productivity, and leveraging expertise. However, several organizations reported no or little benefit as measured by those factors.

Findings about the effects of technology to support cooperative work are inconsistent. Limitations in research methods used in the past leave many questions unanswered. It is still unclear how and to what extents the use of technology supports or limits cooperative work.

*Research attempts at Organizational Learning and Information Technology*

Information systems are potentially powerful tools for facilitating organizational learning. They can support information distribution and interpretation, provide a space for a knowledge repository, and provide mechanisms to transform collective knowledge into a set of standards and routines that everyone within the organization can follow (Edberg & Olfman, 2001). Robey, Boudreau, and Rose's (2000) review of previous

research identified two main streams of research about the use of information technology for organizational learning. The first used organizational learning as a means for implementing information technology in the organization; the second examined how information technology has been designed and used to support organizational learning. Although these two research streams are mostly pursued independently, Robey and colleagues suggest that the two streams are closely linked (Figure 2.3).

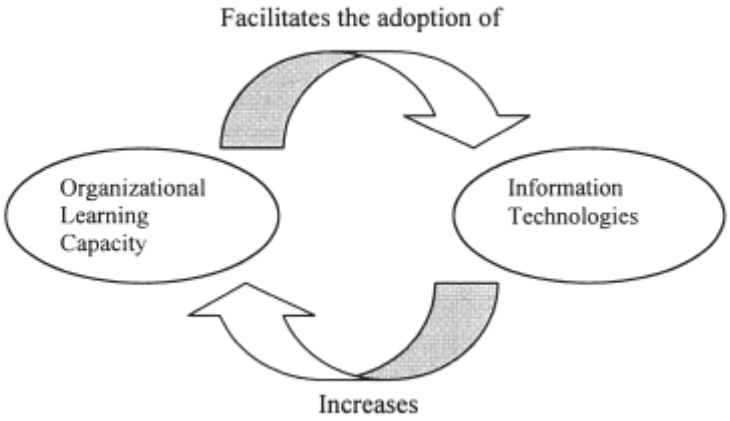



Figure 2.3 Relationship between the two research streams (Robey, et al., 2000, p.128)

The interest of this study, similar to the second stream, was to understand in what ways information technology can be an enabler to support the process of organizational learning and knowledge management within an organization. Advances in information technology provide ways to support organizational learning though capturing, representing, storing, and retrieving data in networked databases. Communication is critical to organizational learning because members must contribute to and share information in various contexts and must communicate with each other to build common understandings (Crossan et al., 1999; Holmberg, 2000; Huber, 1991). New forms of

technology make communication and discourse among members more efficient and effective (Robey, Daniel et al., 2000). Communication technologies make each member's interpretations and problems more easily accessible by other members, enabling them to reconcile competing interpretations of the situation. The proliferation of powerful information systems in cooperative work settings and their interconnection in comprehensive high-capacity networks provide the technological foundation to facilitate and enhance the exchange of information across organizational and professional boundaries (Huber, 1991; Schmidt, K., 1994). Information systems both reduce the costs of recording knowledge and experiences of individuals and transforming them into organizational routines and memory, and gives members greater and quicker access to organizational memory, particularly in distributed work environments (Dewett & Jones, 2001).

Hutchins (1996) argued that organizational cognition is widely distributed among humans and artifacts. Learning in organizations depends partially on enabling technologies, but the use of technologies in practice may vary widely, depending upon the specific task, the participants involved, and the contextual conditions (Robey, Daniel et al., 2000). Chou (2003) used survey instruments to study the relationships between organizational learning computer systems (OLCS) and the organizational learning process. He defined OLCS as computer systems that are used to facilitate organizational learning. Both OLCS and organizational learning process were measured with a 9-item scale developed for this study. The findings suggested the use of OLCS did have a positive impact on organizational learning.

Lines (2005) conducted a study using survey instruments. He measured organizational learning by using a 4-item Likert type scale developed for this study. He found that actions performed by change agents and employee participation were positively associated with organizational learning. The influence of the actions performed by change agents was negatively moderated by participation. Real, Leal, & Roldan (2006) studied the role of information technology in organizational learning and the impact of organizational learning on technological distinctive competencies, such as the technological capability of product innovation and project management and perceived business performance. Using the model of organizational learning developed by Crossan et al. (1999), they measured organizational learning with a survey with 50 items developed by Bontis et al. (2002). Information technology was measured with an IT scale with 11 items developed by Gold et al. (2001). The findings indicated that information technology had a significant effect on organizational learning; both information technology and organizational learning had significant effects on the development of technological competencies. Further, organizational learning and technological competencies had significant effects on business performance, while information technology did not. Although information technology was an important ingredient in the design of the learning organization, the findings showed it was not sufficient for maintaining and generating competitive advantages and performance.

Past studies often use survey instruments in order to examine the effects of technology use. Surveys have helped to examine the relationship between technology use and organizational learning, but more research is needed to more fully understand how technology use contributes to or constrains organizational learning.

### *Research Challenges*

The review of literature in chapter 2 highlights several research problems and challenges for understanding how individuals use technology to cooperate with each other and how the use of technology and cooperative work contribute to organizational learning.

There are inconsistent findings about the effects of information technology on cooperative work and organizational learning. The reasons for the inconsistent findings may be that different research approaches have been used to study different aspects of the issue. Measurement problems stemming from a lack of validated instruments may also contribute to the inconsistent findings because they have not clearly defined the issues or have overlooked important contextual factors such as how the technologies are used or how work activities are carried out.

It is unclear in what ways and to what extent the use of information technology helps and hinders cooperative work and organizational learning. Most past research in cooperative work used survey instruments and examined the constructs through self report of perceptions or attitudes about group work. While organizational learning can be considered a perceptual construct (Bontis et al., 2002), cooperation is an attribute of behavior and needs to be investigated though examination of the ways individuals communicate, coordinate, and negotiate meaning. Research employing only survey instruments is limited in assessing these cooperative and interactive actions.

We need to bear in mind the situated nature of organizational learning. No matter which model we choose to explain organizational learning, learning occurs unintentionally as well as intentionally. Individuals often learn through everyday work practices in work settings rather than from formal training programs or other official interventions in an organization (Robey, Daniel et al., 2000). Learning in the workplace is primarily motivated by the everyday dilemmas and needs involved in work activities. Given the right conditions and the right support, these dilemmas can be occasions for second loop learning. Thus, there is a need to study how everyday work practice contributes to organizational learning.

Technology use is a complex construct and no single measure is appropriate for all purposes and applications (Dolla & Torkzadeh, 1998). Cuellar, McLean, and Johnson (2006) define information system use as "the extent to which an information system is incorporated into the user's business processes" (p.165). The "user" can be an individual, group, or organization. Viewing the use of technology as a process of enactment in organizations enables a deeper understanding of the constitutive role of work practices in the ongoing use and change of technologies in the workplace (Orlikowski, 2000).

The use of technology is often measured by the frequency of usage, either subjectively or objectively. Give the potential problem of measuring only the volume of use, the depth and type of technology use seems to be a better and more appropriate indicator for describing how technology is used by individuals working on cooperative tasks in organizations. The types of technology use, rather than the volume of use, may better explain outcomes in real work settings.

It may be valuable to consider differences in the attributes of use and pay attention to the richness of organizational contexts. System use is not always completely a user's free choice (Brown, Massey, Monotoya-Weiss, & Burkman, 2002). The technology may be the only option given to individuals to complete a certain task. Under this circumstance, users are forced to adopt the technology; this type of usage may not have as strong an influence on individual and organizational learning as usage based on technology freely appropriated by the user (Iivari, 2002).

The present study used an innovative method for identifying technology use and cooperative work. To gain a deeper understanding about individuals' actions and interactions, the tools, and the reasons for the activities within a complex organization, there is a need to go back to the fundamental unit of analysis to look at the activity that occurs within an organization and connects individual members. Leont'ev (1979) defined activity as a "unit of life that is mediated by mental reflection" (p. 46) and characterized it as a reciprocal transformation between subject and object. Norman (2005) defined activity as "a coordinated, integrated set of tasks" (p.14). Geyer et al (2006) defined activity as "a logical unit of work that incorporates all the tools, people, and resources needed to get the job done" (p.720). This study used activity as the unit of analysis for studying the use of technology, the nature of cooperative work in a computer-mediated environment, and the effect on organizational learning.

### *Patient Safety and Event Reporting in Health Care*

This study examined technology use, cooperative work and organizational learning in the context of patient safety and event reporting in a health care organization.

In 1999, the Institute of Medicine estimated that each year 44,000 to 98,000 people die of an iatrogenic injury, either as a main or a contributing cause, and that 1.3 million are injured by medical treatment. Medical errors cause momentous morbidity and mortality to patients. Patient safety has become an important concern of many healthcare stakeholders. Patient safety requires a culture that emphasizes and values safety and cooperative and systematic efforts by all staff to prevent any errors from reoccurring. It has been recommended that all health professionals be educated to deliver patient-centered care as members of an interdisciplinary team (Suresh et al., 2004).

A key process in achieving patient safety is the ability to learn from errors. Within a high risk healthcare environment the occasion of a safety event is difficult to predict. However, the front-line practitioners who spend the most time with patients are most likely to observe and encounter those safety events. Not surprisingly, not many of these events are recognized as learning opportunities during the heat of the crisis (Naidu & Oliver, 1999). To help practitioners recognize safety events that afford learning opportunities for members and the organization, many health care organizations explicitly or implicitly encourage health care professionals to report medical related adverse events as a means to monitor patient care quality and to learn from those events for future prevention.

With the help of advancing networked computer technology, safety event reporting systems have become a critical part of health care information systems. Moreover, the Institute of Medicine (IOM) Committee on Quality of Health Care in America has identified a critical role for information technology for health care systems

that produce care that is "safe, effective, patient-centered, timely, efficient, and equitable." Many hospitals have started using electronic reporting systems as an attempt to improve patient safety and monitor health care quality. Additionally, researchers have demonstrated that the use of web-based, anonymous, and voluntary reporting systems tend to have better results in promoting patient safety across a variety of clinical settings (Dominguez & Portnoy, 2004). An implicit goal of these systems is for practitioners to work together to report safety events and work with managers to identify root causes and safety solutions. Through this cooperative process, collective knowledge and organizational learning are expected when practitioners interact and communicate with each other for developing common understanding.

The nature of reporting is a form of organizational learning that provides a means for new knowledge creation and information distribution as well as the construction of common understandings about patient safety in the hospital (Liu, Laffey, & Cox, 2007). Event reporting can be seen as the process by which a knowledge base is created. Through event reporting, individuals have a chance to continuously examine and monitor their own behavior and experience. The event reporting procedures, rules, and norms reflect shared common understandings among practitioners about event reporting in the organization. The continuous improvement is a shared vision of patient safety that all the members hope to achieve by working as a team and learning from each other. The hope is that individuals see the problems or events from a systems perspective and look for systems improvement. Information systems facilitate the process by which new understanding is negotiated, shared, and stored for future use.

### *Chapter Summary*

Organizational learning relies heavily on communication and information sharing among members and groups for the continuous development of new knowledge and understanding that form organizational memory. In other words, organizations learn through the activity of the individuals within them. In the patient safety reporting context, organizations learn from individuals' experience of reporting, sharing, investigating, and resolving safety events for continuous safety improvement and future error prevention. Past research shows group work and cooperation often promote interaction and thus provide more opportunities for information sharing, communication, and negotiation of meaning among individual members. Therefore, cooperation has great potential to facilitate organizational learning. However, the degree of cooperation often varies depending on the setting. True cooperation can only be reached when all five elements are in place: Positive Interdependence, Promotive Interaction, Social Skills, Accountability, and Group Processing. In patient safety reporting, it is still unclear how health care professionals cooperate with each other for safer practice and to what extent each cooperation element influences organizational learning. Moreover, the use of information technology has been shown to support organizational learning and cooperation in organizations. However, the findings are inconsistent. The development and implementation of PSN provides an opportunity to further examine and investigate how and to what extent the use of technology influences cooperation and organizational learning.

# CHAPTER 3

# METHODOLOGY

# CHAPTER III

## METHODOLOGY

### *Introduction*

This chapter begins with an overview of the context of this study of an electronic patient safety reporting system at the University of Missouri Health Care. The research design describes the process of operationalizing and examining the three main constructs of the study: technology use, cooperation, and organizational learning. Finally, this chapter outlines the process for data analysis to answer the research questions.

### *Context of the Study*

#### *Implementation Site: University of Missouri Health Care (UMHC)*

This study was carried out within the context of University of Missouri Healthcare (UMHC). UMHC supports the education and research missions of the University of Missouri and provides an extensive health care network. Approximately 6,000 health professionals provide care and treat patients from every county in the state. This network consists of hospitals, located in three cities, 49 outpatient clinics located across the state, several affiliate hospitals, and a broadly linked Missouri Telehealth Network as shown in Table 3.1.

Table 3.1

Characteristics of University of Missouri Health Care (Figg, 2007)

| **Characteristics UMHC** |
|---|
| o **UMHC system:**<br>- University Hospital: Level I trauma center; a 280-bed facility<br>- Children's Hospital: 36-bed specialized pediatric services<br>- Regional Hospital: a 185-bed community hospital<br>- Ellis Fischel Cancer Center<br>- University Physicians: 49 clinics<br>- Missouri Rehabilitation Center: 124-bed<br>- Telehealth sites throughout Missouri<br><br>o **Academic Affiliates:**<br>- MU School of Medicine<br>- MU Sinclair School of Nursing<br>- MU School of Health Professions<br><br>o **Affiliates:**<br>- Rusk Rehabilitation Center<br>- Capital Region Medical Center in Jefferson City<br>- Cooper County Memorial Hospital in Boonville |
| **Patient Service - Fiscal Year 2006** |
| o Patient admission: 20,411<br>o Patient days of care: 127,913<br>o Clinic visits: 580,308<br>o Emergency and trauma center visits: 39,366<br>o Major surgical operations: 17,913<br>o Cardiac catheterization procedures: 10,706<br>o Radiology exams and treatments: 267,483<br>o Laboratory tests: 1,395,212<br>o Pharmacy orders: 6,091,662<br>o Patients transported by helicopter: 1,131 |

In 2000 the University of Missouri Health Care (UMHC) developed an electronic event reporting system, Patient Safety Network (PSN), to improve the quality of healthcare services. PSN is a web-based, cooperative, voluntary, event reporting system that allows staff to report comments, patient safety events, and near-miss events from any computer with access to the Internet. PSN has been implemented across all hospitals and

clinics within UMHC for the past five years. More than 15,000 patient safety events have been reported.

Any hospital staff member (including physicians, nurses, pharmacists, technicians, admissions staff, and guest service workers) who has a valid employee ID can log into the PSN to submit comments and reports. Reports can be submitted with information identifying the reporter or anonymously. PSN also allows staff members to submit comments – events not related to medical care – such as comments on food, parking, billing, and comfort. An example of using PSN for patient safety reporting and resolution is shown in *Appendix A: Use of PSN for Patient Safety Reporting and Resolution*.

The focus of this study was patient safety events, including medical errors, near misses, or adverse events. According to Chang, Schyve, Croteau, O'Leary, and Loeb's taxonomy (2005), patient safety events can be classified into five primary dimensions:

1. impact
2. type
3. domain
4. cause
5. prevention and mitigation

In the context of this study of the PSN at UMHC, a patient safety event was limited to two elements: the impact on the patient and the domain of an event. The impact to a patient refers to whether an event affected a patient and the extent to which this event

caused harm or potential harm to a patient at the time of reporting. The domain of the event was classified by the patient safety officers in UMHC to eight specific event types.

1. Blood Bank/Coagulation Lab
2. Medication Reaction
3. Procedure/test/treatment
4. Equipment/device
5. Medication/IVs
6. Skin Impairment
7. Fall
8. All other events not covered in the list were classified as Miscellaneous.

A patient safety event is defined as an event that has the risk of endangering a patient or the process of patient care. Whenever a staff member working in the hospital witnesses such an event, the staff member has the choice of reporting it through the PSN. A report usually requires patient identification, information about whether a patient was harmed, details about where and what happened, and the responsible departments that can help resolve the event. The report also allows those using the system to provide suggestions for solutions, based on their professional knowledge and personal experience with the event.

Once a report is submitted, it is distributed to the managers in the departments selected in the report. An email notification is automatically generated and sent to the managers to notify them of the new event report and the need for resolution. The PSN requires managers to resolve the event and to file a report detailing the actions that have

been taken to resolve the problem. Those who submit the original report can track the progress of the event resolution through the PSN. An example of the reporting and resolution artifact is shown in *Appendix B: Example of a Patient Safety Report*.

The purpose of this study was to build new knowledge about how health care professionals cooperate in event reporting for patient safety and how their use of the PSN influences perceptions of organizational learning. The overall goal was to build new knowledge about how information technology can influence the process of cooperation and organizational learning.

### *Statement of the Research Questions*

1. How do members use the PSN to report and resolve safety events?
2. In what ways and to what extent do members use the PSN to cooperate for patient safety?
3. In what ways and to what extent do staff members perceive that the organization learns through the use of the PSN?
4. In what ways and to what extent does the level of cooperation in the use of PSN influence members' perception of organizational learning?
5. In what ways and to what extent does the use of PSN help people work more cooperatively?
6. In what ways and to what extent does the use of PSN influence members' perception of organizational learning?

## *Methods*

### *Research Design*

This study employed a mixed-methods research design using multiple data sources and analysis techniques to triangulate the findings. Both quantitative and qualitative data were collected, analyzed and triangulated to answer the research questions (Creswell, 2005).

### *Unit of Analysis and Sample*

The unit of analysis in this study was a patient safety activity. An activity may involve multiple actors and processes undertaken at multiple times and across departments through the use of common artifacts, patient safety reports, in a shared virtual work space, the Patient Safety Network (PSN). An activity was defined as a set of work that incorporates all the tools, people, and resources needed to accomplish the task (Geyer et al., 2006). The goal of the study was to understand the reporting and resolution activity across the possible range of actions and under the types of conditions in which the participants function, and within the constraints of the real setting (Norman, 2005). A limitation of this study was that the operational unit of analysis included only the aspects of reporting and resolution that are captured by the PSN.

The study examined the ways and the extent to which the PSN was used to support the cooperative work of reporting and resolving patient safety events and the ways and the extent to which the use of this technology contributed to organizational learning. Analyzing the data at the level of reporting and resolution activities allowed an

examination of how members' actions and interactions can be characterized as cooperative acts and how they contributed to a sense of organizational learning. The target sample for this study included the Patient Safety Reports (PSR) officially closed by all involved parties between June 15 and October 31, 2007. The total number of PSRs during this time frame was approximately 1,300 cases.

*Data Collection*

The data for this study were obtained from:

1. The records of patient safety event reporting and resolution captured in the PSN; that is, a log of action and interaction during the course of the activity, and
2. Surveys sent to those who made reports in the PSN to follow up on their experience and perceptions of organizational learning after reporting an event.

Table 3.2 provides an overview of the data collection activities related to each of the three key constructs: technology use, cooperation, and organizational learning.

Table 3.2

Data Collection Methods

| Construct | Technology Use | Cooperation | Org. Learning |
|---|---|---|---|
| **Data Collection** | Logs and records of patient safety activity in the PSN | Patient safety reports in the PSN | Follow-up survey |

*Instrument*

*Technology Use.* Previous research on the ways individuals transform technological artifacts, systems, and meanings in everyday work practice has examined system use in two ways: subjective measures, through self-reported data, or objective measures, through computer records (Straub, Limayem, & Karahanna-Evaristo, 1995). Subjective data often involve self-estimated ratings of the frequency and length of time users spend on various applications. Computer-recorded data can reveal both the actual amount and the extent of use of systems rather than subjective estimates, through server logs, database entries and records. Thus, computer-recorded data are often used to describe user behavior for system improvement efforts and developing business decisions support (Araya, Silva, & Weber, 2004; Boving & Simonsen, 2004).

In the PSN, members' actions were recorded and represented by the final product, a Patient Safety Report (PSR). Since the focus of this study was on member behaviors around reporting and resolving patient safety events, the data elements stored in PSRs and history logs (see Table 3.3) were of particular importance. PSRs and the history log files stored in the PSN were used as empirical sources for assessing how people used the PSN for each patient safety activity.

Table 3.3

User Actions within Each PSR

| Abbreviation | Description | Formula |
|---|---|---|
| TT | Time spent on reporting | The time spent within PSN on reporting an event in minutes. |
| TR | Time to resolution | The number of days to complete and close a PSR |
| ND | Number of departments selected | The number of responsible department(s) selected by the reporter to review and resolve the event. |
| NA | Number of total actions taken | The number of actions-taken selected for an event. |
| NH | Number of total history records | The number of history records in the history log |
| WE | Number of total characters in event details | The number of characters used in describing the event details |
| WS | Number of total characters in suggestion | The number of characters used in providing suggestion. |
| WA | Number of total characters in additional info | The number of characters used in additional information to this event. |
| WR | Number of total characters in resolution | The number of characters used in describing resolution details |
| RE | Ratio of optional fields used during reporting | The total umber of optional fields used during reporting divided by the total number of possible optional fields in the reporting process. |
| RS | Ratio of optional fields used during resolution | The total number of optional fields used divided by the total number of possible optional fields in resolution. |

*Cooperation.* Cooperation has been measured in various ways in prior research. Some have used a single item (Bacon & Blyton, 2006), while others use indices. Measures often vary, depending on the context. Moreover, because of the dynamic nature of cooperation, much of the previous research has used a qualitative approach, using

thick descriptions to illustrate the dynamics and interrelations of members. Another common qualitative method to capture the dynamics and interactions of members is observation, using observer-ratings to look for cooperation indicators (Sinclair, 2003; Wageman & Baker, 1997). In the context of patient safety reporting, conducting experiments or making observations in the field were not feasible due to the unpredictable nature of when safety events occur. In the context of this study, a systematic approach was undertaken prior to the data collection process, following Rourke and Anderson's (2004) procedure for developing a theoretically valid protocol (Figure 3.1) for testing and measurement. The purpose of this procedure is to use a structured protocol development process to achieve analysis validity by developing a set of rules to help researchers make accurate and consistent judgments based on observable variables extracted from a specific domain and theory.

| **Steps for developing a theoretically valid protocol** |
|---|
| 1. Identify the purposes of the coding data.<br>2. Identify behaviors that represent the construct<br>3. Review the categories and indicators<br>4. Hold preliminary tryouts<br>5. Develop guidelines for administration scoring and interpretation of the coding scheme. |

Figure 3.1 Steps for Developing a Theoretically Valid Protocol (Rourke & Anderson, 2004)

*Step 1: Identifying the purposes of the coding data*

The first step in developing the coding rubric was to identify the purpose of the coding data. One of the main goals of this study was to identity the level of cooperation

for each event report activity. Given the focus on cooperation and the nature of the data in this study, Schmidt and Simone's (1996) notion of a "coordination mechanism" was chosen to help examine the cooperation data more systematically. Schmidt and Simone's coordination mechanism consists of two components: the coordination protocol and the artifact. The coordination protocol refers to an integrated set of procedures and the plans for task interdependencies; the artifact is a stipulation of protocol in a situation-independent manner that provides a shared space to reflect the state of the execution of the protocol and maintains mutual awareness among actors. For example, the coordination mechanisms for patient safety with the PSN in the UMHC included the procedures and artifacts shown in Table 3.4. There are certain procedures and activities that staff need to follow for a patient safety event. Each patient safety report submitted in the PSN serves as the common artifact that reflects the status and maintains the shared understandings of the event among the reporter and resolution managers.

Table 3.4

Example of Coordination Mechanism for Patient Safety Reporting With the PSN

| | **Coordination Protocols** | **Artifacts** |
|---|---|---|
| 1 | A staff member identifies an event that harms or has the potential to harm a patient. | |
| 2 | A staff member reports this event with patient info, harm score, event type, event details, suggestion, and selected departments. The report can also be submitted anonymously. | Event details and background information |
| 3 | After an event submission, a staff member can track the progress of the event. | Submission history |
| 4 | The managers in the responsible departments receive a notification indicating a new event needs resolution. | New report |
| 5 | The managers and/or designated resolvers in the departments review the report and change the status of the resolution. | Event details and report status |
| 6 | The mangers and/or designated resolvers in the departments investigate and resolve the event. | Event resolution and additional information |
| 7 | The managers and/or designated resolvers in the departments review other departments' resolutions and actions | Resolution details |
| 8 | The staff member receives an email notification when the event is resolved | Resolved report |
| 9 | OCE monitors and reviews all patient safety reports and resolutions | Report tracking and follow up |

After the coordination mechanism was built, the major roles, artifacts, and protocols of event reporting and resolution were identified (see Figure 3.2). There are three different roles in coordinating and reporting a patient safety event at UMHC: the reporter, managers and/or designated resolvers in the responsible departments, and the patient safety officers in the Office of Clinical Effectiveness (OCE). The most important common artifact was the completed patient safety report. The artifacts of patient safety reports were recorded as PSRs in the computer-mediated environment, the PSN.

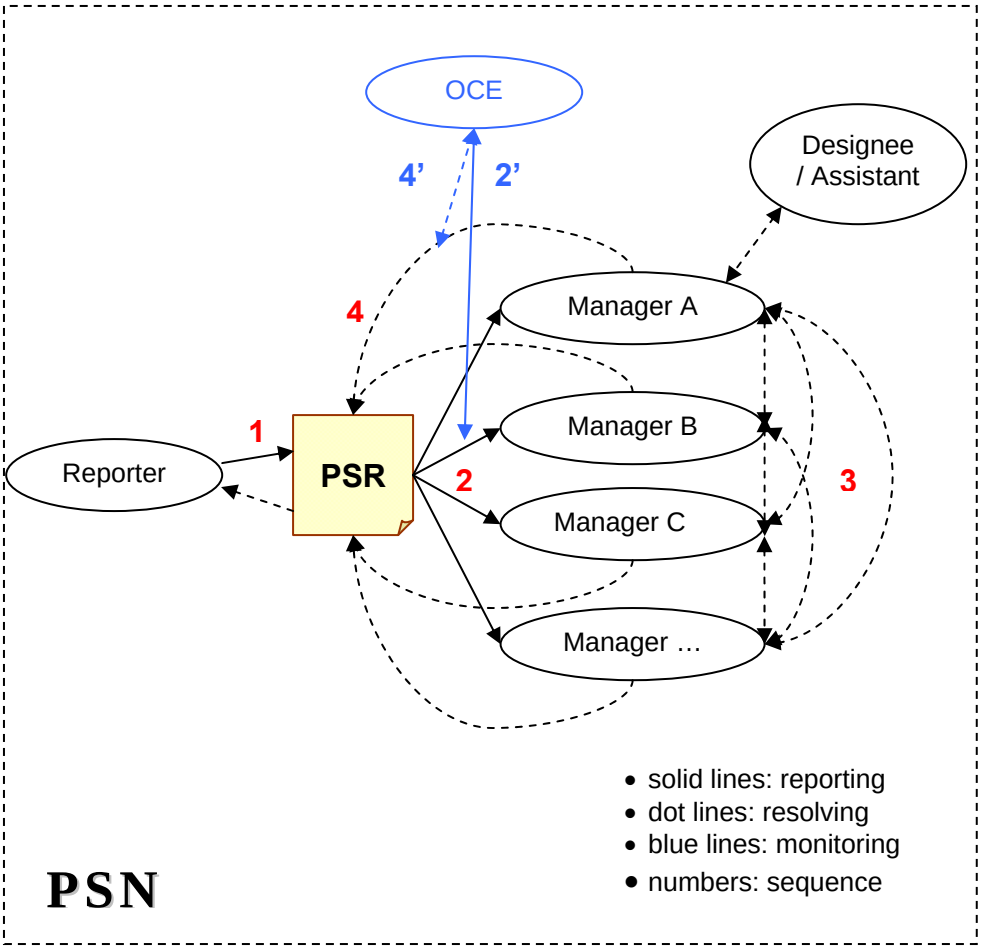



Figure 3.2 Graphic Representation of Coordination Mechanism for Patient Safety Reporting

Following analysis in step one, the PSRs were identified as the critical artifacts that capture the dynamic aspects of patient safety reporting and coordination protocols and therefore critical to understanding cooperation in patient safety events. These presented the data to examine for evidence of cooperation in patient safety events.

*Step 2: Identifying behaviors that represent the construct*

After identifying the key cooperation data source, the PSRs, the next step was to identify observable indicators of cooperation in the PSR that were sufficiently distinct from each other and covered the range of narrative content. A set of 10 randomly-selected PSRs was given to a consultant who is experienced in patient safety and health care. Given the five basic elements of cooperation defined by Johnson and Johnson (2003) – positive interdependence, accountability, promotive interaction, social skills, and group processing – the consultant was asked to independently review each PSR using a think-aloud approach to identify indicators of the elements of cooperation represented in the PSR. The researcher took notes during the think-aloud process, looking for the indicators and the logic of the consultants' decision-making processes.

Within the context of this study, *positive interdependence* is seen when individuals recognized their interdependence and the need to work together to achieve safer practices. An example of high positive interdependence is found in the case of a report about a power outage causing several OR rooms to have improper air exchange so that many patients that were receiving surgery have to be sent to infection control. The narrative of the report described a need to involve other departments working together to solve a problem. This example shows the reporter recognizes that a breakdown in a small part of the system, such as fan malfunction, can result in potential patient harm; thus, the problem has to be addressed across all involved departments as soon as possible to manage the event and to prevent it from happening again.

*Accountability* is seen when individuals recognized that reporting is an important responsibility and were willing to contribute their efforts to help achieve safer practices,

such as reporting with one's identify and profession for easier follow-ups and stronger credibility of the report.

Given the linear nature of coordination via the PSN (e.g., reporters are not allowed to edit and add comments once a PSR is submitted), *promotive interaction* is seen when those who make a report encourage and initiate positive interactions with managers and/or designated resolvers who are in a position to resolve the problem. An example of promotive interaction is when a therapist not only reports an incorrect diet was served to a patient but also provides suggestions of a new color-coded bracelet system for the patients who are under a modified diet plan which could help prevent similar events from happening again in the future. This example shows the reporter's attempt to promote interactions with resolvers to initiate a brainstorming opportunity for constructing possible solutions.

While those who make the report can passively review and follow the actions taken by the managers through the PSN, *social skills* are seen when those who resolve the reports make an effort to help others understand an event and show support for each other in resolving a problem. An example of high social skills is found in a case of teletracking not working properly which caused patient surgery delay. The resolver added more information to the report about the event after talking to the staff, investigated the cause of the event (such as staffing shortages), acted to fix the problem (such as filling the vacant position), and provided guidance to the reporter about how they could properly act if similar events happen again.

*Group processing* is defined as the time and effort managers devote to investigating and resolving a safety event. An example of good group processing is when one resolver went through the investigation process and finished the resolution within ten days resulting in an improvement team being formed for reviewing and discussing the procedure or protocol that needed to change. The average of ten days indicates the resolver investigates and solves the problem in a timely fashion. The strategy of improvement team being formed shows the resolver led and acted on cooperating with other experts for solving the problem.

Based on these definitions, the elements of the coordination mechanism in patient safety reporting, and notes from observing the consultant, the researcher identified eleven observable variables to operationalize cooperation in a PSR (see Table 3.5). For each variable, four different cooperation levels were outlined, from low to high. Thus, an initial analytic rubric was developed. A higher score shows a higher level of cooperation.

Table 3.5

Factors and Indicators of Cooperation in PSRs

| | | |
|---|---|---|
| **Positive interdependence** | | |
| **Definition** | Individuals feel linked with others; they realize that one cannot succeed unless they all do what they should and/or that one must coordinate one's efforts with the efforts of others to complete tasks. They understand that they sink or swim together through the outcome (goal and reward) or means (resource, task, and role). | |
| **PSR Indicator(s)** | System perspective and impacts in the organization | Individuals recognize the interdependent relationship with others. They are aware that a safety event can't be solved alone and believe reporting an event can result in a positive impact on the organization as a whole. |
| | Organization Reporting Expectation | Patient safety expectation of reporting from the organization or management. |
| **Accountability** | | |
| **Definition** | A sense of responsibility for contributing one's efforts to accomplish the common goals. | |
| **PSR Indicator(s)** | Anonymity | An event report is disclosed without a reporter's identity |
| | Event Description | An event is provided with accurate and complete information that expedites resolutions. |
| **Promotive interaction** | | |
| **Definition** | Efforts are used to encourage and facilitate each other to complete tasks and reach the common goal, such as providing help, exchanging information or resources, seeking other's opinions for decision making, achieving mutual benefits, etc. | |
| **PSR Indicator(s)** | Tone of Reporter | An event is neutrally and objectively described using facts without assigning blame. |
| | Constructive Suggestions | Constructive and reasonable suggestions to an event are provided. |
| **Social skills** | | |
| **Definition** | Skills needed for high quality cooperation where members mutually trust each other, communicate accurately and unambiguously, accept and support each other, and resolve conflict constructively. | |
| **PSR Indicator(s)** | Appropriate and congruent resolution | Reporter's perspective and opinions are valued and adapted to make fair judgments for achieving resolution. |
| | Shared Resolution | Clear and sufficient resolution and information details are shared with others. |
| | Acknowledgement of others | Resolvers recognize and acknowledge the contributions of others |
| **Group processing** | | |
| **Definition** | A group functions and supports the effectiveness of the members. | |
| **PSR Indicator(s)** | Actions Taken | The types of resolution actions taken by managers |
| | Resolution Process | The time and efforts devoted to achieving resolution by managers. |

*Step 3: Reviewing the categories and indicators*

The initial rubrics were presented to two OCE experts to evaluate content validity by examining the indicators and the levels for each criterion. Based on their feedback, a revised rubric was created.

*Step 4: Holding preliminary tryouts*

A preliminary tryout was conducted using 30 cases randomly selected from the PSN prior to June 15. Both the content expert consultant and the researcher applied the rubric to analyze these 30 cases independently. Following Neuendorf (2001), problematic categories and values were identified by looking at a matrix that compared coding for the two raters. The two raters then convened to discuss differences as well as any other questions related to the use of the rubric for analysis of the cases. After deliberation on the results, some item descriptions were modified to further clarify the measurement of the indicator. Some indicators were relabeled and some indicators were moved to other categories. The rubric for assessing cooperation levels and describing cooperation patterns in a PSR was then finalized (*Appendix C: Cooperation Rubric for Evaluating a PSR*).

*Step 5: Developing Guidelines for administration, scoring, and interpretation of the coding scheme*

A code book, including the coding instructions, codes, definitions, decision trees, scoring rubrics, examples, exercises, and notes, was developed by the researcher (see *Appendix D: Cooperation Code Book for Evaluating a PSR*). A face-to-face training was

completed to ensure each researcher could independently use the code book and apply the rubrics to the cases.

Having completed the five step process above, the scoring rubric instrument yielded a set of reasonable observable indicators to analyze the data and identify the level of cooperation in each case, based on the five core parameters described above: positive interdependence, promotive interaction, accountability, social skill, and group process.

*Organizational Learning.* Organizational learning is a dynamic process of continuous development in knowledge and capacity, both individually and collectively. The Organizational Learning Survey (OLS) developed by Goh and Richard (1997) was chosen to measure organizational learning in this study. The OLS assesses five organizational characteristics and management practices: clarity of vision, leadership, experimentation, transfer of knowledge, and teamwork with 21 items. The items use a seven-point Likert-type scale (1=strongly disagree to 5=strongly agree).The OLS has a reported Cronbach's alpha of 0.90 (Goh, Swee C. & Richard, 1997). The survey questions were modified to fit the context of this study, based on recommendations from the content expert consultant. The final questions are shown in *Appendix E: Organizational Learning Survey*.

*Procedure*

The sample for this study included the reports in the PSN meeting the following criteria:

- Cases that were related to patient safety within the UMHC, not including comments.
- Cases that were officially closed between June 15, 2007 and October 31, 2007.

To assess an individual's perception of organizational learning after making a report in the PSN, a cross-sectional survey was implemented to gather data describing staff members' attitudes, opinions, and perceptions of organizational learning after participating in a patient safety activity with the PSN. The URL to the web-based survey was included in the email notification (as shown in *Appendix F: Email Notification for a Resolved Report with Survey URL*) sent to the staff member who submitted reports meeting both criteria listed above. In this post-session survey, staff members were asked to rate their perceptions of organizational learning based on their experiences with the specific patient safety event reporting just concluded. They also have an option to provide additional text comments about their experience in the survey. The survey is shown in *Appendix G: Organizational Learning Online Survey*. An average score for each dimension was used to represent and describe their perceptions of organizational learning after their use of the PSN. The five scores were used in an inferential statistical analysis. The text comments were collected for content analysis.

Next, the cases with voluntarily returned OLS surveys were examined for cooperation and technology use. First, content analysis using the Cooperation Rubric was conducted to analyze the data and identify the level of cooperation in the cases for which staff members had returned an OLS survey. The purpose of the content analysis was to establish scores for cooperation indicators within a PSR by applying the rubric.

There were two coders for this content analysis. Before coding began, coders received the code book and completed a face-to-face training session on using the rubric to identify types and levels of cooperation evident in a PSR. Coders were also encouraged to take notes while coding cases.

The scores for each case were entered into SPSS for analysis. Inter-rater reliability was calculated to ensure consistency among raters. Following guidelines by Krippendorff (2004), inter-rater reliability was calculated at two points in the analysis. First, prior to the start of the study, a pilot reliability assessment was conducted to validate the instrument, using a randomly-selected sample of 30 cases from the data set. Inter-rater reliability was calculated at a later point in the analysis on a second randomly-selected sample of 30 cases that both raters coded. This procedure allowed the researchers to validate the instrument and improved its application to the data analysis. After the content analysis was completed, the scores formed a profile that described and characterized cooperation evident in this set of reports. In addition to coding each case, based on the rubric described above, qualitative notes were made about cooperation patterns in each PSR.

To assess how people used the PSN for each patient safety activity, Patient Safety Reports (PSR) and the history log files stored in the PSN were examined and extracted directly using server and database queries. A PSN use profile was built for each activity to describe the ways and extent to which those making reports used the PSN to create a common artifact (the PSR). An example is shown in *Appendix H: Example of Technology*

*Use of a Patient Safety Report*. A more detailed view is can be found *Appendix I: Examples of Detailed Users' Actions in Action in the PSN*.

*Data Analysis*

Data analysis began with screening for missing cases. Next, data were screened for linearity, homoscedasticity, and uni- and multi-variate normality. Descriptive statistical analysis was then used to understand the frequency and tendency of each data set, such as overall use patterns, cooperation levels, and perceived organizational learning capability after using the PSN. The validity and reliability of the instruments used in this study were also examined before further analysis. To understand the potential non-response bias, descriptive statistics were conducted comparing valid cases, non-respondent cases, and the target sample by different types of background variables.

Table 3.6

Data Analysis Strategies

| | Research Question | Analysis Strategy |
|---|---|---|
| 1 | How do members use the PSN to report and resolve safety events? | o Descriptive statistics to describe the overall use.<br><br>o Principle component analysis to categorize and reduce user actions into dimensions |
| 2 | In what ways and to what extent do members use the PSN to cooperate for patient safety? | o Content Analysis using the cooperation rubric to describe cooperation in the PSN.<br><br>o Descriptive statistics to describe the overall cooperation in the PSN<br><br>o EFA analysis for factor loadings |
| 3 | In what ways and to what extent do staff members perceive that the organization learns through the use of the PSN? | o Descriptive statistics to describe the overall individuals' perception toward organizational learning |
| 4 | In what ways and to what extent does the level of cooperation in the use of PSN influence members' perception of organizational learning? | o Correlation analysis to describe the relationship between cooperation and organizational learning |
| 5 | In what ways and to what extent does the use of PSN help people work more cooperatively? | o MANOVA analysis to look at the effects of different types of use on cooperation |
| 6 | In what ways and to what extent does the use of PSN influence members' perception of organizational learning | o MANOVA analysis to look at the effects of different types of use on organizational learning |

Table 3.6 is a summary of data analysis strategies for each research question. The first step to answer research question one was the use of descriptive statistics to describe the overall tendency of technology use behaviors. Next, principle component analysis (PCA) was used to categorize and describe how the staff used the technology to report and resolve events in patient safety. This method is often used to discover structures in data and aims at categorizing different actions into similar and coherent dimensions that

can maximally distinguish the attributes and characteristics of the dimensions. In this study, PCA used the observed technology use behaviors to identify types of technology use.

To answer research question two, content analysis was used to rate cooperation levels within each activity. A profile with the five cooperation parameters was built to characterize the cooperation levels among practitioners during an activity. Descriptive statistics were applied to illustrate cooperation patterns that emerged from the data collected. Exploratory factor analysis (EFA) was used as the first attempt to explore the validity of the cooperation rubric as well as the factor structure of cooperation in this study. The higher factor loading of an observed indicator, the more it contributed to cooperation.

To answer research question three, descriptive statistics were used to describe the perception of organizational learning after a patient safety report. Correlation analysis was used to explore the overall relationships between the cooperation factors and organizational learning factors for research question four. To answer research questions five and six regarding the impact of technology use on cooperation and organizational learning, a MANOVA analysis was used to analyze the mean differences among observed variables across the different levels of technology use. Tukey's posterior tests were conducted for pairwise analysis. Lastly, content analysis was applied to analyze the additional text comments from the OLS survey to find evidence that can help explain or clarify the quantitative results. A deductive approach was chosen to place each text comment into one of the three main categories: technology, cooperation, and

organizational learning. Comments that did not relate to the three constructs were coded as "Other" and were excluded in this study.

### *Chapter Summary*

This chapter describes the context of this study, the sample, the data collection, and the data analysis strategies. This study took place at UMHC using two primary data sources: patient safety reports and follow-up surveys. The sample included the patient safety reports submitted between June 15 and October 31, 2007. Each report was the unit of analysis in this study. Profiles of technology use and cooperation of patient safety reporting were built for each report. Next, a follow-up survey was sent to the person who submitted the report, once the report was officially closed, to obtain his or her perceptions of organizational learning after using the PSN. Technology use was analyzed by descriptive statistical techniques and principle component analysis to reduce indicators into meaningful dimensions that can be used to describe the characteristics of practitioners' actions. Correlation analysis was used to analyze the relationship between cooperation and organizational learning. MANOVA analyses were used to examine the effects of technology use on cooperation and organizational learning.

# CHAPTER 4

# RESULTS

# CHAPTER IV

## RESULTS

### *Introduction*

The purpose of this study was to understand how health care professionals cooperate with one another through the use of a web-based system for patient safety reporting, investigation, and resolution. The study examined the variables of technology use, cooperation, and organizational learning as well as the relationships among them. Technology use was measured by members' behaviors around reporting and resolving a safety event which were captured through the event log and database of PSN. Cooperation among the reporter and resolvers was assessed through a systematic process of examining patient safety reports. Organizational learning was measured by a post-event reporting survey asking reporters' perceptions of organizational learning. This chapter presents the results of data analysis and findings for the research questions posed in Chapter 1.

### *Data Screening and Analysis of Respondent Cases*

#### *Data Screening*

A total of 141 cases were initially available for analysis. Eighteen reports were excluded because some individuals completed more than one survey. (Staff members could submit more than one report and more than one survey.) If an individual submitted

multiple cases and multiple surveys, only one submission was randomly selected for further data analysis.

The second step in data screening was to examine the creation date of all cases. Substantial changes were made in the PSN between version 2 and version 3. One case submitted before implementation of version 3 of the software was eliminated. The third step involved managing missing data. Two cases with less than 80% of the survey completed were excluded. Missing values in the remaining cases were random, amounting to less than 1% of the data. Mean values were substituted for the missing data. Finally, univariate and multivariate outliers were eliminated. Univariate outliers were identified using standardized Z scores in excess of 3.29 ($p<.001$, two-tailed test). Multivariate outliers were examined using a Mahalanobis distance of $p<.001$, evaluated as a Chi-Square value with degrees of freedom equal to the number of variables. The cases with a Mahalanobis distance greater than 55.476 ($df=27$, $p<.001$) were considered multivariate outliers. Seventeen univariate and multivariate outliers were excluded from this study.

*Descriptive Analysis of Respondent Cases*

After data screening, 103 cases remained in the pool for data analysis. Table 4.1 shows descriptive statistics for the four variables: facilities, profession of the reporter, harm scores, and event types. More than half of the cases were submitted through University Hospital (52.4%); over a quarter (26.2%) came from Columbia Regional Hospital; nearly one in six came from Missouri Rehabilitation Center (14.6%). Only a few came from Ellis Fischel Cancer Center (3.9%) and University Physicians (2.9%).

The vast majority (68%) of those submitting reports were Registered Nurses (RN). Almost all the cases reported (85.8%) involved patients, but the majority (53.4%) did not result in harm to the patients; only a quarter (26.2%) reported minor changes in patient status (with harm score 1). Only a small percentage (6.8%) of the reports indicated changes in a patient's vital signs. A small percentage of the cases (7.8%) were considered "near misses," events that were caught before they reached the patients, including 2.9% that were considered high risks and 4.9% that were low risks. Another small percentage (5.8%) was classed as Control Drug Variance, which involved medication/pharmaceutical issues that did not directly involve patients. Most of the cases were categorized as involving an actual or potential fall (27.2%), a medication or IV error (21.4%), or miscellaneous other events (23.3%).

Table 4.1

Description of Cases for This Study

| Condition Variable | N | % |
|---|---|---|
| **I. Facility** | | |
| University Hospital (UH) | 54 | 52.4 |
| Columbia Regional Hospital (CRH) | 27 | 26.2 |
| Missouri Rehabilitation Center (MRC) | 15 | 14.6 |
| Ellis Fischel Cancer Center | 4 | 3.9 |
| University Physicians -Clinics | 3 | 2.9 |
| **II. Reporter Profession** | | |
| Registered Nurse (RN) | 70 | 68.0 |
| Licensed Practical Nurse (LPN) | 15 | 14.6 |
| Other | 4 | 3.9 |
| Manager | 2 | 1.9 |
| Radiology Technician | 2 | 1.9 |
| Respiration Therapist | 2 | 1.9 |
| Nurse Technician | 1 | 1.0 |
| Nursing Student | 1 | 1.0 |
| Occupational Therapist | 1 | 1.0 |
| Speech Therapist | 1 | 1.0 |
| Unit Clerk | 1 | 1.0 |
| Pharmacist | 1 | 1.0 |
| Physical Therapist | 1 | 1.0 |
| Missing/Blank | 1 | 1.0 |
| Total | 103 | 100.0 |

| Condition Variable | N | % |
|---|---|---|
| **III. Harm Score** | | |
| 0 | 55 | 53.4 |
| 1 | 27 | 26.2 |
| 2 | 4 | 3.9 |
| 3 | 2 | 1.9 |
| 4 | 0 | 0.0 |
| 5 | 1 | 1.0 |
| Control Drug Variance | 6 | 5.8 |
| Near Miss - Low | 5 | 4.9 |
| Near Miss - High | 3 | 2.9 |
| **IV. Event Type** | | |
| Fall | 28 | 27.2 |
| Miscellaneous | 24 | 23.3 |
| Medication/IVs | 22 | 21.4 |
| Procedure/Test/Treatment | 7 | 6.8 |
| Skin Impairment | 6 | 5.8 |
| Control Drug Variance | 6 | 5.8 |
| Equipment/Device | 6 | 5.8 |
| Medication Reaction | 2 | 1.9 |
| Blood/Blood Products | 2 | 1.9 |
| Total | 103 | 100.0 |

*Analysis of Response Rate*

The examination of response rate began with examining the differences in the respondent cases and the sample pools (see Table 4.2). The sample pools represent the maximum number of staff members, PSRs, and resolutions that could be selected in this study. There were total 1,340 PSRs, including 128 anonymous reports, reported by 599 staff members and officially closed with 2,038 resolution action reports between June 15 and October 31, 2007.

The response rate by the number of subjects was approximately 17.2%. The response rates for both PSRs and resolutions were approximately 8.5% and 8.2%. Anonymous reports were excluded from this study.

Table 4.2

Overall Response Rates

| | Number of Respondent Cases | Number of Sample Pools | Response Rate |
|---|---|---|---|
| Number of Subjects | 103 | 599 | 17.2% |
| Number of PSRs | 103 | 1,212 | 8.5% |
| Number of Anonymous PSRs | 0 | 128 | 0.0% |
| Number of Resolutions | 168 | 2,038 | 8.2% |

Next, differences in characteristics of valid respondent cases and the sample pools were explored. Table 4.3 shows the detailed comparisons. The last column "Representative % of Valid Respondent Cases" was calculated by the number of valid cases divided by the number of sample pool. It showed how representative the cases in this study were of the total sample pool. It averaged 6.9-13.0% across the different characteristics. This analysis suggests that generalization of the findings in this study to the full sample should be done with caution.

Table 4.3

Analysis of Characteristics for Valid Cases and Target Sample

| Characteristics | Valid Respondent Cases | | Sample Pool | | Representative % of Valid Respondent Cases |
|---|---|---|---|---|---|
| | N | % | N | % | |
| **I. Facility** | | | | | Ave: 9.7% |
| University Hospital (UH) | 54 | 52.4 | 790 | 59.0 | 6.8% |
| Columbia Regional Hospital (CRH) | 27 | 26.2 | 275 | 20.5 | 9.8% |
| Missouri Rehabilitation Center (MRC) | 15 | 14.6 | 212 | 15.8 | 7.1% |
| Ellis Fischel Cancer Center | 4 | 3.9 | 23 | 1.7 | 17.4% |
| University Physicians -Clinics | 3 | 2.9 | 40 | 3.0 | 7.5% |
| **II. Reporter Profession** | | | | | Ave: 13.0% |
| Registered Nurse (RN) | 70 | 68.0 | 841 | 62.8 | 8.3% |
| Licensed Practical Nurse (LPN) | 15 | 14.6 | 87 | 6.5 | 17.2% |
| Other | 4 | 3.9 | 74 | 5.5 | 5.4% |
| Manager | 2 | 1.9 | 49 | 3.7 | 4.1% |
| Radiology Technician | 2 | 1.9 | 23 | 1.7 | 8.7% |
| Respiration Therapist | 2 | 1.9 | 36 | 2.7 | 5.6% |
| Nurse Technician | 1 | 1 | 6 | 0.4 | 16.7% |
| Nursing Student | 1 | 1 | 5 | 0.4 | 20.0% |
| Occupational Therapist | 1 | 1 | 5 | 0.4 | 20.0% |
| Speech Therapist | 1 | 1 | 2 | 0.1 | 50.0% |
| Unit Clerk | 1 | 1 | 4 | 0.3 | 25.0% |
| Pharmacist | 1 | 1 | 20 | 1.5 | 5.0% |
| Physical Therapist | 1 | 1 | 14 | 1.0 | 7.1% |
| Missing/Blank | 1 | 1 | 59 | 4.4 | 1.7% |
| All other professions on the list | 0 | 0 | 115 | 8.6 | 0.0% |
| **III. Harm Score** | | | | | Ave: 6.9% |
| 0 | 55 | 53.4 | 574 | 50.3 | 8.2% |
| 1 | 27 | 26.2 | 247 | 18.4 | 10.9% |
| 2 | 4 | 3.9 | 93 | 6.9 | 4.3% |
| 3 | 2 | 1.9 | 51 | 3.8 | 3.9% |
| 4 | 0 | 0.0 | 9 | 0.7 | 0.0% |
| 5 | 1 | 1.0 | 6 | 0.4 | 16.7% |
| Control Drug Variance | 6 | 5.8 | 122 | 9.1 | 4.9% |
| Near Miss - Low | 5 | 4.9 | 54 | 4.0 | 9.3% |
| Near Miss - High | 3 | 2.9 | 84 | 6.3 | 3.6% |
| **IV. Event Type** | | | | | Ave: 8.5% |
| Fall | 28 | 27.2 | 188 | 14.0 | 14.9% |
| Miscellaneous | 24 | 23.3 | 364 | 27.2 | 6.6% |
| Medication/IVs | 22 | 21.4 | 262 | 19.6 | 8.4% |
| Procedure/Test/Treatment | 7 | 6.8 | 244 | 18.2 | 2.9% |
| Skin Impairment | 6 | 5.8 | 49 | 3.7 | 12.2% |
| Control Drug Variance | 6 | 5.8 | 122 | 9.1 | 4.9% |
| Equipment/Device | 6 | 5.8 | 57 | 4.3 | 10.5% |
| Medication Reaction | 2 | 1.9 | 19 | 1.4 | 10.5% |
| Blood/Blood Products | 2 | 1.9 | 35 | 2.6 | 5.7% |
| Total : | 103 | 100 | 1340 | 100 | |

### *Reliability and Validity Analysis of Instruments*

The validity and reliability of the instruments used in this study, the Organizational Learning Survey and the Cooperation Rubric, were examined before conducting further analysis.

*Organizational Learning Survey*

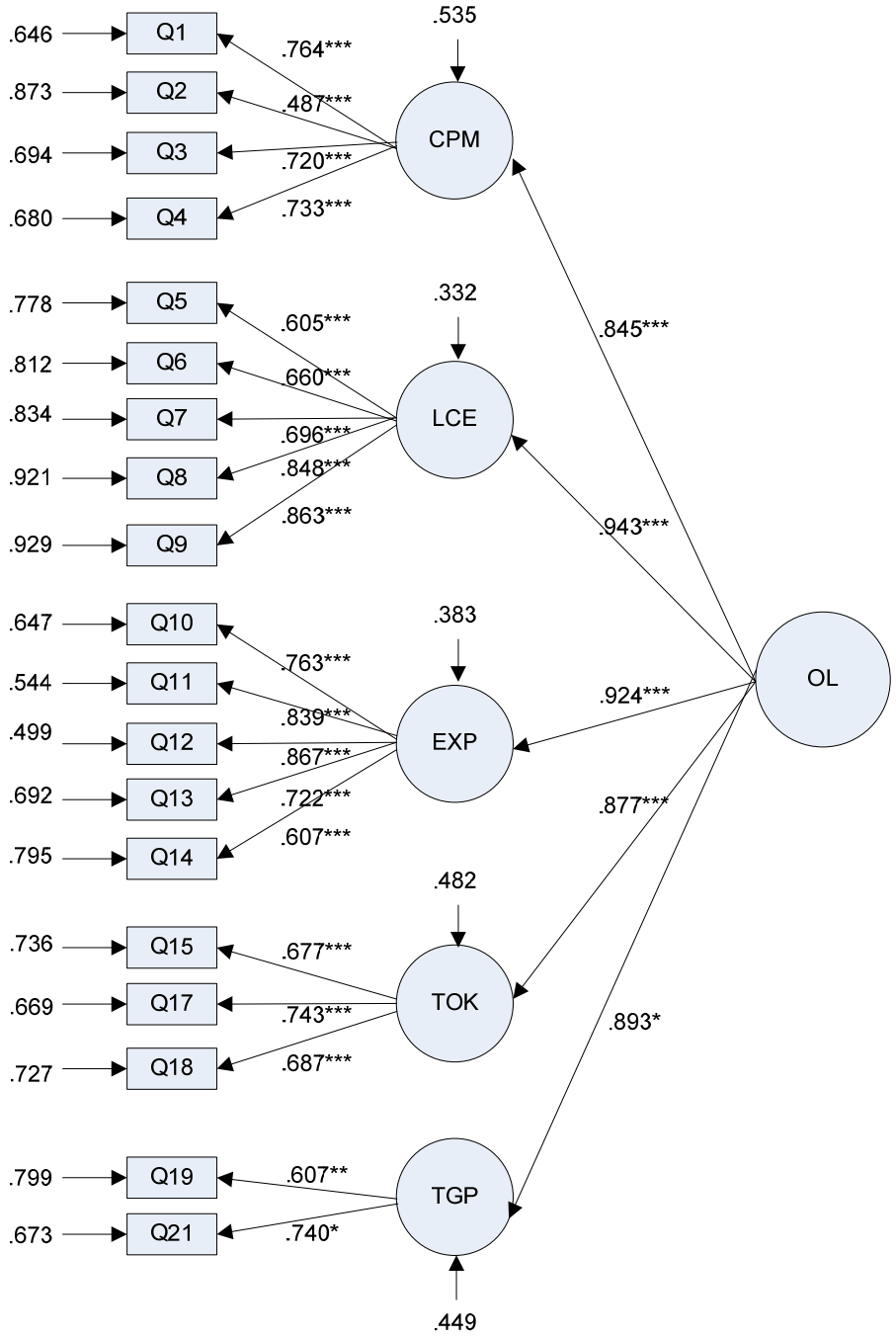
Since the Organizational Learning Survey (OLS) by Goh and Richard (1997) was modified to fit the context of this study, it was appropriate to reassess the reliability and validity of the revised scale before further analysis. Cronbach's Alpha was used to assess the degree of reliability of the scales. It measures how consistent the scale items are inter-correlated with one another. A value of 0.70 or higher is considered good; 0.60 is usually considered a minimum. Items with low reliability were removed to improve internal consistency of the scale variables. For example, item 16 was removed to improve the reliability of the factor Transfer of Knowledge (TOK) from 0.682 to 0.746. Item 20 was removed to improve the reliability of the Teamwork and Group Problem Solving (TGP) factor from 0.565 to 0.614. The final reliabilities of the factors are shown in Table 4.4.

Table 4.4

Reliability Analysis for Organizational Learning Survey

| OLS Variables | Question Items | Cronbach's Alpha |
|---|---|---|
| Clarity of Mission and Vision (CMV) | Q1, Q2r, Q3, Q4 | .763 |
| Leadership Commitment and Empowerment (LCE) | Q5r, Q6, Q7, Q8, Q9 | .852 |
| Experimentation (EXP) | Q10, Q11, Q12, Q13, Q14r | .868 |
| Transfer of Knowledge (TOK) | Q15, Q17, Q18 | .746 |
| Teamwork and Group Problem Solving (TGP) | Q19, Q21 | .614 |

After establishing the internal consistency of the OLS scale, the quality of factors within the scale was also examined. The quality of a factor or a construct is often judged by its reliability and validity. The improved index of construct reliability coefficient by Hancock and Mueller (2001) was chosen to estimate construct reliability using standardized loadings. The construct validity is indicated by the amount of standardized variance extracted by the constructs. A Confirmation Factor Analysis (CFA) was used to test the validity and structure of the OLS measurement model. The CFA results are shown in Figure 4.1. Most of the path coefficients are significant at the $p<.001$ level. Only the paths related to Teamwork and Group Problem Solving (TGP) were significant at a lower level. Additionally, the Comparative Fit Index (CFI) showed the CFA model fit to be 0.909 and the Goodness of Fit Index (GFI) was 0.894. The Root Mean Square Error of Approximation (RMSEA) was 0.079, less than 0.10. The Standardized Root Mean Square Residual (SRMR) was 0.068, less than 0.09. Thus, the overall result shows a good model fit.




* Path coefficient is significant at the 0.05 level
** Path coefficient is significant at the 0.01 level
*** Path coefficient is significant at the 0.001 level

Figure 4.1 Graphic of CFA Results

More detailed results of the measurement level are shown in Table 4.5.The R-square values indicate the variance in each item that is accounted for by the correspondent OLS construct. Standardized loadings in Table 4.5 show the path coefficients in Figure 4.1. Residuals indicate errors; more specifically, the square root value of a residual is the path coefficient of the error for the item, as shown in Figure 4.1.

In the construct level, construct variance extracted and construct reliability were calculated using the standardized loadings (Hancock & Mueller, 2001). Variances extracted for the five OLS variables account for the variance for 45.44% to 58.55% of the items. Most factors indicate strong construct reliability, ranging from 0.7483 to 0.8944, greater than the general guideline of 0.70. The Teamwork and Group-Problem Solving (TGP) factor has a weaker construct reliability of 0.6398.

Table 4.5

Construct Reliability and Validity Analysis for Five Factors in the Organizational Learning Survey (N=103)

| OLS Items | R-Square | Standardized Loading | Residuals | Construct Variance Extracted | Construct Reliability |
|---|---|---|---|---|---|
| **Clarity of Mission and Vision (CMV)** | | | | | |
| Q1: There is widespread support and acceptance of the UMHC's mission statement for improving quality of patient safety. | 0.583 | 0.764*** | 0.417 | 0.4691 | 0.7980 |
| Q2: I do not understand how the UMHC mission of improving the quality of patient safety is to be achieved. | 0.237 | 0.487*** | 0.763 | | |
| Q3: The UMHC's mission statement in quality/patient safety identifies values around event reporting in which all employees must conform. | 0.518 | 0.720*** | 0.482 | | |
| Q4: I have opportunities for self-assessment with respect to the UMHC goal of patient safety through event reporting. | 0.537 | 0.733*** | 0.463 | | |
| **Leadership Commitment and Empowerment (LCE)** | | | | | |
| Q5: Top management in UMHC resist change and are afraid of new ideas that are obtained from event reporting. | 0.366 | 0.605*** | 0.605 | 0.5500 | 0.8859 |
| Q6: Top management and employees in the UMHC share a common vision of work to be accomplished in patient safety through event reporting. | 0.436 | 0.660*** | 0.660 | | |
| Q7: Managers in UMHC can accept criticism without becoming overly defensive for issues related to patient safety reports. | 0.484 | 0.696*** | 0.696 | | |
| Q8: Managers in UMHC provide useful feedback that helps to identify potential problems and opportunities in patient safety and event reporting. | 0.719 | 0.848*** | 0.848 | | |
| Q9: Managers in UMHC frequently involve employees in important decisions related to patient safety and event investigation/resolution. | 0.745 | 0.863*** | 0.863 | | |

| OLS Items | R-Square | Standardized Loading | Residuals | Construct Variance Extracted | Construct Reliability |
|---|---|---|---|---|---|
| **Experimentation (EXP)** | | | | | |
| Q10: I can often bring new ideas into UMHC through patient safety reporting. | 0.582 | 0.763*** | 0.418 | 0.5855 | 0.8944 |
| Q11: From my experience, people who are new in UMHC are encouraged to question the way things are done for patient safety improvements. | 0.704 | 0.839*** | 0.296 | | |
| Q12: Managers in UMHC encourage team members to try new ideas in order to improve work processes related to patient safety and event reporting. | 0.751 | 0.867*** | 0.249 | | |
| Q13: Innovative ideas in event reporting are often rewarded by management. | 0.521 | 0.722*** | 0.479 | | |
| Q14: In my experience, new ideas raised from event reporting are not treated seriously by management. | 0.368 | 0.607*** | 0.632 | | |
| **Transfer of Knowledge (TOK)** | | | | | |
| Q15: After a safety event, I often have an opportunity to talk to other staff about successful experiences or work activities in order to understand why they succeed. | 0.459 | 0.677*** | 0.541 | 0.4941 | 0.7483 |
| Q17: New work processes related to enhancing patient safety that may be useful to UMHC as a whole are usually shared with all employees. | 0.552 | 0.743*** | 0.448 | | |
| Q18: We have a system that allows us to learn successful practices related to patient safety events from other organizations. | 0.472 | 0.687*** | 0.528 | | |
| **Teamwork and Group-Problem Solving (TGP)** | | | | | |
| Q19: Current organizational practice encourages employees to solve problems related to patient safety and event reporting together before discussing them with a manager. | 0.362 | 0.601** | 0.638 | 0.4544 | 0.6398 |
| Q21: Most problem solving groups or committees related to patient safety in UMHC feature employees from a variety of functional areas. | 0.547 | 0.740* | 0.453 | | |

* Path coefficient is significant at the 0.05 level
** Path coefficient is significant at the 0.01 level
*** Path coefficient is significant at the 0.001 level

The overall latent factor, Organizational Learning, accounts for 80.47% of the variance in the five individual factors and the reliability is 0.9536 (Table 4.6).

Table 4.6

Construct Reliability and Validity Analysis for the Latent Factor Organizational Learning (N=103)

| Factors in Organizational Learning Scale | R-Square | Standardized Loading | Residuals | Construct Variance Extracted | Construct Reliability |
|---|---|---|---|---|---|
| Clarity of Mission and Vision (CMV) | .714 | .845*** | .286 | | |
| Leadership Commitment and Empowerment (LCE) | .890 | .943*** | .110 | | |
| Experimentation (EXP) | .853 | .924*** | .147 | .8047 | 0.9594 |
| Transfer of Knowledge (TOK) | .768 | .877*** | .232 | | |
| Teamwork and Group-Problem Solving (TGP) | .798 | .893* | .202 | | |

* Path coefficient is significant at the 0.05 level
** Path coefficient is significant at the 0.01 level
*** Path coefficient is significant at the 0.001 level

The results show that the modified OLS scale has good reliability. The CFA results also indicate high construct reliability and validity for each of the five factors as well as the latent OLS factor. Thus, it is appropriate to use this scale and factors for data analysis.

*Cooperation Scoring Rubric Instrument*

Content analysis is commonly used to study computer mediated communication, learning processes, knowledge construction, and negotiation of meanings in online environments (Beers, Boshuizen, Kirschner, & Gijselaers, 2007). In this study, content analysis was used to examine the levels of cooperation in each event in the PSN.

The cooperation rubric developed in the pilot stage was also examined before further analysis. Following the guidelines of Krippendorff (2004, p. 227) and Neuendorf (2001, p. 146), inter-rater reliability was assessed at two points in time during the analysis process. Before formal data analysis, the pilot inter-rater reliability was established using 30 cases randomly selected from the sample. Both coders rated all 30 cases independently. Minor wording changes in the rubric were made, and the overall percent agreement reached 0.827 (item level range from .72 to 1.00). Based on the changes, all the 30 cases were then recoded using the revised rubric before the final analysis. The final reliability assessment was done on another set of 30 cases randomly selected from the sample. The overall percent agreement was .843.

According to Rourke and Anderson (2004), the first step to ensure the validity of a rating rubric is to follow a systematic development process and then by gathering empirical evidence in follow-up studies using correlations, comparisons or interventions.

A cooperation rubric was developed, based on Johnson and Johnson's five cooperation elements (1996; 1998; 2005), following the Five Steps of Developing a Theoretically Valid Protocol by Rourke and Anderson (2004). Cooperation in the context of this study was first analyzed using the Coordination Mechanism (Schmidt, K. & Simone, 1996) and operationalized by identifying behaviors representing each construct, reviewing and evaluating, holding preliminary tryouts, and developing guidelines for coding.

Exploratory Factor Analysis (EFA) was chosen to assess the validity of the scoring rubric. EFA examines the correlation matrix to determine the number of factors

and to determine which observed variables are indicators of each factor. The EFA uses principle axis factoring extraction. Varimax rotation was conducted on the eleven PSN cooperation indicators to determine the extent to which the indicators meet the five-factor structure. Indicators with factor loading greater than .30 and which did not load on more than one factor were retained. The indicators that did not meet the criteria were removed, one at a time. The EFA analyses were repeated until a solution was achieved that all the remaining items met all criteria in the analysis. The two indicators removed were Event Description and Actions Taken. Using Eigenvalues greater than 1 and more than one indicator per factor, the remaining nine indicators yielded a four-factor structure that explained 73.22% of the variance. The Social Skills factor accounted for the most variance (24.629%), followed by Positive Interdependence accounting for 13.014% of variance and Promotive Interaction for 9.107% of variance. Indicators in Accountability and Group Processing were merged into one factor labeled Accountable Group Processing and accounted for 6.884% of variance. Factor structure and loadings are shown in Table 4.7.

Table 4.7

Factor Structure and Loadings for Cooperation Indicators (N=103)

| | Factor Loadings | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| | **Social Skills** | **Positive Interdependence** | **Promotive Interaction** | **Accountable Group Processing** |
| Mean Shared Resolution | 0.868 | | | |
| Mean Proper and Congruence Resolution | 0.827 | | | |
| Mean Narrative of Resolvers | 0.804 | | | |
| Beyond Organization Reporting Expectation | | 0.657 | | |
| Systems Perspective and Impacts to the Organization | | 0.643 | | |
| Tone of Reporter | | | 0.643 | |
| Constructive Suggestion | | | 0.574 | |
| Anonymity | | | | 0.562 |
| Mean Resolution Process | | | | 0.410 |

Overall, the results show good reliability for applying the cooperation rubric to the content analysis and provide support for the factor structure, with a fair amount of variance extracted. The factor scores of the four cooperation factors were used for further analysis.

### *Analysis of Technology Use*

To answer the first research question "*How do members use the PSN to report and resolve safety events?*", the first step was to use descriptive statistics to describe the overall Technology Use based on the 11 indicators recorded in the database and history logs. The use patterns were summarized by conducting principle component analysis to maximize the variance extracted.

*Research Question One: Descriptive Analysis of Technology Use*

It took staff members an average of 11.86 minutes of time in PSN to enter a safety report; it took an average of 11.65 days to investigate and resolve an event (see Table 4.8). Each PSR involved an average of 1.63 departments and 1.68 actions to achieve resolution. An average of 2.75 activities was recorded in the history log in a PSR. An average event description was 417 characters in length; the average length of a suggestion was 109 characters. Resolution reports were much shorter, by comparison, with an average of 70 characters of additional information and 128 characters in providing the resolution details. Over three-fourths of the optional fields (77%) were used by the staff members for reporting a safety event; only 26% of the optional fields were used by those who were responsible for resolutions.

Table 4.8

Descriptive Statistics for Technology Use Indicators (N=103)

| Technology Use Indicators | Abbr. | Mean | Std. | Min | Max |
|---|---|---|---|---|---|
| Reporting Time (minutes) | TT | 11.86 | 9.196 | 1.45 | 62.92 |
| Resolution Time (days) | TR | 11.65 | 22.749 | 0.00 | 147.15 |
| Number of Department | ND | 1.63 | 0.792 | 1.00 | 4.00 |
| Number of Action | NA | 1.68 | 0.831 | 1.00 | 4.00 |
| Number of Activities in History Log | NH | 2.75 | 2.359 | 1.00 | 11.00 |
| Number of Characters in Event Description | WE | 417.49 | 282.137 | 31.00 | 1,361.00 |
| Number of Characters in Suggestion | WS | 109.2 | 98.844 | 0.00 | 464.00 |
| Number of Characters in Additional Info | WA | 70.42 | 141.789 | 0.00 | 690.00 |
| Number of Characters in Resolutions | WR | 128.43 | 146.525 | 0.00 | 659.00 |
| Ratio of Optional Fields Used in Reporting | RE | 0.77 | 0.209 | 0.17 | 1.00 |
| Ratio of Optional Fields Used in Resolutions | RS | 0.26 | 0.175 | 0.00 | 0.67 |

*Research Question One: Principle Component Analysis of Technology Use*

Principle Component Analysis (PCA) with Varimax rotation was applied to reduce the number of variables to a smaller set and create meaningful components that summarize the patterns. The purpose of PCA is to extract from an original larger set of variables a smaller set of components that can account for most of the variance from the data set (Tabachnick & Fidell, 2007). Before starting PCA, the correlation matrix of all 11 indicators was inspected by the levels of correlation with other indicators. Table 4.9 shows the correlation matrix for the 11 indicators of PSN Technology Use. All indicators had significant correlations with one or more indicators. Thus, there was no unique indicator eliminated at this time.

Table 4.9

Correlation Matrix for PSN Technology Use Indicators (N=103)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Reporting time (minutes) | 1 | | | | | | | | | | |
| 2. Resolution time (days) | 0.018 | 1 | | | | | | | | | |
| 3. Number of Department | 0.127 | 0.360** | 1 | | | | | | | | |
| 4. Number of Action | 0.131 | 0.340** | 0.936** | 1 | | | | | | | |
| 5. Number of Activities in History Log | 0.032 | 0.535** | 0.747** | 0.694** | 1 | | | | | | |
| 6. Number of Event Details | 0.404** | 0.070 | 0.238* | 0.280** | 0.141 | 1 | | | | | |
| 7. Number of Suggestion | 0.288** | 0.001 | 0.044 | 0.055 | -0.039 | 0.321** | 1 | | | | |
| 8. Number of Additional Info | -0.036 | 0.062 | 0.301** | 0.295** | 0.101 | -0.097 | -0.036 | 1 | | | |
| 9. Number of Resolution | -0.001 | 0.056 | 0.340** | 0.374** | 0.225* | 0.221* | 0.057 | 0.114 | 1 | | |
| 10. Ratio Optional Reporting | 0.139 | -0.018 | -0.043 | -0.009 | -0.074 | 0.145 | 0.125 | -0.285** | -0.174 | 1 | |
| 11. Ratio Optional Resolution | 0.020 | 0.053 | 0.019 | 0.040 | 0.049 | -0.024 | -0.148 | 0.323** | 0.325** | -0.104 | 1 |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

As seen in Table 4.10, the overall Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) was .659, which was above the minimum requirement of .50. This number indicates a good sampling adequacy for the PCA analysis (Kinnear & Gary, 1997). The degree of common variance among the 11 indicators was adequate and the components extracted in the PCA account for a fair amount of variance. Additionally, Bartlett's Test of Sphericity was significant at the level of $p<.001$, which indicates the sample correlation matrix was not an identity matrix (see Table 4.10). This result indicates that the component model was appropriate (Kinnear & Gary, 1997).

Table 4.10

KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.659 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 444.054 |
| | df | 55.000 |
| | Sig. | 0.000 |

Using the rule of Eigenvalues greater than 1, three components were extracted that explained 58.561% of the variance in the first iteration. Estimated commonality values were used to remove unique and outlier indicators. The Ratio of Optional Fields Used in Reporting indicator had the lowest communality value of .354, less than .40, and thus was removed. In the second iteration, using the remaining 10 indicators and Varimax rotation, three components were extracted. The three components shown in Table 4.11 accounted for a total of 62.531% of the variance after rotation. More specifically, the first component accounted for 28.63% of the variance; the second component accounted

for 17.69% of the variance, and the third component accounted for 16.22% of the variance.

Table 4.11

Sums of Squared Loadings for Components Extracted in PSN Technology Use

| Component | Rotation Sums of Squared Loadings | | |
|---|---|---|---|
| | Eigenvalues | % of Variance | Cumulative % |
| 1 | 2.863 | 28.627 | 28.627 |
| 2 | 1.769 | 17.689 | 46.316 |
| 3 | 1.622 | 16.215 | 62.531 |

The last step in PCA is to provide descriptive labels for each component. The three components were labeled: Event Complexity, Appropriation of Resolution, and Appropriation of Reporting. Event Complexity is defined as the scope and complexity of a safety event indicated through the PSN. Appropriation of Reporting includes uses of the PSN to enter a safety event. Appropriation of Resolution includes uses of the PSN for investigating and resolving a safety event. The three components and their indicators are shown in Table 4.12.

Table 4.12

Loadings and Structure of Components in PSN Technology Use

| Indicators \ Component Loadings | Component | | |
|---|---|---|---|
| | 1 **Event Complexity** | 2 **Appropriation of Reporting** | 3 **Appropriation of Resolution** |
| Number of Activities in the History Log | .892 | | |
| Number of Department | .890 | | |
| Number of Actions | .860 | | |
| Resolution Time (days) | .648 | | |
| Number of Characters in Event Description | | .781 | |
| Reporting Time (minutes) | | .726 | |
| Number of Characters in Suggestion | | .690 | |
| Ratio Optional Resolution | | | .817 |
| Number of Characters in Additional Information | | | .635 |
| Number of Characters in Resolution Strategy | | | .627 |

Each extracted component has three or four indicators. The component loadings were 0.63 or greater (see Table 4.12), which demonstrates that the indicators are good measures of their correspondent components. Component scores for each case were then generated using the loading and correlation matrix with the regression approach. These component scores were used for further analysis and comparisons.

In conclusion, Event Complexity explained 28.627% of the variance in technology use. It includes the use of PSN features to indicate the scope (number of departments) and complexity (the number of activities in the history, the number of actions, and the time for resolution) of a safety event. In general, individuals selected more than one responsible department per safety event. Those departments engaged in more than one resolution activity, recorded approximately three activities in the history log, and took approximately 12 days to resolve an event. Appropriation of Reporting explained 17.69% of the variance in technology use. Appropriation of Resolution

explained 16.22% of the variance in technology use. Overall, Appropriation of Reporting is higher than Appropriation of Resolution.

## *Analysis of Cooperation and Organizational Learning*

### *Research Question Two: Descriptive Analysis of Cooperation*

Research question two asked: "*In what ways and to what extent do members use the PSN to cooperate for patient safety?*" The results shown in Table 4.13 demonstrate that participants showed low to middle level of Positive Interdependence, with mean scores of 1.45 and 1.22 on the scale 0 to 3. For Promotive Interaction, reporters scored high in using a neutral or objective tone (mean score 2.61) but only medium in providing constructive suggestions (mean score 1.66). Managers who provided resolutions demonstrated similar social skills to reporters' efforts (mean scores of 1.75 to 1.77). Reporters demonstrated high accountability for investigation of a PSR by revealing their personal identities (mean score 2.96). Those engaged in resolving issues demonstrated good group processing by working to resolve issues as soon as possible, within 10 days, or going through an investigation process that took less than one month (mean score 1.98).

Table 4.13

Descriptive Statistics for Cooperation Indicators (N=103)

| Cooperation Indicators | Mean | SD | Min | Max |
|---|---|---|---|---|
| **Positive Interdependence** | | | | |
| Systems Perspective and Impacts to the Organization | 1.45 | 0.751 | 0.0 | 3 |
| Beyond Organization Reporting Expectation | 1.22 | 1.066 | 0.0 | 3 |
| **Promotive Interaction** | | | | |
| Tone of Reporter | 2.61 | 0.675 | 1.0 | 3 |
| Constructive Suggestions | 1.66 | 0.761 | 0.0 | 3 |
| **Social Skills** | | | | |
| Appropriate and Congruent Resolution | 1.76 | 0.848 | 0.0 | 3 |
| Shared Resolution | 1.75 | 0.629 | 0.0 | 3 |
| Acknowledgement of Report | 1.77 | 0.712 | 0.5 | 3 |
| **Accountable Group Processing** | | | | |
| Anonymity | 2.96 | 0.194 | 2.0 | 3 |
| Resolution Process | 1.98 | 0.606 | 0.0 | 3 |

The results indicate that at the time of the study, those using PSN show evidence of working cooperatively through the online system, but in general are not scoring high on the indicators of cooperation. Keeping in mind that the system is used to fulfill an organizational reporting expectation we see reporters promoting positive interaction with those empowered to resolve a problem by describing the event in an objective and neutral tone. However the opportunity to suggest resolution strategies seems low when compared to goals of the system to get those closest to the problem to be forthcoming with possible solutions. In turn, those who were working to resolve problems demonstrated relatively low cooperative efforts in sharing information about their resolution strategies and provide little acknowledgment of other's work.

*Research Question Three: Descriptive Analysis of Organizational Learning*

Research question three asked "*In what ways and to what extent do staff members perceive that the organization learns through the use of the PSN?*" The results (Table 4.14) show that participants universally saw high levels of organizational learning in the UMHC. Scores for Clarity of Mission and Vision (CMV) were the highest (mean=3.78, SD=0.6423), indicating that individuals perceive a clear vision and mission for improving the quality of patient safety in the organization. Secondly, scores were also high for Leadership Commitment and Empowerment (LCE) (mean=3.53, SD=0.7637), indicating that they believe the leaders in the organization are open to change and are committed to empowering the staff to learn from safety reporting as well as each other. Third, scores on Teamwork and Group Problem-Solving (TGP) (mean=3.35, SD=0.6208) show that participants perceive a high degree of teamwork possible in the organization to resolve safety events. Forth, high scores (mean=3.28, SD=0.7192), on Transfer of Knowledge (TOK) demonstrate that the systems in place enable them to learn from safety events. Last, scores (mean=3.21, SD=0.7942) on Experimentation (EXP) showed that participants see themselves as having freedom to pursue new ways of doing things and able to present new ideas on the job for improving patient safety.

Table 4.14

Descriptive Statistics for Organizational Learning Scale (N=103)

| | Mean | Std. | Min | Max |
|---|---|---|---|---|
| Clarity of Mission and Vision (CMV) | 3.78 | 0.6423 | 2.00 | 5.00 |
| Leadership Commitment and Empowerment (LCE) | 3.53 | 0.7637 | 1.60 | 5.00 |
| Experimentation (EXP) | 3.21 | 0.7942 | 1.00 | 5.00 |
| Transfer of Knowledge (TOK) | 3.28 | 0.7192 | 1.67 | 5.00 |
| Teamwork and Group-Problem Solving (TGP) | 3.35 | 0.6208 | 2.00 | 5.00 |

*Research Question Four: Correlation Analysis for Cooperation and Organizational Learning*

Research question four asked "*In what ways and to what extent does the level of cooperation in the use of PSN influence members' perception of organizational learning?*" Correlation analysis was used to explore this relationship. As shown in Table 4.15, only one cooperation factor, Positive Interdependence, was significantly correlated with all five OLS factors at either the $p < .05$ or $p < .01$ level. However, the relationship was negative. The higher the Positive Interdependence, the lower the perception of organizational learning. Promotive Interaction, Social Skills, and Accountable Group Processing all showed weak but not significant correlations with the five organizational learning factors.

Table 4.15

Correlation Analysis for Cooperation and Organizational Learning (N=103)

| | | Organizational Learning Factor | | | | | Cooperation Factor | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | Clarity of Mission and Vision (CMV) | 1 | | | | | | | | |
| 2 | Leadership Commitment and Empowerment (LCE) | 0.724** | 1 | | | | | | | |
| 3 | Experimentation (EXP) | 0.570** | 0.786** | 1 | | | | | | |
| 4 | Transfer of Knowledge (TOK) | 0.596** | 0.614** | 0.667** | 1 | | | | | |
| 5 | Teamwork and Group-Problem Solving (TGP) | 0.522** | 0.561** | 0.661** | 0.596** | 1 | | | | |
| 6 | Social Skills | 0.161 | 0.126 | 0.066 | 0.065 | 0.088 | 1 | | | |
| 7 | **Positive Interdependence** | **-0.279**** | **-0.287**** | **-0.313**** | **-0.368**** | **-0.214*** | 0.020 | 1 | | |
| 8 | Promotive Interaction | -0.106 | 0.009 | -0.045 | 0.029 | -0.124 | 0.025 | -0.072 | 1 | |
| 9 | Accountable Group Processing | 0.078 | 0.078 | -0.012 | -0.028 | -0.011 | 0.008 | -0.097 | -0.003 | 1 |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

### *Multivariate analysis of variance (MANOVA)*

*Research Question Five: MANOVA Analysis of Cooperation by Technology Use*

To answer research question five regarding the impact of technology use on cooperation, MANOVA was chosen to analyze the overall mean differences among observed variables by the three levels (low, middle, and high) of three types of technology use (Event Complexity, Appropriation of Reporting, and Appropriation of Resolution) on four cooperation variables (Positive Interdependence, Promotive Interaction, Social Skills, and Accountable Group Processing). Results are shown in Table 4.16.

Wilks' Lambda is the commonly used multivariate statistic to examine the effect, using F tests. The value is calculated by the pooled ratio of error variance to effect variance plus error variance (Tabachnick & Fidell, 2007). Partial Eta Squared ($\eta^2$) shows the proportion of variability in the overall dependent variables accounted for by each independent variable and interaction. Observed power is related to the chances of not making a Type-II error, the odds of finding there is no difference when, in fact, there is one. More specifically, observed power is equal to one minus Type-II error. The higher the observed power, the stronger the confidence in finding a difference when there is one.

Table 4.16

Multivariate Analysis for Cooperation under Different Technology Use Types

| Effect | Wilks' Lambda | F | Hypothesis df | Error df | Sig. | Partial $\eta^2$ | Observed Power |
|---|---|---|---|---|---|---|---|
| Event Complexity | 0.824 | 1.879 | 8 | 148 | 0.067 | .092 | .781 |
| Appropriation of Resolution | 0.887 | 1.139 | 8 | 148 | 0.341 | .058 | .514 |
| **Appropriation of Reporting** | **0.485** | **8.063** | **8** | **148** | **0.000** | **.304** | **1.000** |
| Event Complexity x Appropriation of Resolution | 0.933 | 0.323 | 16 | 227 | 0.994 | .017 | .163 |
| **Event Complexity x Appropriation of Reporting** | **0.702** | **1.743** | **16** | **227** | **0.040** | **.085** | **.815** |
| Appropriation of Resolution x Appropriation of Reporting | 0.810 | 1.011 | 16 | 227 | 0.446 | .051 | .519 |
| Event Complexity x Appropriation of Resolution x Appropriation of Reporting | 0.742 | 0.827 | 28 | 268 | 0.720 | .072 | .678 |

The F test result shows the significant main effect of Appropriation of Reporting on overall cooperation, $F_{(8,148)}=8.063$, $p < .001$. The effect size $\eta^2$ is 0.304, which means that 30.4% of the variability in the overall cooperation is accounted by Appropriation of Reporting. The observed power reaches 1.00. There is also a significant interaction effect between Event Complexity and Appropriation of Reporting ($F_{(16,227)}=1.743$, $p < .05$) with a medium effect size, $\eta^2 =0.085$, and observed power of 0.815. There is a marginal main effect of Event Complexity on overall Cooperation, with a p value of .067, an effect size of $\eta^2 =.092$, and a power of 0.781. No other main effect or interaction effects were significant. These results show that overall cooperation is significantly influenced by the level of Appropriation of Reporting and marginally by the levels of Event Complexity.

The significant interaction effect indicates that the effect of Appropriation of Reporting on overall cooperation also depends on the level of Event Complexity.

To investigate the impact of each significant MANOVA effect on individual cooperation factors, univariate analysis was performed to examine the effect of technology use types on each of the cooperation factors. The significant relationship between overall cooperation and Appropriation of Reporting in Table 4.16 is shown to be mainly on one cooperation factor, Social Skills ($p < .001$), as shown in Table 4.17. Significant interaction between Event Complexity and Appropriation of Reporting on overall cooperation is shown in Table 4.16. Univariate analysis shows the significant interaction is mainly on Social Skills ($p < .05$) as well. Moreover, the marginally significant effect of Event Complexity on cooperation, shown in table 4.16, is shown to be contributed largely by the significant relationship between Event Complexity and Positive Interdependence. Table 4.17 shows a statistically significant difference of mean Positive Interdependence by Event Complexity ($p < .05$).

Table 4.17
Univariate Analysis for Individual Cooperation Factors under Different Technology Use Types

| Technology Use Source Type | Cooperation Dependent Variable | Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Observed Power |
|---|---|---|---|---|---|---|---|---|
| Event Complexity | Social Skills | 0.554 | 2 | 0.277 | 0.645 | 0.527 | 0.016 | 0.155 |
| | Positive Interdependence | 5.324 | 2 | 2.662 | 4.128* | 0.020 | 0.097 | 0.714 |
| | Promotive Interaction | 2.796 | 2 | 1.398 | 2.116 | 0.127 | 0.052 | 0.422 |
| | Accountable Group Processing | 0.446 | 2 | 0.223 | 0.480 | 0.621 | 0.012 | 0.126 |
| Appropriation of Resolution | Social Skills | 1.562 | 2 | 0.781 | 1.818 | 0.169 | 0.045 | 0.369 |
| | Positive Interdependence | 0.005 | 2 | 0.003 | 0.004 | 0.996 | 0.000 | 0.051 |
| | Promotive Interaction | 0.523 | 2 | 0.262 | 0.396 | 0.674 | 0.010 | 0.112 |
| | Accountable Group Processing | 2.315 | 2 | 1.158 | 2.493 | 0.089 | 0.061 | 0.486 |
| **Appropriation of Reporting** | **Social Skills** | **28.203** | **2** | **14.101** | **32.835**** | **0.000** | **0.460** | **1.000** |
| | Positive Interdependence | 1.420 | 2 | 0.710 | 1.101 | 0.338 | 0.028 | 0.237 |
| | Promotive Interaction | 1.220 | 2 | 0.610 | 0.923 | 0.402 | 0.023 | 0.204 |
| | Accountable Group Processing | 1.374 | 2 | 0.687 | 1.480 | 0.234 | 0.037 | 0.307 |
| Event Complexity x Appropriation of Resolution | Social Skills | 0.267 | 4 | 0.067 | 0.155 | 0.960 | 0.008 | 0.081 |
| | Positive Interdependence | 0.233 | 4 | 0.058 | 0.090 | 0.985 | 0.005 | 0.067 |
| | Promotive Interaction | 1.621 | 4 | 0.405 | 0.613 | 0.654 | 0.031 | 0.193 |
| | Accountable Group Processing | 0.692 | 4 | 0.173 | 0.372 | 0.828 | 0.019 | 0.131 |
| **Event Complexity x Appropriation of Reporting** | **Social Skills** | **5.631** | **4** | **1.408** | **3.278*** | **0.016** | **0.146** | **0.814** |
| | Positive Interdependence | 3.316 | 4 | 0.829 | 1.286 | 0.283 | 0.063 | 0.384 |
| | Promotive Interaction | 1.550 | 4 | 0.387 | 0.586 | 0.673 | 0.030 | 0.186 |
| | Accountable Group Processing | 2.877 | 4 | 0.719 | 1.549 | 0.197 | 0.074 | 0.458 |
| Appropriation of Resolution x Appropriation of Reporting | Social Skills | 1.725 | 4 | 0.431 | 1.004 | 0.411 | 0.050 | 0.303 |
| | Positive Interdependence | 1.177 | 4 | 0.294 | 0.456 | 0.768 | 0.023 | 0.152 |
| | Promotive Interaction | 0.901 | 4 | 0.225 | 0.341 | 0.849 | 0.017 | 0.123 |
| | Accountable Group Processing | 4.139 | 4 | 1.035 | 2.228 | 0.074 | 0.104 | 0.628 |
| Event Complexity x Appropriation of Resolution x Appropriation of Reporting | Social Skills | 2.827 | 7 | 0.404 | 0.940 | 0.481 | 0.079 | 0.379 |
| | Positive Interdependence | 1.878 | 7 | 0.268 | 0.416 | 0.890 | 0.036 | 0.174 |
| | Promotive Interaction | 2.749 | 7 | 0.393 | 0.594 | 0.759 | 0.051 | 0.240 |
| | Accountable Group Processing | 4.269 | 7 | 0.610 | 1.313 | 0.256 | 0.107 | 0.526 |

** Mean difference is significant at the 0.01 level (2-tailed).
* Mean difference is significant at the 0.05 level (2-tailed).

These results show scores on Social Skills are significantly influenced by the levels of Appropriation of Reporting as well as by the interaction between the level of Event Complexity and Appropriation of Reporting. In other words, the effect of Appropriation of Reporting on Social Skills depends upon the levels of Event Complexity. Additionally, the means of Positive Interdependence are significantly influenced by the level of Event Complexity.

To further analyze the significance of the different levels of technology use on cooperation factors, Tukey's posteriori t tests were used to make pairwise comparisons of the mean differences to determine which group means differ significantly from others. Table 4.18 summarizes the results of the post hoc Tukey's significance tests.

Table 4.18

Tukey's Post Hoc Analysis for Cooperation under Different Technology Use Types

| Technology Use Source Type | Cooperation Dependent Variable | Mean Difference (middle-low/high-low/high-middle) | | |
|---|---|---|---|---|
| **Appropriation of Reporting** | Social Skills | low | middle | high |
| | low | 0 | | |
| | middle | 1.097** | 0 | |
| | high | 1.512** | 0.415* | 0 |
| **Event Complexity** | Social Skills | low | middle | high |
| | low | 0 | | |
| | middle | -0.828** | 0 | |
| | high | -0.514** | 0.313 | 0 |
| | Positive Interdependence | low | middle | high |
| | low | 0 | | |
| | middle | 0.224 | 0 | |
| | high | 0.730** | 0.506* | 0 |

** Mean difference is significant at the 0.01 level (2-tailed).
* Mean difference is significant at the 0.05 level (2-tailed).

The significant mean difference in Social Skills by level of Appropriation of Reporting was contributed by all three mean differences among the high, middle, and low

group. The significant mean difference in Social Skills by the interaction between Event Complexity and Appropriation of Reporting is shown in Figure 4.2. The significant mean difference in Positive Interdependence by level of Event Complexity is mainly contributed by two mean differences: high-low and high-middle.

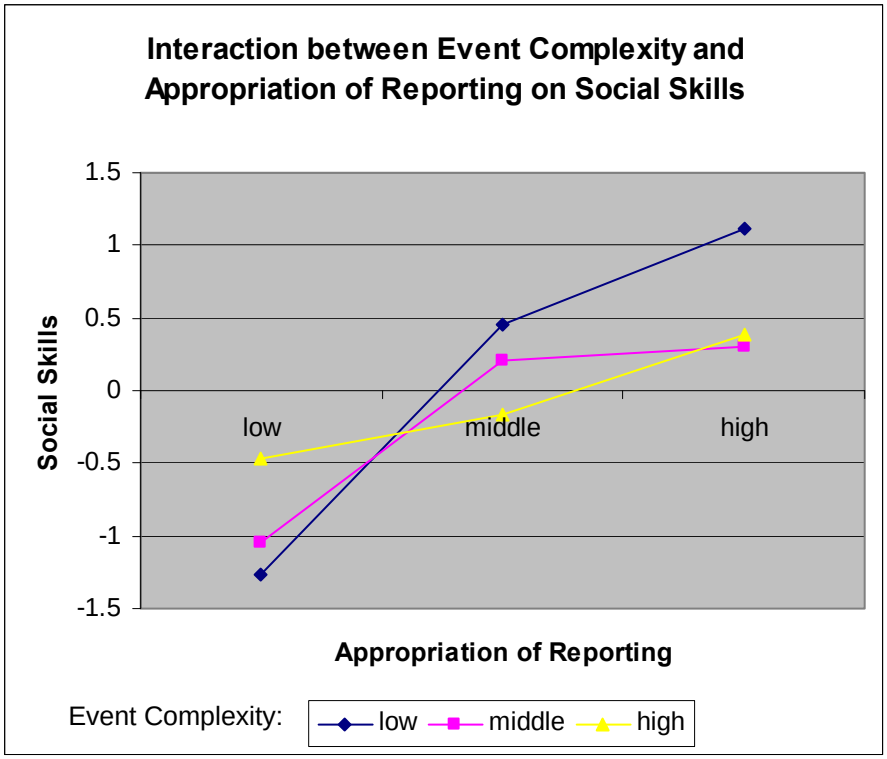



Figure 4.2 Interaction between Event Complexity and Appropriation of Reporting on Social Skills

Finally, Tukey's Honestly Significant Difference (HSD) tests were used to test the homogeneity of subsets of the cooperation factors by group means in different technology use types and levels. Within each subgroup, the difference in means is statistically insignificant. Table 4.19 shows that the low, middle, and high levels of Appropriation of

Reporting are all unique subsets. The differences among mean Social Skills of the low, middle, and high groups are statistically significant.

Table 4.19

Tukey's HSD Tests for Social Skills by Levels of Appropriation of Reporting

| GROUP for Appropriation of Reporting | N | Subset | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Low | 34 | -0.872 | | |
| Middle | 35 | | 0.225 | |
| High | 34 | | | 0.640 |
| Sig. | | 1.000 | 1.000 | 1.000 |

Figure 4.3 shows that, in general, the greater the Appropriation of Reporting, the higher the Social Skills was found in a PSR.

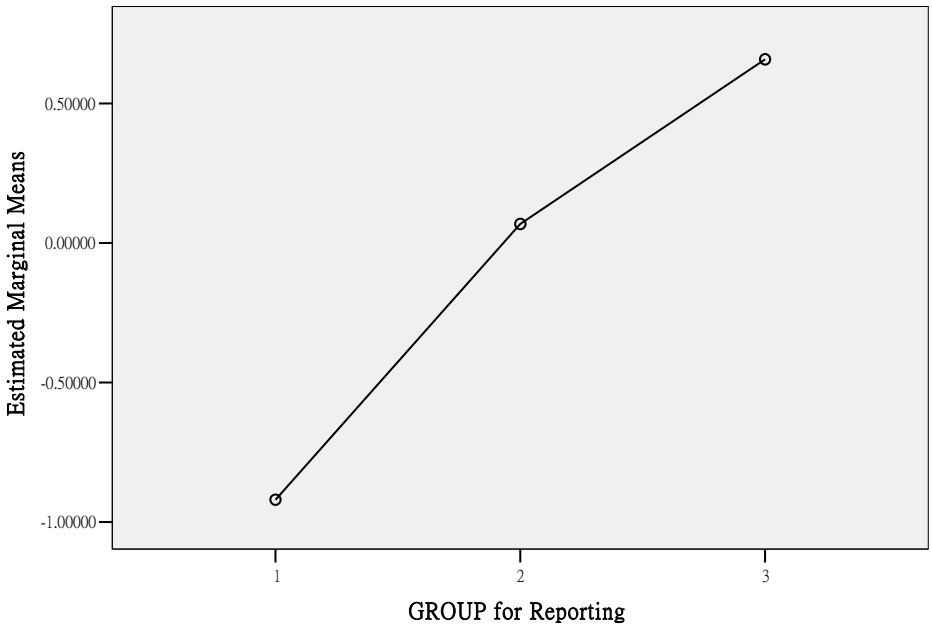



Figure 4.3 Estimated Marginal Means of Social Skills per level of Appropriation of Reporting

Table 4.20 shows that the middle and high levels of Event Complexity could be considered a subset. The difference between mean Social Skills of the middle and high groups is statistically insignificant and their means are significantly different from the mean of the low group in Event Complexity.

Table 4.20

Tukey's HSD Tests for Social Skills by Levels of Event Complexity

| GROUP for Event Complexity | N | Subset | |
|---|---|---|---|
| | | 1 | 2 |
| Middle | 35 | -0.377 | |
| High | 34 | -0.063 | |
| Low | 34 | | 0.451 |
| Sig. | | 0.124 | 1.000 |

Figure 4.4 provides visual illustration that in general the higher Event Complexity of a PSR the lower Social Skills identified within a PSR.

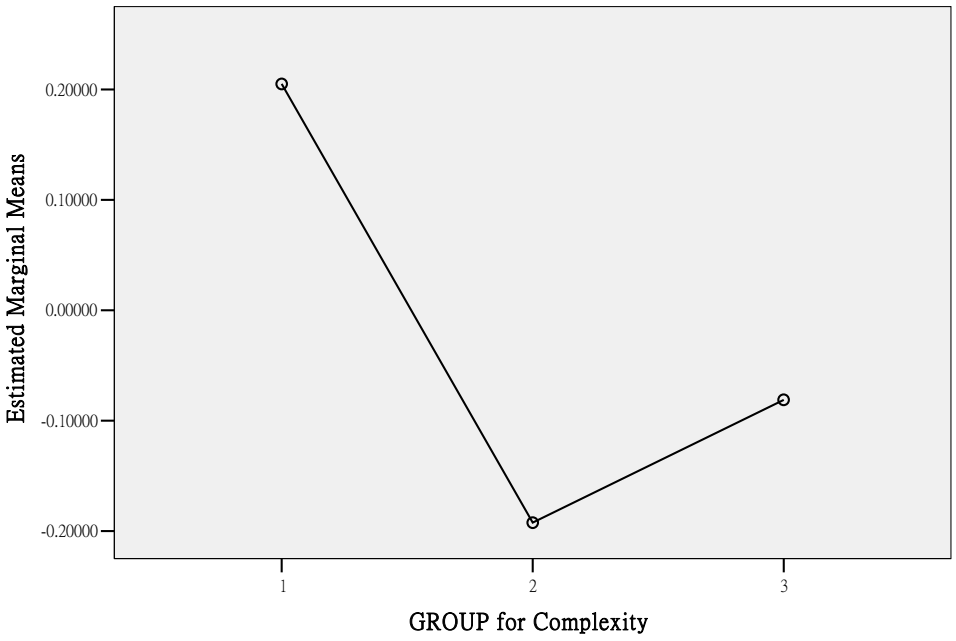



Figure 4.4 Estimated Marginal Means of Social Skills per level of Event Complexity

Table 4.21 shows that the low and middle levels of Event Complexity could be considered a subset. The difference between the mean Positive Interdependence of the low and middle groups is statistically insignificant and their means are significantly different from the mean of the high group in Event Complexity.

Table 4.21

Tukey's HSD Tests for Positive Interdependence by Levels of Event Complexity

| GROUP for Event Complexity | N | Subset | |
|---|---|---|---|
| | | 1 | 2 |
| Low | 34 | -0.317 | |
| Middle | 35 | -0.093 | |
| High | 34 | | 0.413 |
| Sig. | | 0.483 | 1.000 |

Figure 4.5 shows that, in general, the greater the Event Complexity, the higher the Positive Interdependence was found in a PSR.

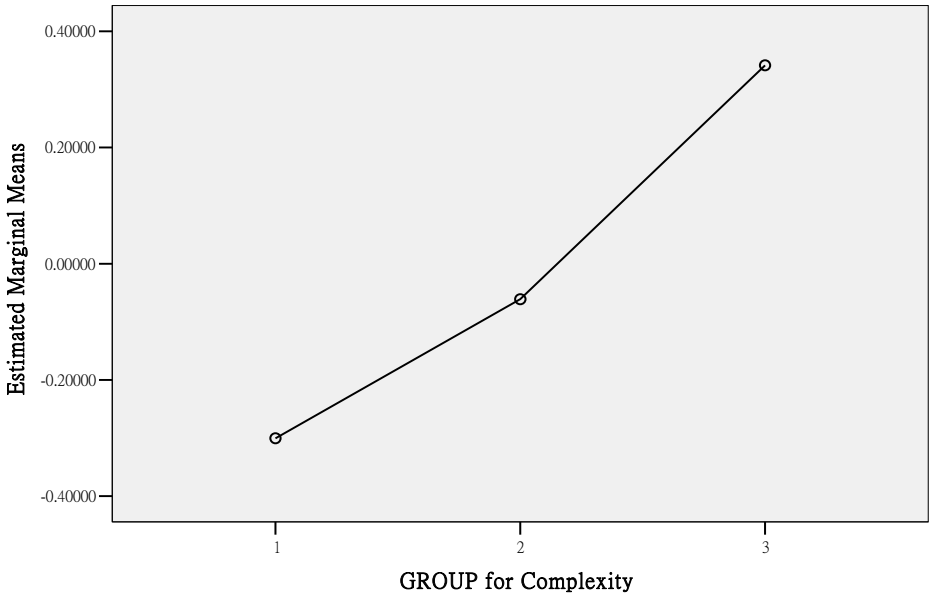



Figure 4.5 Estimated Marginal Means of Positive Interdependence per level of Event Complexity

In conclusion, the results show the higher the Appropriation of Reporting, the higher the overall cooperation was found. This effect was primarily on the Social Skills factor. Additionally, the effect Appropriation of Reporting had on overall cooperation, as well as the single factor Social Skills, also depends on the level of Event Complexity. More specifically, Event Complexity reduces the effect of Appropriation of Reporting on Social Skills. Event Complexity showed a marginal significant effect on the overall cooperation, and this marginal effect was contributed by the significant mean differences in Positive Interdependence across the levels of Event Complexity.

*Research Question Six: MANOVA Analysis of Organizational Learning by Technology Use*

To answer research question six, regarding the effect of technology use on perceived organizational learning, MANOVA was applied to analyze the overall mean differences by the three levels of use of three types of technology (Event Complexity, Appropriation of Reporting, and Appropriation of Resolution) on five organizational variables (Clarity of Purpose and Mission, Leadership Commitment and Empowerment, Experimentation, Transfer of Knowledge, Teamwork and Group Problem Solving). Significant main effects were observed for overall organizational learning by Event Complexity ($F_{(10,146)}=2.104$, $p < .05$) and Appropriation of Resolution ($F_{(10,146)}=1.966$, $p < .05$) (see Table 4.22). The effect size $\eta^2$ of Event Complexity was medium (0.126): 12.6% of the variability in overall organizational learning can be accounted for by Event Complexity, with an observed power of 0.886. The effect size of $\eta^2 =0.119$ of Appropriation of Resolution shows that 11.9% of the variability in overall organizational learning can be accounted for by Appropriation of Resolution. The observed power of Appropriation of Resolution is 0.859. There was no significant main effect on overall organizational learning by Appropriation of Reporting. Furthermore, there was no significant interaction effect among the three different types of Technology Use.

Table 4.22

Multivariate Analysis for the overall Organizational Learning under Different Technology Use Types

| Effect | Wilks' Lambda | F | Hypothesis df | Error df | Sig. | Partial Eta Squared | Observed Power |
|---|---|---|---|---|---|---|---|
| **Event Complexity** | **0.764** | **2.104** | **10** | **146** | **0.028** | **.126** | **.886** |
| **Appropriation of Resolution** | **0.777** | **1.966** | **10** | **146** | **0.041** | **.119** | **.859** |
| Appropriation of Reporting | 0.909 | 0.711 | 10 | 146 | 0.713 | .046 | .361 |
| Event Complexity x Appropriation of Resolution | 0.857 | 0.578 | 20 | 243 | 0.926 | .038 | .357 |
| Event Complexity x Appropriation of Reporting | 0.745 | 1.128 | 20 | 243 | 0.322 | .071 | .698 |
| Appropriation of Resolution x Appropriation of Reporting | 0.713 | 1.306 | 20 | 243 | 0.175 | .081 | .779 |
| Event Complexity x Appropriation of Resolution x Appropriation of Reporting | 0.653 | 0.941 | 35 | 310 | 0.568 | .082 | .786 |

Univariate analysis was performed to examine the effect of technology use on each of the five organizational learning factors. Results (see Table 4.23) show that the significant MANOVA main effect on the overall organizational learning by Event Complexity is mainly contributed by the significant relationship between Event Complexity and Transfer of Knowledge (TOK) in organizational learning ($p < .01$). The effect size of $\eta^2=0.123$ indicates a medium level of variability in TOK accounted for by Event Complexity. The observed power is 0.832. The other significant MANOVA main effect on overall organizational learning by Appropriation of Resolution is mainly on Transfer of Knowledge (TOK) ($p < .05$). The effect size is $\eta^2=0.098$ and the observed power is 0.718.

Table 4.23

Univariate Analysis for Individual Organizational Learning Factors under Different Technology Use Types

| Technology Use Source Type | Org Learning Dependent Variable | Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Observed Power |
|---|---|---|---|---|---|---|---|---|
| **Event Complexity** | Clarity of Mission and Vision (CMV) | 1.010 | 2 | 0.505 | 1.477 | 0.235 | 0.037 | 0.306 |
| | Leadership Commitment and Empowerment (LCE) | 1.653 | 2 | 0.827 | 1.638 | 0.201 | 0.041 | 0.336 |
| | Experimentation (EXP) | 1.234 | 2 | 0.617 | 1.094 | 0.340 | 0.028 | 0.235 |
| | **Transfer of Knowledge (TOK)** | **4.394** | **2** | **2.197** | **5.417**** | **0.006** | **0.123** | **0.832** |
| | Teamwork and Group-Problem Solving (TGP) | 0.556 | 2 | 0.278 | 0.662 | 0.519 | 0.017 | 0.157 |
| **Appropriation of Resolution** | Clarity of Mission and Vision (CMV) | 0.532 | 2 | 0.266 | 0.779 | 0.462 | 0.020 | 0.178 |
| | Leadership Commitment and Empowerment (LCE) | 0.240 | 2 | 0.120 | 0.237 | 0.789 | 0.006 | 0.086 |
| | Experimentation (EXP) | 2.971 | 2 | 1.485 | 2.632 | 0.078 | 0.064 | 0.509 |
| | **Transfer of Knowledge (TOK)** | **3.376** | **2** | **1.688** | **4.162*** | **0.019** | **0.098** | **0.718** |
| | Teamwork and Group-Problem Solving (TGP) | 0.162 | 2 | 0.081 | 0.194 | 0.824 | 0.005 | 0.079 |
| Appropriation of Reporting | Clarity of Mission and Vision (CMV) | 0.539 | 2 | 0.270 | 0.789 | 0.458 | 0.020 | 0.180 |
| | Leadership Commitment and Empowerment (LCE) | 0.884 | 2 | 0.442 | 0.876 | 0.421 | 0.022 | 0.196 |
| | Experimentation (EXP) | 2.730 | 2 | 1.365 | 2.419 | 0.096 | 0.059 | 0.474 |
| | Transfer of Knowledge (TOK) | 0.535 | 2 | 0.268 | 0.660 | 0.520 | 0.017 | 0.157 |
| | Teamwork and Group-Problem Solving (TGP) | 0.602 | 2 | 0.301 | 0.718 | 0.491 | 0.018 | 0.167 |
| Event Complexity x Appropriation of Resolution | Clarity of Mission and Vision (CMV) | 0.992 | 4 | 0.248 | 0.725 | 0.577 | 0.036 | 0.224 |
| | Leadership Commitment and Empowerment (LCE) | 2.142 | 4 | 0.536 | 1.061 | 0.381 | 0.052 | 0.320 |
| | Experimentation (EXP) | 3.924 | 4 | 0.981 | 1.738 | 0.150 | 0.083 | 0.508 |
| | Transfer of Knowledge (TOK) | 0.655 | 4 | 0.164 | 0.404 | 0.805 | 0.021 | 0.139 |
| | Teamwork and Group-Problem Solving (TGP) | 1.971 | 4 | 0.493 | 1.174 | 0.329 | 0.057 | 0.352 |

| Technology Use Source Type | Org Learning Dependent Variable | Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Observed Power |
|---|---|---|---|---|---|---|---|---|
| Event Complexity x Appropriation of Reporting | Clarity of Mission and Vision (CMV) | 0.779 | 4 | 0.195 | 0.570 | 0.685 | 0.029 | 0.182 |
| | Leadership Commitment and Empowerment (LCE) | 2.733 | 4 | 0.683 | 1.354 | 0.258 | 0.066 | 0.404 |
| | Experimentation (EXP) | 1.413 | 4 | 0.353 | 0.626 | 0.645 | 0.031 | 0.197 |
| | Transfer of Knowledge (TOK) | 1.953 | 4 | 0.488 | 1.204 | 0.316 | 0.059 | 0.361 |
| | Teamwork and Group-Problem Solving (TGP) | 0.487 | 4 | 0.122 | 0.290 | 0.883 | 0.015 | 0.111 |
| Appropriation of Resolution x Appropriation of Reporting | Clarity of Mission and Vision (CMV) | 3.352 | 4 | 0.838 | 2.452 | 0.053 | 0.113 | 0.676 |
| | Leadership Commitment and Empowerment (LCE) | 2.410 | 4 | 0.602 | 1.194 | 0.320 | 0.058 | 0.358 |
| | Experimentation (EXP) | 0.403 | 4 | 0.101 | 0.179 | 0.949 | 0.009 | 0.086 |
| | Transfer of Knowledge (TOK) | 2.572 | 4 | 0.643 | 1.585 | 0.187 | 0.076 | 0.468 |
| | Teamwork and Group-Problem Solving (TGP) | 0.696 | 4 | 0.174 | 0.415 | 0.797 | 0.021 | 0.142 |
| Event Complexity x Appropriation of Resolution x Appropriation of Reporting | Clarity of Mission and Vision (CMV) | 5.290 | 7 | 0.756 | 2.211* | 0.042 | 0.167 | 0.793 |
| | Leadership Commitment and Empowerment (LCE) | 6.141 | 7 | 0.877 | 1.739 | 0.112 | 0.136 | 0.671 |
| | Experimentation (EXP) | 2.764 | 7 | 0.395 | 0.700 | 0.672 | 0.060 | 0.282 |
| | Transfer of Knowledge (TOK) | 2.610 | 7 | 0.373 | 0.919 | 0.496 | 0.077 | 0.371 |
| | Teamwork and Group-Problem Solving (TGP) | 1.085 | 7 | 0.155 | 0.369 | 0.918 | 0.032 | 0.157 |

** Mean difference is significant at the 0.01 level (2-tailed).

* Mean difference is significant at the 0.05 level (2-tailed).

An analysis of the three-way interaction effect of Event Complexity, Appropriation of Reporting, and Appropriation of Resolution was only significant on one individual organizational learning factor Clarity of Mission and Vision (CMV) at the $p < .05$ level (see Table 4.23 and Figure 4.6).

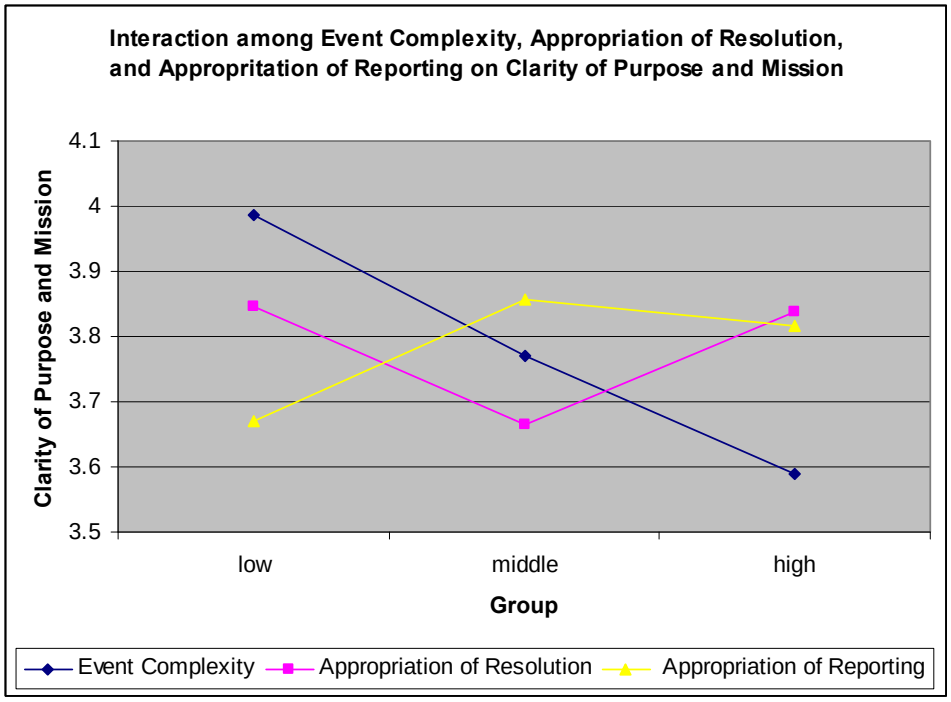



Figure 4.6 Graphic of the Three-Way Interaction among Event Complexity, Appropriation of Resolution, and Appropriation of Reporting on Clarity of Mission and Vision (CMV)

Tukey's posteriori tests were also applied to show that the significant mean differences in Transfer of Knowledge (TOK) by levels of Event Complexity were mainly contributed by differences between the high-low and high-middle. The significant mean difference in Transfer of Knowledge by levels of Appropriation of Resolution was mainly

contributed by the difference between the middle and low group. Table 4.24 shows the results of the Tukey's post hoc analyses for organizational learning.

Table 4.24

Tukey's Post Hoc Analysis for Organizational Learning under Different Technology Use Types

| Technology Use Source Type | Cooperation Dependent Variable | Mean Difference (middle-low/high-low/high-middle) | | |
|---|---|---|---|---|
| **Event Complexity** | Transfer of Knowledge (TOK) | low | middle | high |
| | low | 0 | | |
| | middle | -0.313 | 0 | |
| | high | -0.686** | -0.374* | 0 |
| **Appropriation of Resolution** | Transfer of Knowledge (TOK) | low | middle | high |
| | low | 0 | | |
| | middle | -0.529** | 0 | |
| | high | -0.167 | 0.362 | 0 |

** Mean difference is significant at the 0.01 level (2-tailed).
* Mean difference is significant at the 0.05 level (2-tailed).

Tukey's HSD tests were also used to test the homogeneity of subsets of the Organizational Learning factors by Technology Use. Table 4.25 shows that the low and middle levels of Event Complexity could be considered a subset. The difference between the means of Transfer of Knowledge (TOK) of the low and middle group is statistically insignificant and their means are significantly different from the mean of the high group in Event Complexity.

Table 4.25

Tukey's HSD Tests for Transfer of Knowledge (TOK) by Levels of Event Complexity

| GROUP for Event Complexity | N | Subset 1 | Subset 2 |
|---|---|---|---|
| high | 34 | 2.922 | |
| middle | 35 | | 3.295 |
| low | 34 | | 3.608 |
| Sig. | | 1.000 | 0.111 |

Figure 4.7 also provides additional evidence that illustrates that the greater the Event Complexity, the lower the perceived Transfer of Knowledge (TOK).

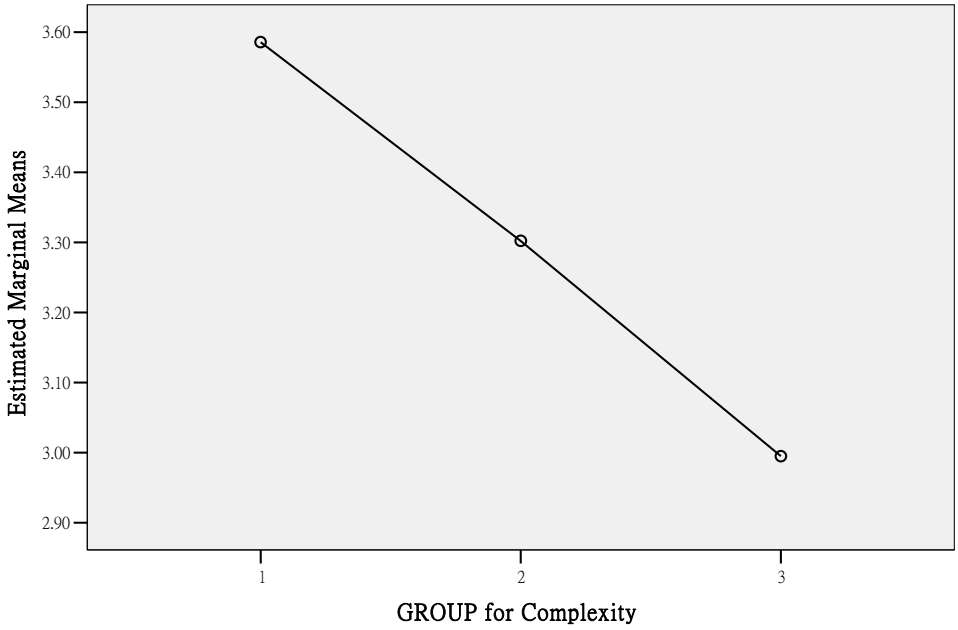



Figure 4.7 Estimated Marginal Means of Transfer of Knowledge (TOK) per level of Event Complexity

Table 4.26 shows that both the low-middle and middle-high levels of Appropriation of Resolution could be considered subsets. The difference between the mean scores of perception of Transfer of Knowledge (TOK) of the two subsets, the middle-high group and the high-low groups, are statistically insignificant. However, the means of the low and high group in Appropriation of Resolution are much closer to each another than the middle group.

Table 4.26

Tukey's HSD tests for Transfer of Knowledge (TOK) by Levels of Appropriation of Resolution

| GROUP for Appropriation of Resolution | N | Subset 1 | Subset 2 |
|---|---|---|---|
| middle | 35 | 2.981 | |
| High | 34 | 3.343 | 3.343 |
| low | 34 | | 3.510 |
| Sig. | | 0.054 | 0.527 |

Figure 4.8 shows that the more extreme the Appropriation of Resolution, either low or high, the greater the perceived Transfer of Knowledge (TOK).

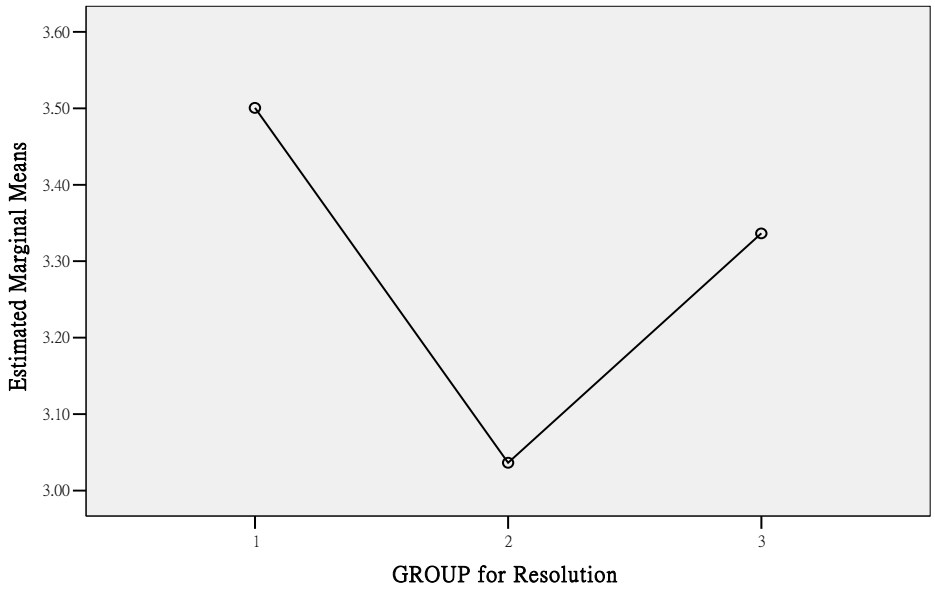



Figure 4.8 Estimated Marginal Means of Transfer of Knowledge (TOK) per level of Appropriation of Resolution

Overall, the results show that the higher the Event Complexity, the lower the overall perception of organizational learning. More specifically, the higher the Event Complexity, the lower the perception of Transfer of Knowledge (TOK). Extremely high and extremely low overall scores on Appropriation of Resolution had higher perceptions of Transfer of Knowledge (TOK). Moreover, the three-way interaction among Event Complexity, Appropriation of Reporting, and Appropriation of Resolution was merely on the Clarity of Mission and Vision (CMV), suggesting that the effect of any PSN Use factor on the Clarity of Mission and Vision (CMV) depends on the level of other two PSN Use factors.

### *Analysis of Respondent Comments*

A total of 23 text comments were collected along with the OLS survey to help explain and clarify the quantitative results (Creswell, 2005). The unit chosen for content analysis was a comment. Applying a deductive approach, the text comments were coded by association with the three main constructs: technology use, cooperation, and organizational learning. Comments that did not relate to the three construct were coded as "Other". Table 4.27 shows the total number of codes for each construct.

Table 4.27

Number of Code for Constructs

| Code | Number of Code |
|---|---|
| Cooperation | 4 |
| Organizational Learning | 7 |
| Technology Use | 7 |
| Other | 5 |

Respondents commented on the ease of use of the PSN for reporting and also provided some suggestions to improve features in the PSN.

Examples are:

> "The new PSN is more user friendly."
>
> "The PSN tool is very user friendly!"
>
> "I was impressed with how easy it was to navigate the PSN reporting system. I think that encourages staff to report more."
>
> "Having the pt's date of birth should not be a required field. Many times for our trauma patients, we do not have this information"
>
> "I would like to ask that there be some designation for APN on the PSN drop down list of type pf reporter. I have to choose RN or Other. PAs have a listing. But APNs do not."

Comments for cooperation by respondents showed dissatisfaction about no or little feedback from the resolvers, no staff involvement for resolution, and resolution taking too long.

Examples of comments are:

> "When suggestions are made, there is never any feedback as to if or why the post ideas would work or not work"
>
> "I think when you report to staff that the psn has been resolved it would be nice to include how it was resolved; otherwise staff never know the outcome or how things are to be improved."
>
> "Resolutions take too long and the staff are not involved. It would be nice to know that you are taken seriously. When I make a mistake and spend time I don't have doing a PSN, it would be nice to know that the information I provide is actually read and acted on.

> How are problems resolved without talking to staff involved? It is a broken system that frustrates staff."

Respondents showed frustration from missing opportunities for learning from safety events. They were concerned that no constructive options were shared, nor are detailed actions provided about how to prevent an occurrence from happening in the future. Also, one respondent expressed a concern for the lack of common vision across departments. This kind of experience hindered their intention to use PSN.

Example comments are:

> "I don't feel my report was taken seriously."
>
> "There is not any form of constructive options, and the PSN is treated as if it is so minor that it does not need to be corrected. I would also suggest that it be mandatory for there to be a detailed description of actions taken and how the actions will prevent an occurrence from happening in the future."
>
> "I have been disappointed in the handling of the past 2 PSN's I have submitted. Neither were resolved in a way that improves patient care. I am less inclined to use the PSN system since these experiences."
>
> "I am very frustrated by the abdication of responsibility that I see repeatedly by some departments. If they are not directly responsible for the error then they also assume that they have no responsibility for the solution. I believe that if I personally have acted well but my actions have lead to someone else to make an error, then I may need to change my behavior. I do not see this happening. I feel like I am swatting at flies while the screen door is open. If all departments do not see that they own part of the solution, this will not work."

### *Chapter Summary*

This chapter describes the examination of Technology Use, Cooperation, and Organizational Learning in the context of UMHC and presents the results of data analysis to answer the research questions posed in Chapter 1. After excluding 18 cases which represented multiple cases from single respondents and data screening, 103 cases were valid for data analysis. The analysis started with descriptive analysis of respondent cases and response rate. The results showed low representativeness of the sample across different characteristics based on percent responding. Overall, the instruments used in this study were examined and found to be valid for data analysis. To answer research question one, descriptive analysis and principle component analysis were used to examine PSN Technology Use. Three components of PSN Technology Use were found: Event Complexity, Appropriation of Reporting, and Appropriation of Resolution. Among the three components, Event Complexity explained most of the variance in PSN Technology Use. In general, Appropriation of Reporting was higher than Appropriation of Resolution. To answer research question two, cooperation in the PSN was evaluated through measures of Positive Interdependence, Promotive Interaction, Social Skills, and Accountable Group Processing in the common artifacts, patient safety reports. The results showed evidence of working cooperatively through the online system but in general did not represent high levels of cooperation. To answer research question three, organizational learning was operationalized and examined through individuals' perception on a post-event-reporting survey. The results show high scores on all five organizational learning factors. To answer research question four, correlation analysis was conducted to examine the relationships between cooperation and individuals'

perception of organizational learning. Only one factor Positive Interdependence in cooperation was found to have a significant relationship with the five organizational learning factors and this relationship is negative. The other three factors all showed weak relationships with all five organizational learning factors. The examination of how technology influences cooperation and individuals' perception of organizational learning used multivariate analysis of cooperation and organizational learning by different types and levels of technology use. In response to research question five, Appropriation of Reporting in technology use was found to have a significant influence on cooperation, in particular the Social Skills factor. However, higher levels of Event Complexity reduced this effect. In response to research question six, Event Complexity and Appropriation of Resolution in technology use were found to have significant effects on organizational learning, particularly on the Transfer of Knowledge factor. The greater the Event Complexity, the lower the perceived Transfer of Knowledge. The more extreme, either low or high, in Appropriation of Resolution, the higher the perceived Transfer of Knowledge. Twenty-three text comments from reporters also provided evidence that can be used to help explain or support the statistical findings.

# CHAPTER 5

# DISCUSSION AND CONCLUSION

# CHAPTER V

## DISCUSSION AND CONCLUSION

### *Introduction*

The goal of this research was to develop new knowledge about how and to what extent the use of technology affects cooperation and organizational learning. It is hoped that this new knowledge can ultimately inform the design and development of information technology to support cooperative work and organizational development. This study examined technology use, cooperation and organizational learning in a patient safety reporting and resolution context. This study had three objectives: to test and verify new methods and analytics for examining computer supported cooperative work, to examine how practitioners used PSN for patient safety at UMHC, and to examine the effects of technology use on cooperation and organizational learning. To address these questions, the data for technology use was collected through database and history logs of the PSN system and examined by descriptive statistics and principle component analysis. Cooperation was measured through content analysis of patient safety reports and examined through descriptive statistics, correlation analysis, and MANOVA. Organizational Learning was measured through post-reporting surveys and examined through descriptive statistics, correlation analysis, and MANOVA. Data analysis results in Chapter 4 show there are three types of technology use and they have differential effects, both positive and negative, on cooperation and organizational learning. Evidence of cooperation during a patient safety reporting event had weak relationships with organizational learning. This chapter starts with a discussion about the challenge of

measurement issues in past research and then follows with a discussion for each of the sets of findings presented in chapter 4. Limitations of this study are also addressed. Recommendations for theory development and practical implications are also suggested.

## *Discussion*

### *Measurement Challenge*

The review of literature reveals the challenge of examining technology use and cooperation in context because they are complex constructs and no single measure is appropriate for all purposes. Oftentimes, single aspect and over-simplified definitions are applied when operationalizing those concepts (Bacon & Blyton, 2006; Tjosvold, Dean & Tsao, 1989). In a response to this challenge, the unit of analysis in this study was activity, which was defined as a set of work that incorporated all the tools, people, and resources needed to accomplish the task (Geyer et al., 2006). In this study, patient safety reporting and resolution is a work activity involving multiple actors and processes at different times and across departments through the use of common artifacts, patient safety reports, in a shared virtual workspace, the PSN. By using activity as the unit of analysis, the multiple aspects and the possible range of actions and interactions by all participants surrounding the activity can be examined.

In this study, technology use was examined by looking at all the user actions for a common work activity through the representations of tool use recorded in the database and history logs. This approach contrasts with past research which has operationalized technology use by individual use frequency, either subjectively or

objectively (Easley, Devaraj, & Grant, 2003; Straub et al., 1995; Szajna, 1996). To capture interactive and multiple aspects of cooperation, a cooperation rubric was developed to examine a theory based framework of elements of cooperation: Positive Interdependence, Promotive Interaction, Social Skills, and Accountable Group Processing (Johnson, David W. & Johnson, 1996; Johnson, David W. & Johnson, 1998; Johnson, David W. & Johnson, 2005) in the safety reporting context.

These efforts to examine technology use and cooperation through contextually relevant performance indicators offers potential for new perspectives and insights into computer supported cooperative work. The valuable lesson of the effort to develop performance indicators for this research is that through a systematic process reliable and theoretically interesting measures can be obtained. The measure of technology use for this study is the result of a systematic evaluation of activity within the online system and yielded constructs which offer new information about technology use relative to past practices of frequency counts or questions about recollections of use, and these constructs may have generalizability across other CSCW systems. Of course the details of what happens in other systems will vary, but the constructs for how different member types work in CSCW and the complexity of work tasks relative to usage offer new eyes into CSCW.

Similarly the measure of cooperation in this study is a performance indicator developed through a systematic process which may also offer utility to CSCW researchers. Whereas the technology use variable was generated solely from empirical evidence, the cooperation measure starts with a theoretical framework for cooperation

(Johnson, David W. & Johnson, 2005) and through a systematic process provides a contextually relevant and reliable measure of cooperation. This study demonstrates of how this process can be applied to the development of reliable and generalizable sub-constructs for the cooperation framework. Researchers have encountered difficulty and reported challenges of evaluating CSCW (Neale et al., 2004; Pinelle, Gutwin, & Greenberg, 2002). The findings of this study have demonstrated the value of this approach and how it can be done. However, a limitation of these new methods is that the operational unit of analysis included only the aspects of actions and interactions that could be captured by the technology.

*Technology Use for Patient Safety Reporting and Resolution*

Previous research (Tuttle, Holloway, Baird, Sheehan, & Skelton, 2004) has identified uncertainty about the benefits of using technology to support safety event reporting. This study, however, has discovered three major types of technology use in the context of patient safety reporting: Event Complexity, Appropriation of Reporting, and Appropriation of Resolution. These three types of use reflect different aspects of the ways participants use the technology for safety reporting and resolution.

Event Complexity is a key construct new to the domain of technology use and indicates the scope and complexity of the online activities needed to address a safety event. In general, individuals selected more than one responsible department per safety event. Those departments engaged in more than one resolution activity, recorded approximately three activities in the history log, and took approximately 12 days to resolve an event. This finding suggests the importance of coordination mechanisms for

systems like PSN. Mechanisms that provide activity awareness for what other participants in the safety event resolution are doing are more needed when events are complex and take place across departments and actors.

Appropriation of Reporting and Resolution involve the two primary types of target users, reporters and resolvers, and the ways they appropriate the technology for the common activity. In general, individuals' appropriation of the technology is higher for reporting than resolution. More specifically, it took staff members an average of 11.86 minutes of system usage to report a safety event, and it took all parties an average of 11.65 days to investigate and resolve per event. Furthermore, an average event description was 417 characters in length and a suggestion was 109 characters whereas resolution details had an average of only 128 characters and additional information was 70 characters. This discrepancy between the number of characters used in the event report y by reporters and resolvers may indicate a difference in effort or commitment to the reporting process. A concern for this difference in effort was noted in the comments on the OLS instrument, and may well serve as in impediment to feelings of cooperation and organizational learning. These relationships are discussed later in the chapter.

Technology use has been one of the major indicators to evaluate the success and impact of a technology innovation. However, the conclusions in past research oftentimes emphasized only frequency of usage, and that neglected the cooperative context and use. By using a common activity as the unit of analysis in this study, the findings reveal different components of technology use to describe how multiple actors use the technology to work together for ensuring patient safety. Furthermore, those

components are not necessarily weighted equally for the common activity. In this study, Event Complexity seems to play a role with more significance than users' actions of reporting an event. Also, the findings show the reporters' appropriation of the technology for entering a safety event tends to be higher than resolvers' appropriation of the technology for investigating and resolving the safety event. A possible explanation is the difference of workload between reporters and resolvers. Workload here refers to the volume of cases a person has to deal with. Unlike reporters who may voluntarily enter a report every once in a while, resolvers, mostly managers, are not only fewer in number but also have to deal with all reports related to their departments in addition to their daily hectic work. Furthermore, investigating and resolving an event tends to take a lot longer than reporting. This much heavier workload of the resolvers in patient safety activities could hinder their use of PSN.

As Hollan, Hutchins, and Kirsh (2000) noted the distributed cognition approach for designing CSCW emphasizes looking beyond individual cognition and considering the dynamic interaction and meanings distributed in real workplaces. An implication of this finding is to improve appropriation of resolution by changing resolvers' workload through both work and technology design. In work design, one possible CSCW solution could be sharing resolution responsibility with subordinates and/or experts in the field. For system designers and developers, a more effective and efficient process for resolving events and reporting the results may help resolvers manage the large volume of reports and create a way to empower the staff without losing control.

This study gives us a closer look at a performance oriented and comprehensive view of technology use in CSCW. More importantly, not all technology uses are the same; thus, they should not be treated and measured in the same way across various settings, particularly for those applications designed to support cooperative work! The findings provide strong support for the importance of incorporating the cooperation context into technology use that involves all members as well as their actions and interactions for common activity, which may vary by important distinctions such as complexity, in distributed work settings.

*Cooperation during Event Reporting*

There is a great amount of diversity in people's expertise and professions in health care environments. In safety reporting, to resolve a safety event and hazard requires a team of doctors, nurses, and other healthcare professionals who are experts in different specialties (Bardram & Bossen, 2005). Following from the theoretical framework that cooperation can only be maximized when all five elements are in place (Johnson, David W. & Johnson, 1996; Johnson, David W. & Johnson, 1998; Johnson, David W. & Johnson, 2005), it is evident that the concept of cooperation has frequently been over simplified in past research, such as instances of using only a few items on a survey measure (Bacon & Blyton, 2006; Tjosvold, Dean & Tsao, 1989) or through experiments with manipulations that are out of the work context (Sinclair, 2003; Wageman & Baker, 1997). To further investigate cooperation as an aspect of safety reporting, an innovative approach was undertaken by examining the cooperation process as recorded in the common artifacts, Patient Safety Reports (PSRs). The examination of

cooperation in PSN used a cooperation rubric developed to articulate: Positive Interdependence, Promotive Interaction, Social Skills, and Accountable Group Processing.

The results show cooperation among the participants in a safety event resolution, but show there is room for cooperation in PSN to be improved. Positive interdependence and promotive interaction are not highly realized through the use of PSN. Most people are acting in ways that implement PSN as a way to fulfill the organizational reporting expectation. If individuals interpret safety reporting as not interdependent work, it tends to lead to an absence of interaction (Deutsch, 1962). These findings suggest more efforts are needed to help individuals understand the systems aspect of reporting and how reporting can lead to positive changes. Furthermore, there is a need to encourage reporting beyond organizational reporting expectations, such as reporting near misses that did not reach to patients (Reason, 1997). The types of events that do not result in patient harm also tend to provide greater opportunities for more productive learning experience (Kaplan & Fastman, 2003).

Reporters encouraged interactions with resolvers by describing the event in an objective and neutral tone without blame as well as showing some attempts to provide suggestions for possible resolution strategies. However, resolvers showed less effort in helping reporters and other resolvers understand the event resolution by sharing little about resolution activity or strategy. Participants also provide low levels of support to each other by showing little acknowledgment of others' work. These results show resolvers contribute less cooperative effort than do reporters in a safety event. This

finding could be explained by the mandatory nature of developing resolution in comparison to the voluntary nature of reporting. Past research has shown voluntariness has effects on attitudes. More specifically, under mandatory contexts, individuals have been shown to form negative attitudes, are less likely to appreciate the technology, and simply do enough to meet the requirement (Brown et al., 2002). Another explanation may be the hierarchical status relations among members within a safety activity. The current resolution process is mainly assigned to department managers. The status relation, between reporters and resolvers, in a cooperative activity seems to be hierarchical and may not be perceived equally. This hierarchical status relation may hinder cooperation. Edmondson (2002) showed that member's perceptions of power and hierarchy has a negative effect on group interaction. The study found that members reveal a fear of speaking up and making mistakes in front of others or offending those with power when the hierarchical status relation is salient. Instead of constructive interactions, because of fear members tend to engage in abstract conversation as a safe alternative yet still meeting the minimum expectation of participation. Member relations based on equal status are most likely to promote cooperation (Eaton, 1948). There is also evidence that technology can help reduce, but not eliminate, this status and authority relation (Driskell et al., 2003). However, Saunder, Robey, and Vaverek (1994) found the status relations still remain among hospital personnel when they communicate through computer conferencing in the healthcare context. Future research is needed to investigate whether the mandatory nature and status relations impact the safety reporting activity as well as explore other possible factors that contribute to the difference in appropriation between reporters and resolvers.

The results show that the resolution process of investigating and resolving a safety event was above midpoint for cooperation and most reporters recognized reporting as an important responsibility and were willing to contribute effort to help achieve safer practices with confidence and credibility, however, we need to remain cautious about generalization of the findings in that only the confidential reports that disclosed reporters' identities to the resolver were included in the sample. In particular, past research has shown that anonymous reports typically provide less details about an event than confidential reports due to no opportunity for follow-up or clarification of event details (Pace et al., 2003). Under this circumstance, anonymous reports may be less helpful than confidential reports and possibly slow down the resolution process. Thus, further investigation is needed to establish whether anonymity has negative effects on the cooperative resolution process.

In conclusion, the degree of cooperation depends on how well the basic elements of cooperation are fulfilled. The findings show health care practitioners cooperating through the use PSN but also with room for improvement in how and how much cooperation can be achieved for patient safety activities. The current cooperation level in PSN seems to be at the coordination level of many members only passively working together to achieve the common goal (Bardram, 1998). Also, the current mostly linear process does not provide members much opportunity to interact, nor invites desirable cooperative behavior (Taylor & Todd, 1995). After all, reciprocity plays a significant role in the establishment of cooperative behaviors (Axelrod & Dion, 1988; Fehr et al., 2002).

*Perceived Organizational Learning for Patient Safety*

Learning in organizations is widely distributed among humans and artifacts (Hutchins, 1996) and highly depends upon the specific task, the participants involved, and the contextual conditions faced (Robey, Daniel et al., 2000). In healthcare, the patient safety reporting activity has great promise for organizational learning by giving an opportunity for healthcare professionals to learn from errors through reflecting and sharing knowledge and expertise in the workplace (Carroll & Quijada, 2004; Liu et al., 2007).

The results of this study showed overall individuals perceived good organizational learning after participating in a safety activity. Individuals perceived Clarity of Mission and Vision (CMV) as the highest construct, indicating that individuals have a clear vision and mission for improving the quality of patient safety in the organization. Leadership Commitment and Empowerment (LCE) was also high, indicating that reporters believe the leaders in the organization are open to change and are committed to empowering the staff to learn from safety reporting. High scores on Teamwork and Group Problem-Solving (TGP) showed that participants perceive a high degree of teamwork is possible in the organization to resolve safety problems. High scores on Transfer of Knowledge (TOK) demonstrate that the systems in place enable them to learn from safety events by sharing and through discussion with others. Scores on Experimentation (EXP) were relatively lower, but also showed that reporters see themselves as having support to pursue new ways of doing things and able to present new ideas on the job for improving patient safety.

These findings provide support for a belief that patient safety reporting and resolution processes could be seen as a mechanism for organizational learning. Of note is that while most people perceived clear vision for the organization, there may be a need for more support to the frontline health care professionals for using PSN to provide new ideas and ways for improving patient safety.

*The Influence of Cooperation on Organizational Learning*

Putting people together doesn't guarantee they will cooperate, co-construct knowledge, create better performance, or produce superior outcomes. From the discussion about cooperation above, cooperation in patient safety reporting and resolution activity can be improved, too often individuals complete and coordinate parts of the work individually. Not surprisingly, the results of this study showed an overall weak relationship between cooperation and organizational learning. Only one cooperation factor, Positive Interdependence, was significantly correlated with all five organizational learning factors. However, the relationship was negative. The higher the Positive Interdependence, the lower individuals perceived organizational learning. Promotive Interaction, Social Skills, and Accountable Group Processing all showed weak and not significant correlations with the five organizational learning factors. The weak relationship could be attributed to a need for improved cooperation in patient safety activities as discussed above.

An interesting finding of this study appears that when individuals show behaviors that indicate positive interdependence with others, it has a negative relationship with their perceptions of organizational learning. One explanation for this finding could be the

cooperation work design for safety event reporting and resolution does not match and support organizational learning for patient safety, such as the focus of functional support and the lack of two-way communication mechanisms between reporters and resolvers. Mulholland, Zdrahal, & Domingue (2005) point to the possibility of having some tensions between organizational and team perspectives of workplace learning in organizations; thus, it is important that teamwork cooperation must be designed to support organizational learning. Another possible explanation could be that individuals who perceive higher positive interdependence may have higher expectations for organizational learning than those who act in ways that show lower positive interdependence after participating in patient safety activities. Thus, they are not satisfied with the current managerial practice indicators of organizational learning due to this higher expectation.

*The Effects of Technology Use on Cooperation*

Past findings about the effects of technology to support cooperation are inconsistent (Cordella & Simon, 1997; Driskell et al., 2003; Rafaeli & Ravid, 2003; Thompson & Coovert, 2003). The results of this study show that the more individuals utilize PSN for reporting, the higher overall cooperation is observed. Also, the strength of the effect of Appropriation of Reporting on cooperation depends on the level of Event Complexity (see Figure 5.1). More specifically, the effect primarily is on the Social Skills factor in cooperation. In other words, the higher Appropriation of Reporting in PSN use by the reporter, the higher Social Skills of the resolver, which means the more likely the

reporter's perspective and opinions are valued and the more clear resolution details are shared back to the reporter as well as with other resolvers.

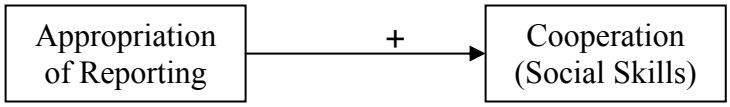



Figure 5.1 Direct and Positive Effect of Appropriation of Reporting on Cooperation

Furthermore, there is an interaction between Appropriation of Reporting and Event Complexity in PSN use on overall cooperation, indicating the effect that Appropriation of Reporting has on cooperation depends on the level of Event Complexity. This interaction effect is found primarily for the Social Skills factor in cooperation. Specifically, the effect of Appropriation of Reporting on Social Skills is different based on the low, middle, or high level of Event Complexity. In general, the higher is the Appropriation of Reporting then the higher the Social Skills of cooperation. However, the strength of this positive relationship is weakened when the event gets more complex. Event Complexity serves as a moderator that reduces the influence of Appropriation of Reporting on Social Skills. The highest Social Skills happen under the condition that the Event Complexity is low and Appropriation of Reporting is high; the lowest Social Skills occur when both Event Complexity and Appropriation of Reporting are low. Figure 5.2 shows this moderation effect of Event Complexity on the relationship between Appropriation of Reporting and Cooperation (Social Skills).

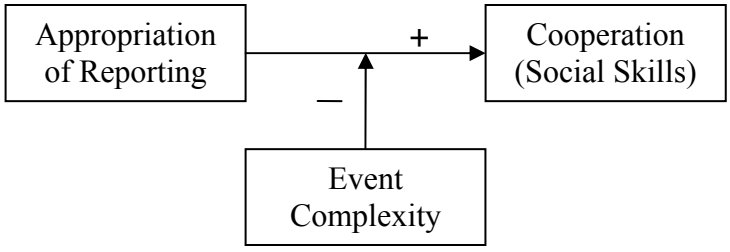



Figure 5.2 Moderation Effect of Event Complexity on the Relationship between Appropriation of Reporting and Cooperation

The results show that the actions of reporters in PSN play a critical role in cooperation for patient safety reporting and resolution. The negative moderation effect of Event Complexity may suggest that the mechanisms of PSN are less successful in supporting cooperation when the safety events are more complex. This interaction result may show weaknesses in coordination, communication and information sharing mechanisms of the technology for more complicated events. Schmidt and Simone (1996) also pointed out when the degree of complexity increases, a greater amount of information needs to be communicated, negotiated, articulated for the cooperative activities. Therefore, the design of technology must be specialized to accommodate such complex communication and coordination needs.

In addition, the findings show a marginal effect on cooperation by Event Complexity. This effect was mainly explained by the significant mean differences in Positive Interdependence by the level of Event Complexity. In other words, the more complex the safety event, the more interdependent is the activity seen in reporting patient safety. This finding shows individuals act in more interdependent ways as events gets more complex. Cataldo, Wagstrom, Herbsleb, and Carley (2006) reported cooperative

technology can help individuals identify their interdependent relationships with others when such relationships are not obvious or explicit. They found cooperative technology can reduce the gap between recognized and actual interdependence.

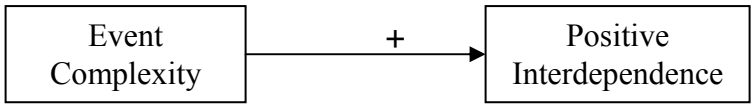



Figure 5.3 Direct and Positive Effect of Event Complexity on Positive Interdependence

Lastly, the Appropriation of Resolution has no significant direct or interaction relationship with overall cooperation or with the individual four cooperation factors. A possible explanation is that since the overall tendency of appropriation by resolvers is low in general as discussed in the technology use section above, the little variation within Appropriation of Resolution masks any possible relationships with cooperation. Further study of systems where resolvers have higher and more varied levels of appropriation is needed to explore the merits of this explanation.

Applying a CSCW framework (Bannon & Schmidt, 1989; Hutchins, 1996) to explain the results, the current PSN design seems to provide support for functional cooperation through common cognitive artifacts, PSRs, but yet needs improvement for supporting group dynamics and interaction (Hutchins, 1996; Thompson & Coovert, 2003) particularly under a more complex situation. True cooperation demands a great amount of personal contact and quality communication (Borghoff & Schlichter, 2000; Neale et al., 2004) which are not often shown in the PSN activity. The findings of this study also provide evidence that technology may be a double-edged sword. When it is designed

properly to support both cognitive artifacts and members' interaction, it is more likely to have positive effects on cooperation. If not so, it may limit the effect and even hinder cooperation. Hartwood, Procter, Rouncefield, and Slack's work (2003) on electronic medical records discovered important discrepancies between the assumed and actual benefits of the system and questioned the role of technology in supporting medical work. They pointed out design should not be the simple creation of technical fixes as supplement or replacement of work practice. They characterize the prior design approach as making work practice fit the requirements of the system. They suggest that the system needs to fit the work practice. To maximize the benefits of technology, they argued there is a need to examine the technology in use because users and activities are constantly adapting and evolving. Most importantly, design and development is an ongoing process and must actively support the cooperative aspect of work.

In addition, not all forms of technology use have significant effects on cooperation. This study demonstrates different types of technology use have different effects on cooperative behavior. The findings suggest that finding ways to encourage high levels of appropriation on the parts of reporters while entering a safety event may lead to higher levels of cooperation (resolvers are more likely to make an effort to help others understand and support each other when resolving an event). Another important implication is that system designers and developers must create features that fit and support appropriation by reporters, especially for the condition when the event has a bigger scope involving more departments and the issue is more complex. Future research is needed to study in what ways the system design can help better handle complex events and reduce its negative effect on cooperation.

*The Effects of Technology Use on Organizational Learning*

Technology has been demonstrated to support communication and dialog in workplaces that allow and encourage participation and engagement in communicative and productive work practices and activities (Holmberg, 2000). Complex events often require more expertise from different specialties and should afford more learning opportunities. However, the findings in this study show opposite results. The bigger scope and greater the complexity of an event as indicated in PSN Use, the lower overall organizational learning is perceived. More specifically, the negative effect is primarily on the Transfer of Knowledge (TOK) factor in organizational learning (see Figure 5.4). In other words, reporters taking on complex events felt lower levels of information sharing and discussion going on with others in the organization after reporting than did reporters of less complex events. In a qualitative study of a computer-aided system for organizational learning, Goodman (1998) also found difficulty for supporting and handling complex tasks through an electronic library system. One possible explanation could be when an event gets complex, it tends to take longer to resolve so there is no timely feedback and communication and there is also a greater chance that a member may not participate or contribute efforts, such as the free-rider or social loafing effects (Chidambaram & Tung, 2005; Liden, Wayne, Jaworski, & Bennett, 2004). Reporters' comments collected by the OLS provide evidence supporting this explanation. An implication of this finding is the need to improve PSN to include features that can help manage complex events more efficiently and effectively. Moreover, there is a need for management to support reporters and develop a common ground for safer practice.

Reporters' text comments on the OLS survey support this explanation.

> "In my experience there is not a quick enough turn around time with resolutions. It took over two weeks for a PSN to be resolved. I feel that to be extremely unsatisfactory, and it is something that needs to be addressed."
>
> "I am very frustrated by the abdication of responsibility that I see repeatedly by some departments. If they are not directly responsible for the error then they also assume that they have no responsibility for the solution. I believe that if I personally have acted well but my actions have lead to someone else to make an error, then I may need to change my behavior. I do not see this happening. I feel like I am swatting at flies while the screen door is open. If all departments do not see that they own part of the solution, this will not work".

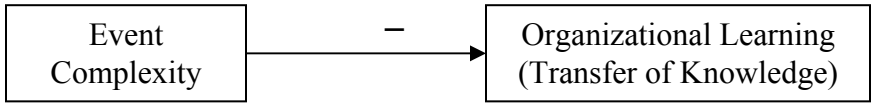



Figure 5.4 Direct and Negative Effect of Event Complexity on Organizational Learning

Another finding is a negative significant relationship between Appropriation of Resolution and overall organizational learning. More specifically, the effect is on the Transfer of Knowledge factor in organizational learning. However, the results also show an interesting tendency that the more extreme, low or high, in Appropriation of Resolution in PSN Use is, the higher Transfer of Knowledge (TOK) is perceived in organizational leaning.

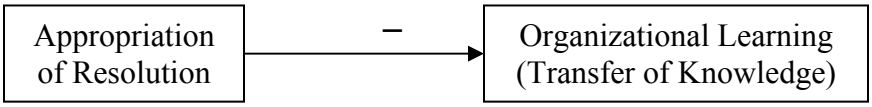



Figure 5.5 Direct and Negative Effect of Appropriation of Resolution on Organizational Learning

A possible explanation of why the middle level of Appropriation of Resolution correlates with the lowest sense of Transfer of Knowledge (TOK) may be the lack of two-way communication mechanism built in for further clarification of information which, in turn, has a greater potential to result in mis-understanding and mis-communication among members. In Edmondson's study on group level work (2002), she discovered group members tend to not inquire into issues that might be mis-understood or have disagreements. This finding indicates that sharing information with others does not necessarily lead to a sense of transfer of knowledge. The quality of shared information is the key. Sharing high quality information, regardless of the quantity, leads to a sense of transferring knowledge. Given the importance of providing timely feedback recommended by past studies (Suresh et al., 2004; Tuttle et al., 2004), we must consider that sharing insufficient or poor quality information may result in an even more negative impact on the sense of transferring knowledge than sharing no information at all because employees' perception that the organization did not utilize their ideas often resulted in negative consequences (Bontis et al., 2002).

Reporters' text comments on the OLS survey support this explanation.

> "I don't feel like my report was taken seriously"
>
> "When suggestions are made, there is never any feedback as to if or why the post ideas would work or not work"
>
> "It would be nice to know that you are taken seriously. When I make a mistake and spend time I don't have doing a PSN, it would be nice to know that the information I provide is actually read and acted on"
>
> "I have also noticed that when a PSN is resolved the resolution is as short a comment as possible. There is not any form of constructive

> options, and the PSN is treated as if it is so minor that it does not need to be corrected".

Therefore, future research needs to work on ways for helping resolvers create constructive opinions and share useful resolution to promote transfer of knowledge among members.

Lastly, Appropriation of Reporting has no significant direct and only very weak interaction relationships with overall organizational learning as well as the individual five organizational learning factors. This finding suggests that although reporters initiate interaction and show motivation to learn from a safety event, the learning process and cycle simply cannot be completed without proper responses by resolvers and group efforts in the pursuit of common goals.

These findings suggest that the potential of information technology use to impact an individuals' perception of organizational learning is limited by the quality of shared information and the limitations of technology affordances (Driskell et al., 2003; Gaver, 1991, 1996; Sarker & Sahay, 2002; Thompson & Coovert, 2003).

### *Limitation*

There are several limitations identified during the course of this study. The most significant limitation is the relatively small sample size (N=103), low response rates (8.2%-17.2%) and low representativeness (6.9%-13.0%) of the target population. Moreover, this study was conducted in UMHC using the home-grown system PSN. Therefore, the generalization of the findings to a larger community of healthcare CSCW users should be done with caution. Replication of these processes in a larger and more

representative sample is needed. Further research needs include wider representation of healthcare professionals and other similar settings and applications.

The analytic instruments used in this study were developed or modified to fit with the patient safety context. Organizational learning was measured by the OLS survey after modification for the patient safety context. However, the OLS survey was only sent to the reporter once an event had been officially closed by all parties. Therefore, only the reporters' perspective of organizational learning was collected. Future research is needed to collect multiple aspects of all members involved in the common activity. Technology use was measured by all users' actions recorded in the database and history log. Cooperation was measured by examining the common artifacts, PSRs, using a newly developed rubric. The measures for technology use and cooperation only included the aspects of actions and interactions through and captured by the PSN. More evidence needs to be continuously collected to test and verify the new developed methods and instruments

Anonymous reports were excluded in this study. Past research has shown potential problems with anonymous safety reports, including less details and no opportunity for follow-up or clarification. (Pace et al., 2003). Future research is needed to further examine the impact of anonymity on the findings shown here for technology use, cooperation, and organizational learning.

### *Recommendation*

The primary recommendation to theory development in the area of cooperation, information technology, and organizational learning is the importance of considering activity as the unit of analysis. This approach provides a more comprehensive view and can capture the dynamic nature and multiple aspects of these complex constructs that involve multiple individuals, tools, and resources surrounding a common activity.

Organizational learning does not just happen. It needs to be carefully designed, engineered, and supported. Opportunities for learning are diminished if any part of the dynamic process across individual, group, and organization level is disconnected. The same rule can be applied to cooperation as well! Putting people together in the same place and time does not guarantee a result of cooperation. Cooperative work must be designed to meet all elements of cooperation. Technology does not necessarily have positive impacts on cooperation or organizational learning. Technology may be a double edged sword. It can facilitate cooperation and help achieve organizational learning only when it is designed and implemented properly. If not, negative side effects are foreseeable. To maximize the positive effects of technology, it must be carefully designed to support both the common artifacts and group behaviors in context.

In the practical context of patient safety reporting and resolution, the tensions and status relations between reporters and resolvers need to be addressed, such as by inviting reporters to participate in the resolution process and by providing more constructive feedback to reporters about how the event is resolved. The key to bridge the

difference between reporters and resolvers seems to be two-way interaction and communication.

Moreover, the heavy workload and responsibility of investigating and resolving an safety event needs to be managed by sharing resolution responsibility through work design and technology support  New work design could be achieved by assigning this responsibility to one or more experienced subordinates or inviting experts who have a specialty for the event to work together for a robust resolution that has learning value. By doing so, department managers change their role from resolvers to supervising the process and providing comments that related to managerial and departmental level practices. They still have the first-hand investigation information, yet without losing control. Furthermore, by empowering staff, the assigned staff have the opportunity to learn by actually working on how to solve a practical safety problem in an open and cooperative manner. The findings from this study suggest that resolution is a key to organizational learning. There is no better learning opportunity than the hands-on experience of going through or participating in an investigation and resolution process.

Complex events seem to be the major barrier to cooperation and organizational learning. There is a strong need to improve the system to help manage the scope and complexity of an event and support cross department communication and discussion.

# Appendix A

## Use of PSN for Patient Safety Reporting and Resolution

Appendix A: Use of PSN for Patient Safety Reporting and Resolution

This appendix provides an illustrating current use of PSN v3 for patient safety event reporting and resolution. Primary actors include: Lisa (a registered nurse), Beth (an assistant manager in a nursing department), and Mark (a manager in a pharmacy department).

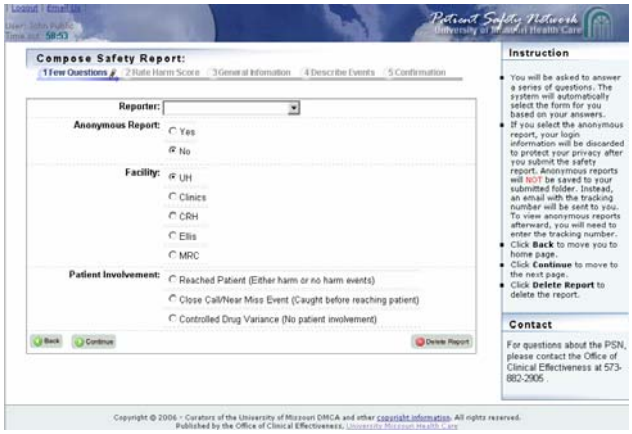
**Safety Event**

Lisa is doing a regular round of giving medications to the patients. When Lisa is giving the medication to Mr. Smith, she checks the charts but does not find a order for this medication. Lisa immediately double checks the charts of all other patients and finds out this medication should have also been ordered and given to Mr. White. Lisa contacts the pharmacy and corrects the orders. Lisa also notifies the attending physician.

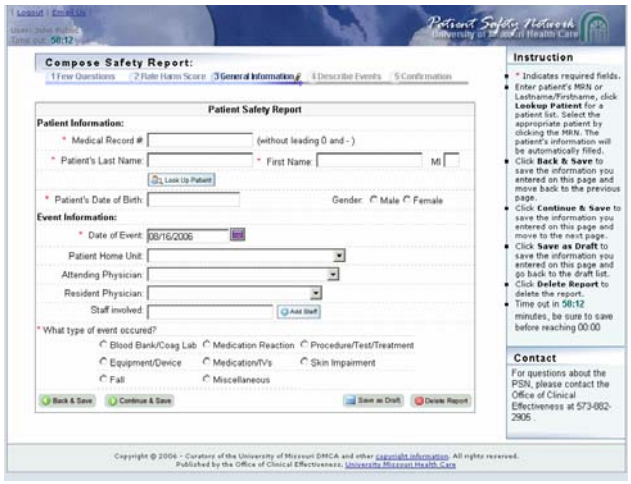
**Reporting**

Lisa feels there is a need to report this safety event through the use of PSN. Lisa goes to the nurse station and logs on to the PSN. On the home page, Lisa clicks on the button to create a new patient safety report.

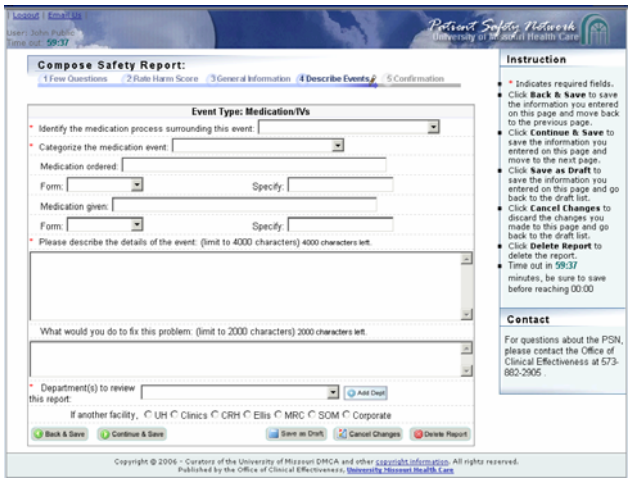
In step 1, Lisa answers some background questions about anonymity, facility, patient involvement, and harm score. (If Lisa chooses to submit the report anonymously, her personal identification information will be discarded for this specific report.)




In step 2, Lisa fills out patient information, provides home unit and physician information, and indicates that this event belongs to the "Medication/IV" event type.

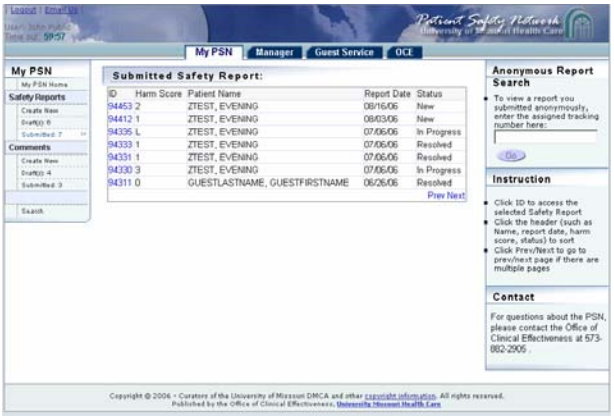



In step 3, Lisa fills out event details for this event, including further categorization of this medication event, and what happened. Lisa also provides suggestions for what she thinks could help prevent this type of event from happening again. Finally, she selects a nursing department and



pharmacy department to review and resolve this report.

During the time while responsible departments are investigating and resolving this report, Lisa can go to her submission history and check the resolution progress.



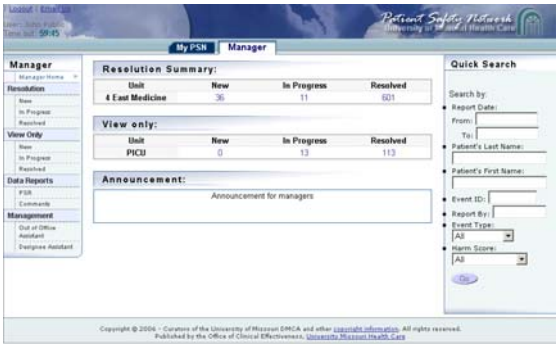

If interrupted while reporting, Lisa has the option to save the report as a draft and return to it later. After completing the report submission, Lisa receives a thank-you email notification that the report has been sent to the responsible departments for review and resolution.

Next, the selected department managers, Beth and Mark, receive an email notification indicating a new patient safety report in the PSN needs their attention.

Once this event is officially closed and resolved by both Beth and Mark. An email notification is delivered back to Lisa telling her that the report has been officially closed by all parties and asking her to review the resolution.

**Resolution**

After seeing the email notification, Beth/Mark logs on to the PSN and sees the new report in the summary table on her/his manager home page. Beth/Mark clicks the number under the new category.

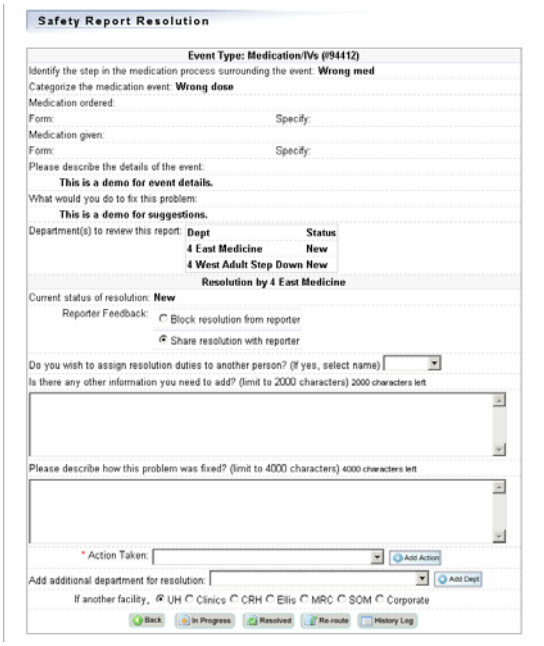



A list of new patient safety reports shows up. Beth/Mark finds Lisa's report by the report ID, reporter name, and date. Beth/Mark clicks on the report ID.


When Beth reviews the report, she sees there is one other department that needs to be involved in the resolution of this event. Beth selects the new department and forwards this event to that department's manager. Beth clicks on the resolution button to see the event details and start the resolution process.

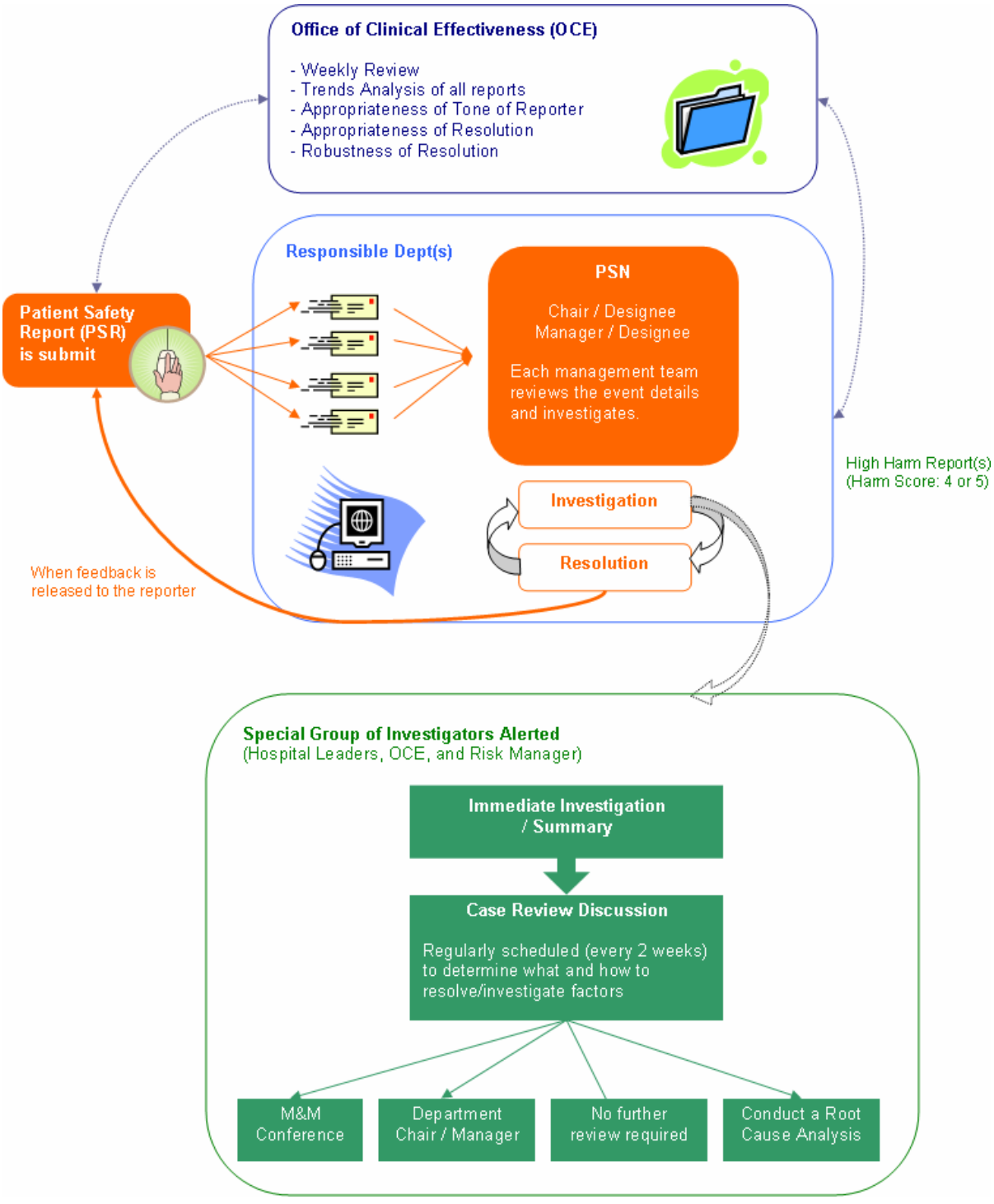

Throughout the resolution process, the managers can see what the other departments are doing for the resolution.

When Beth is reviewing the information provided by Lisa about what happened in this safety event, she can also see Lisa's suggestions to help resolve this event. During the investigation, the managers add additional information about this event from her/his perspective and also provide resolution strategies that they undertake to help prevent this type of event from happening again in the future.




If interrupted or as the investigation proceeds, the managers can always save the information and come back to it later. If the resolution is sensitive, there is an option to block the resolution details from being viewed by Lisa. Also, a manager can assign the resolution to an assistant.

**Note:** For more information about reporting and resolution within the PSN, please visit the PSN Learning Center at https://apps.muhealth.org/psn_staff/index.html, including overview of features, user manuals, and interactive tutorials.

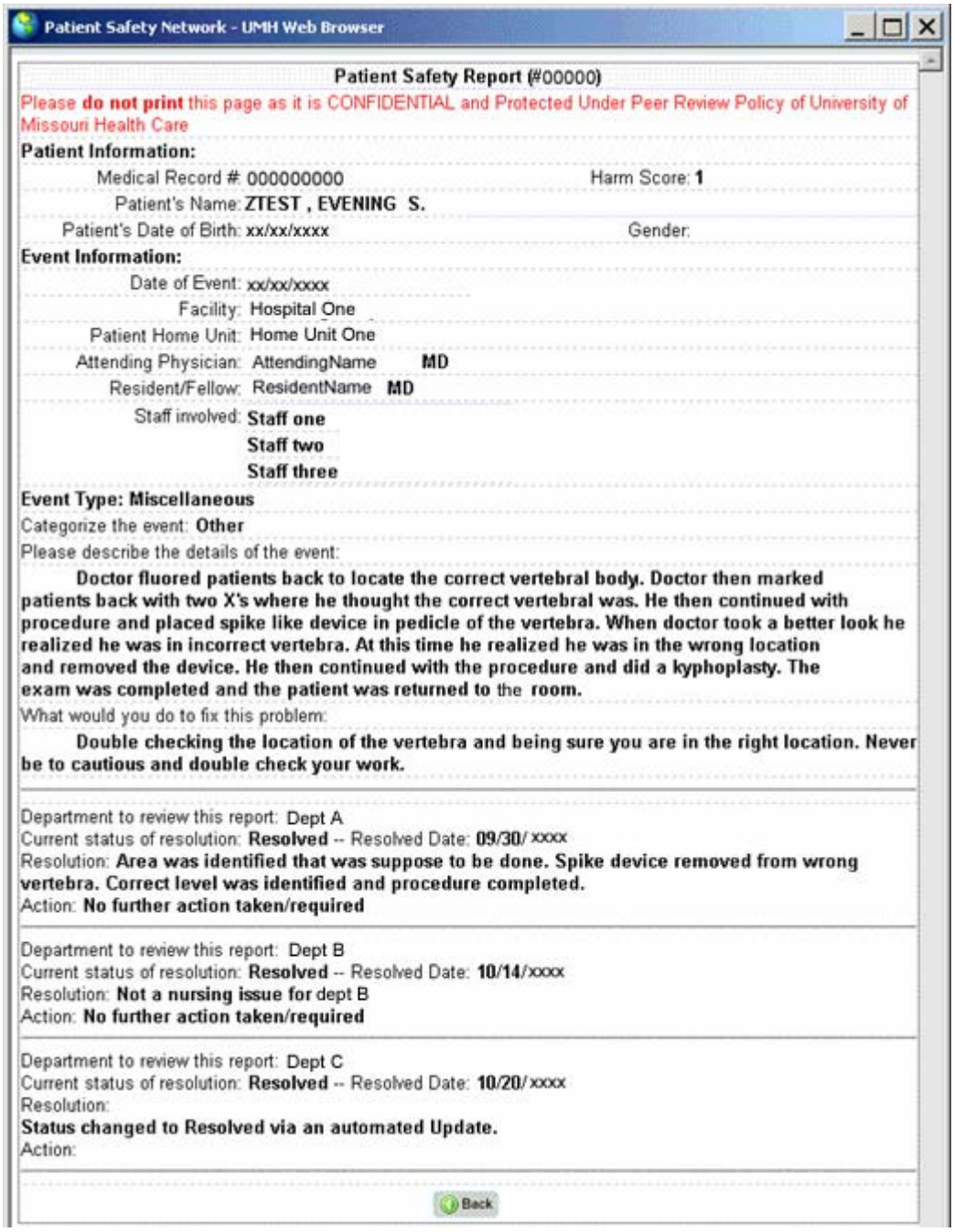


## Appendix B

## Example of a Patient Safety Report

Appendix B: Example of a Patient Safety Report

This patient safety event is reported by a staff member and several resolutions are provided by department managers. The personal identification information in this example has been masked for anonymity.



Patient Safety Network - UMH Web Browser

**Patient Safety Report (#00000)**

Please **do not print** this page as it is CONFIDENTIAL and Protected Under Peer Review Policy of University of Missouri Health Care

**Patient Information:**

Medical Record #: 000000000 Harm Score: **1**

Patient's Name: **ZTEST , EVENING S.**

Patient's Date of Birth: **xx/xx/xxxx** Gender:

**Event Information:**

Date of Event: xx/xx/xxxx

Facility: Hospital One

Patient Home Unit: Home Unit One

Attending Physician: AttendingName **MD**

Resident/Fellow: ResidentName **MD**

Staff involved: **Staff one**
**Staff two**
**Staff three**

**Event Type: Miscellaneous**

Categorize the event: **Other**

Please describe the details of the event:

**Doctor fluored patients back to locate the correct vertebral body. Doctor then marked patients back with two X's where he thought the correct vertebral was. He then continued with procedure and placed spike like device in pedicle of the vertebra. When doctor took a better look he realized he was in incorrect vertebra. At this time he realized he was in the wrong location and removed the device. He then continued with the procedure and did a kyphoplasty. The exam was completed and the patient was returned to the room.**

What would you do to fix this problem:

**Double checking the location of the vertebra and being sure you are in the right location. Never be to cautious and double check your work.**

Department to review this report: Dept A
Current status of resolution: **Resolved** -- Resolved Date: **09/30/xxxx**
Resolution: **Area was identified that was suppose to be done. Spike device removed from wrong vertebra. Correct level was identified and procedure completed.**
Action: **No further action taken/required**

Department to review this report: Dept B
Current status of resolution: **Resolved** -- Resolved Date: **10/14/xxxx**
Resolution: **Not a nursing issue for** dept B
Action: **No further action taken/required**

Department to review this report: Dept C
Current status of resolution: **Resolved** -- Resolved Date: **10/20/xxxx**
Resolution:
**Status changed to Resolved via an automated Update.**
Action:

Back

## Appendix C

## Cooperation Rubric for Evaluating a PSR

Appendix C: Cooperation Rubric for Evaluating a PSR

| | Criteria in PSN | Level of Cooperation | | | |
|---|---|---|---|---|---|
| | | **0** | **1** | **2** | **3** |
| **Positive Interdependence** | Systems perspective and impacts in the organization | o Reporter **fails** to recognize the interdependent relationships with others. The report is obviously **judgmental, snitching, and tattle tail**. | o Reporter document little discussion of motivation or relevance of this event in patient safety. This event is reported because the reporter is **asked or requested to do** OR for the purpose of giving a heads-up or simply documenting an event. | o The motivation for reporting this event and its relevance in patient safety are addressed in a way that the reporter expresses concerns related to patient safety and hopes the **unit management** or supervisors to pay attention and look into the problem. | o The motivation for reporting this event and its relevance in patient safety are clearly and persuasively established in a way that the reporter has confidence that reporting this event will bring positive impacts to the **organization as a whole**. |
| | Beyond Organization Reporting Expectation | -This event is reported as one of the event types that meet the **reporting expectations of the organization**, such as: Falls, Skin Impairment, Control Drug Variance, Incorrect Count, Adverse Drug Reaction, etc. | o This event is reported when it is not included in the reporting expectations and this event reaches and causes harm to a patient with a **harm score ≥ 2**. | o This event is reported when it is not included in the reporting expectations and this event reaches and causes harm to a patient with a **harm score 0 or 1**. | o This event is reported when it is not included in the reporting expectations and this event does not reach to a patient (**near-miss: high and low**). |
| **Promotive Interaction** | Tone of Reporter | o The report is written in a **self-blaming or blaming of a patient** tone. Subjectivity and bias are noticeable in the event description. | o The report is written with **negative emotion** and **to blame others** with either subjective or objective tone. | o The event description of others is referred to **neutrally and no blame**, but the report is primarily a **subjective tone**. | o The event description of others is referred to **neutrally and no blame**. **AND,** the event description is written with an **objective tone or self-report**. |
| | Constructive suggestions | o Reporter provides no system information or **negative comments or focus** is on **fallible human** behaviors. | o Reporter provides **simple comments and no suggestion** to this event **OR** describes **what they did during the event** instead of providing suggestions for future prevention. | o Reporter provides **constructive suggestions** but the suggestions are either **out-of-reach, not operationable,** or suggests following **current policies**. | o Reporter provides constructive suggestions and reasonable **systems improvements** to the event. |

| | Criteria in PSN | Level of Cooperation | | | |
|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 |
| **Social Skills** | Proper and congruence of resolution | o **No suggested fix** by the reporter **AND none** by the resolvers.<br>o Routed | o **No suggestion** is provided by the reporter **OR no new resolution** strategy is written by the resolvers. | o Resolvers **value** the reporter's view points but do **not adapt** the reporter's opinions for resolution strategies. OR, resolvers provide resolution but do **not take** a **leadership** role to fix problem. | o Resolvers **value** the reporter's view points **and adapt** the reporter's opinions to make fair decisions for resolution strategies that may or may not match with reporter's suggested fix. |
| | Shared resolution | o Resolvers **block** the resolutions to the reporter.<br>o Routed | o Resolvers open the resolution to the reporter and resolvers **only** select **actions** and do **no**t provide **substantive resolution details**. | o Resolvers open the resolution to the reporter. The resolvers select **actions** and provide **some resolution details.** | o Resolvers open resolution to the reporter, select **actions,** and provide **sufficient and clear resolution details**. |
| | Narratives of Resolvers | o The resolution narrative is written in a non-systems aspect and blaming others (fallible human behaviors) rather than constructive strategies. | o There is no resolution narrative and additional information by the resolvers which show no attempt is made to acknowledge the work of the reporter.<br>o Don't know/ not our problem. | o There is resolution narrative and additional information by the resolvers but no acknowledge to the work of the reporter. | o There is resolution narrative and additional information by the resolvers, and resolvers express appreciation and acknowledge the work of the reporter. |
| **Accountability** | Event description | o The event description seems **intentionally insufficient and vague** that the resolvers gain little information from the report. It appears that little attempt has been made to help the resolvers understand this event | o **Some detail** is included in the event description but does not allow the resolvers to fully understand the context or make judgments for resolutions. The resolvers **need to add additional contextual information**. | o **Sufficient detail** is presented in the event description to allow the resolvers to understand the context and make judgments for resolutions. The resolvers need to present **additional facts** of event. | o An **accurate and complete event description** with preceding causes is presented to allow the resolvers to understand the context and make judgments for resolutions. The resolvers do **not need add additional information**. |
| | Anonymity | o The PSR is submitted anonymously and the report lack of details to associate with a group of professionals or an individual. | o The PSR is submitted anonymously but include details that can be used to associate with a group of professionals. | o The PSR is submitted and disclosed one's professional identification OR without an individual's identity. | o The PSR is submitted and disclosed with an individual's identity and profession. |

| | Criteria in PSN | Level of Cooperation | | | |
|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 |
| Group Processing | Actions taken | o Resolvers select and use the following actions for resolutions:<br><br>-Do not meet reporting criteria.<br>-No further action taken / required.<br>-Unable to identify device<br>-Re-route | o Resolvers select and use no cooperative actions for resolutions:<br><br>- Device tracking<br>- Patient record labeled<br>- Policy / procedure changed<br>- Coaching /education - individualized | o Resolvers select and use low cooperative actions for resolutions:<br><br>- Coaching/education – comprehensive<br>- Device troubleshooting / operational check/repair<br>- Removed from service<br>- Reviewed/discussed (Staff/QI meetings) | o Resolvers select and use high cooperative actions for resolutions:<br><br>-Root cause analysis planned / completed<br>-Improvement team formed |
| | Resolution Process | o The event is not yet completely closed by all parties, so there is no information regarding the time and effort spent on investigating and resolving this event. | o The event is completely closed by all parties. The resolution process takes more than 1SD average resolution time and it does not go through any investigation process: New→ Resolved. | o The event is completely closed by all parties. The resolution process takes less than 1SD average resolution time AND it goes through the investigation process: New→ In-Progress→ Resolved. | o The event is completely closed by all parties. The resolution process takes less than 1SD average resolution time OR it goes through the investigation process: New→ In-Progress→ Resolved. |

## Appendix D

## Cooperation Code Book for Evaluating a PSR

Appendix D: Cooperation Code Book for Evaluating a PSR

# COOPERATION CODE BOOK V2.0

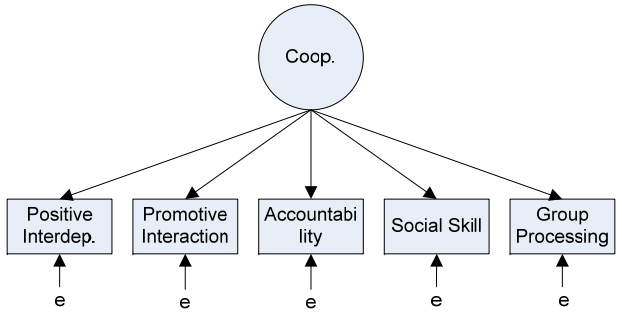
November 10th, 2007
BY Pei-Ju Liu

## INDEX





**Cooperation**: Individuals work interdependently and contribute efforts to achieve mutual benefits through active participation and communication among one another.




(Johnson & Johnson, 1996)

## DEFINITION OF CONSTRUCTS

| Construct | Definition |
|---|---|
| **Positive interdependence** | Individuals feel like linked with others in a way that one cannot succeed unless they all do and/or that one must coordinate one's efforts with the efforts of others to complete tasks. They understand that they sink or swim together through the outcome (goal and reward) or means (resource, task, and role) interdependence. |
| **Accountability** | It is a sense of responsibility for contributing one's efforts to accomplish the common goals. |
| **Promotive interaction** | Efforts are used to encourage and facilitate each other to complete tasks and reach the common goal, such as providing help, exchanging information or resources, using other's opinion for decision making, achieving mutual benefits, etc. |
| **Social skills** | Skills needed for high quality cooperation where members must mutually trust each other, communicate accurately and unambiguously, accept and support each other, and resolve conflict constructively. |
| **Group processing** | A group functions and supports the effectiveness of the members. |

| PSN Indicator | Level of Cooperation | | | | Constructs |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | |
| Systems perspective and impacts in the organization (1) | o Reporter **fails** to recognize the interdependent relationships with others. The report is obviously **judgmental, snitching, and tattle tail**. | o Reporter document little discussion of motivation or relevance of this event in patient safety. This event is reported because the reporter is **asked or requested to do** OR for the purpose of giving a heads-up or simply documenting an event. | o The motivation for reporting this event and its relevance in patient safety are addressed in a way that the reporter expresses concerns related to patient safety and hopes the **unit management** or supervisors to pay attention and look into the problem. | o The motivation for reporting this event and its relevance in patient safety are clearly and persuasively established in a way that the reporter has confidence that reporting this event will bring positive impacts to the **organization as a whole**. | **Positive Interdependence** |
| Event description (1) | o The event description seems **intentionally insufficient and vague** that the resolvers gain little information from the report. It appears that little attempt has been made to help the resolvers understand this event | o **Some detail** is included in the event description but does not allow the resolvers to fully understand the context or make judgments for resolutions. The resolvers **need to add additional contextual information**. | o **Sufficient detail** is presented in the event description to allow the resolvers to understand the context and make judgments for resolutions. The resolvers need to present **additional facts** of event. | o An **accurate and complete event description** with preceding causes is presented to allow the resolvers to understand the context and make judgments for resolutions. The resolvers do **not need add additional information**. | **Accountability** |
| Tone of Reporter (1) | o The report is written in a **self-blaming or blaming of a patient** tone. Subjectivity and bias are noticeable in the event description. | o The report is written with **negative emotion** and **to blame others** with either subjective or objective tone. | o The event description of others is referred to **neutrally and no blame**, but the report is primarily a **subjective tone**. | o The event description of others is referred to **neutrally and no blame**. **AND,** the event description is written with an **objective tone or self-report**. | **Promotive Interaction** |
| Constructive suggestions (2) | o Reporter provides no system information or **negative comments or focus** is on **fallible human** behaviors. | o Reporter provides **simple comments and no suggestion** to this event **OR** describes **what they did during the event** instead of providing suggestions for future prevention. | o Reporter provides **constructive suggestions** but the suggestions are either **out-of-reach, not operationable,** or suggests following **current policies**. | o Reporter provides constructive suggestions and reasonable **systems improvements** to the event. | **Promotive Interaction** |
| Proper and congruence of resolution (4) | o **No suggested fix** by the reporter **AND none** by the resolvers.<br>Routed | o **No suggestion** is provided by the reporter **OR no new resolution** strategy is written by the resolvers. | o Resolvers **value** the reporter's view points but do **not adapt** the reporter's opinions for resolution strategies. OR, resolvers provide resolution but do **not take** a **leadership** role to fix problem. | o Resolvers **value** the reporter's view points **and adapt** the reporter's opinions to make fair decisions for resolution strategies that may or may not match with reporter's suggested fix. | **Social skill** |

| PSN Indicator | Level of Cooperation | | | | Constructs |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | |
| Shared resolution 4 | o Resolvers **block** the resolutions to the reporter.<br>o Routed | o Resolvers open the resolution to the reporter and resolvers **only** select **actions** and do **not** provide **substantive resolution details**. | o Resolvers open the resolution to the reporter. The resolvers select **actions** and provide **some resolution details.** | o Resolvers open resolution to the reporter, select **actions,** and provide **sufficient and clear resolution details**. | **Social skill** |
| Narratives of Resolvers 4 | o The resolution narrative is written in a non-systems aspect and blaming others (fallible human behaviors) rather than constructive strategies. | o There is no resolution narrative and additional information by the resolvers which show no attempt is made to acknowledge the work of the reporter.<br>o Don't know/ not our problem. | o There is resolution narrative and additional information by the resolvers but no acknowledge to the work of the reporter. | o There is resolution narrative and additional information by the resolvers, and resolvers express appreciation and acknowledge the work of the reporter. | **Social skill** |
| Anonymity 5 | o The PSR is submitted anonymously and the report lack of details to associate with a group of professionals or an individual. | o The PSR is submitted anonymously but include details that can be used to associate with a group of professionals. | o The PSR is submitted and disclosed one's professional identification OR without an individual's identity. | o The PSR is submitted and disclosed with an individual's identity and profession. | **Accountability** |
| Organization Reporting Expectation 6 | - This event is reported as one of the event types that meet the **reporting expectations of the organization**, such as: Falls, Skin Impairment, Control Drug Variance, Incorrect Count, Adverse Drug Reaction, etc. | o This event is reported when it is not included in the reporting expectations and this event reaches and causes harm to a patient with a **harm score ≥ 2**. | o This event is reported when it is not included in the reporting expectations and this event reaches and causes harm to a patient with a **harm score 0 or 1**. | o This event is reported when it is not included in the reporting expectations and this event does not reach to a patient (**near-miss: high and low**). | **Positive Interdependence** |

| PSN Indicator | Level of Cooperation | | | | Constructs |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | |
| Actions taken<br>3 | o Resolvers select and use the following actions for resolutions:<br>- Do not meet reporting criteria.<br>- No further action taken / required.<br>- Unable to identify device<br>- Re-route | o Resolvers select and use no cooperative actions for resolutions:<br>- Device tracking<br>- Patient record labeled<br>- Policy / procedure changed<br>- Coaching /education - individualized | o Resolvers select and use low cooperative actions for resolutions:<br>- Coaching/education – comprehensive<br>- Device troubleshooting / operational check/repair<br>- Removed from service<br>- Reviewed/discussed (Staff/QI meetings) | o Resolvers select and use high cooperative actions for resolutions:<br>- Root cause analysis planned / completed<br>- Improvement team formed | **Group Processing** |
| Resolution Process<br>7 | o The event is **not yet completely closed** by all parties, so there is no information regarding the time and effort spent on investigating and resolving this event. **OR**, the resolution takes **more than 1 month**. | o The event is completely closed by the party. The resolution process takes **more than 10 days AND** it does not go through any investigation process: **New→ Resolved.** | o The event is completely closed by the party. The resolution process takes **equal or less than 10days OR** it goes through the investigation process: **New→ In-Progress→ Resolved.** | o The event is completely closed by the party. The resolution process takes **less than 10days AND** it goes through the investigation process: **New→ In-Progress→ Resolved.** | **Group Processing** |

# EXAMPLE – Visual Mapping

**Patient Safety Report (#demo101 )**

Please **do not print** this page as it is CONFIDENTIAL and Protected Under Peer Review Policy of University of Missouri Health Care

**Patient Information:**

Medical Record #: Harm Score: 1

Patient's Name:

Patient's Date of Birth: Gender:

**Event Information:**

Date of Event: **05/07/2007**

Facility: **University Hospital**

Patient Home Unit: **6 West Adult Medicine Services**

Attending Physician: **Physician 1, MD**

Resident/Fellow: **Resident 1, MD**

Staff involved: **Staff1** **Staff2.**

5

6 **Event Type: Equipment/device**

Categorize the equipment event: **Malfunction**

Description of equipment: **Ross Patrol enteral pump**

Clinical Engineering Tag # Manufacturer: **Ross**

Serial Number: **2005037** Model Number: **patrol**

Date removed from service: **05/07/2007**

Please describe the details of the event:

1 **anorexic patient with tube feedings; in am at shift change the nurse and patient noticed less tube feeding in bag than expected. patient c/o abdominal discomfort. pump was taken to clinical engineering and found to be infusing 50 cc hr more than what is set to infuse. Dr. Wisdom was notified**

What would you do to fix this problem:

2 **calibrate the feeding pumps more frequently**

---

Department to review this report: **UH - 6 West Adult Medicine Services**
Current status of resolution: **Resolved** -- Resolved Date: **05/17/2007**
Action: **Device troubleshooting/operational check/repair**

3

---

Department to review this report: **UH - Clinical Engineering (MUHC)**
Current status of resolution: **Resolved** -- Resolved Date: **05/16/2007**

4

Resolution: **Pump was sent to manufacturer for repair/calibration. Feeding pumps are maintained by vendor.**
Action: **Device troubleshooting/operational check/repair**

History Log:

| Change By | Change Date | Field | Old Value | New Value |
|---|---|---|---|---|
| wittingjg | 5/7/2007 12:02:53 PM | STATUS | New | In progress |
| wittingjg | 5/16/2007 7:30:11 AM | STATUS | In progress | Resolved |
| robbinsb | 5/17/2007 12:17:51 PM | STATUS | New | Resolved |

7

## RECORDING – Original Categories

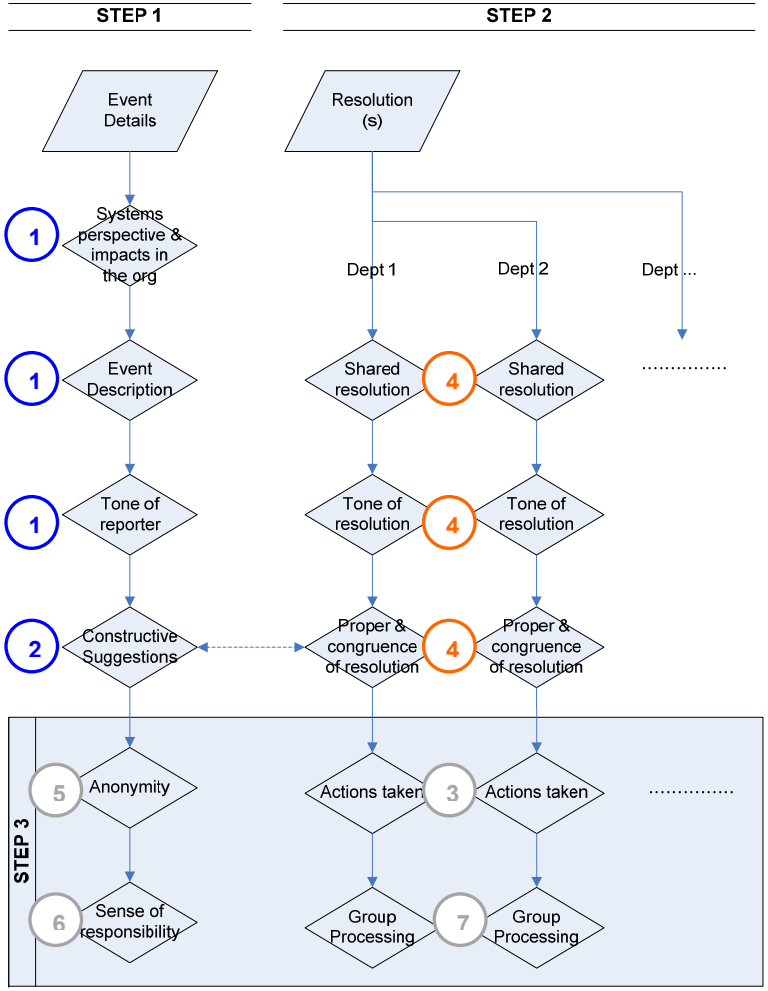
| | | Criteria in PSN | reporter | dept | dept | dept | dept |
|---|---|---|---|---|---|---|---|
| Positive Interdependence | 1 | System perspective & impacts in the organization | 2 | | | | |
| | 6 | Sense of Responsibility | 3 | | | | |
| Promotive Interaction | 1 | Tone of Reporter | 3 | | | | |
| | 2 | Constructive Suggestions | 2 | | | | |
| Account ability | 5 | Anonymity | 3 | | | | |
| | 1 | Event Description | 3 | | | | |
| Social Skills | | Proper & congruence of Resolution | | 1 | 2 | | |
| | 4 | Shared Resolution | | 1 | 2 | | |
| | | Narratives of Resolvers | | 1 | 2 | | |
| Group Processing | 3 | Actions Taken | | | | | |
| | 7 | Resolution Process | | 2 | 3 | | |

## SIMPLIFIED RECORDING FORM

| dept | | | Criteria in PSN | reporter | dept | dept |
|---|---|---|---|---|---|---|
| | Positive Interde. | 1 | System perspective & impacts in the organization | 2 | | |
| | Acount. | 1 | Event Description | 3 | | |
| | Promo. Interact. | 1 | Tone of Reporter | 3 | | |
| | Promo. Interact. | 2 | Constructive Suggestions | 2 | | |
| | Social Skills | 4 | Proper & congruence of Resolution | | 1 | 2 |
| | Social Skills | 4 | Shared Resolution | | 1 | 2 |
| | Social Skills | 4 | Narratives of Resolvers | | 1 | 2 |
| | Acount. | 5 | Anonymity | 3 | | |
| | Positive Interde. | 6 | Sense of Responsibility | 2 | | |
| | Group Pro. | 3 | Actions Taken | | 2 | 2 |
| | Group Pro. | 7 | Resolution Process | | 2 | 3 |

SIMPLFIED RECORDING FORM

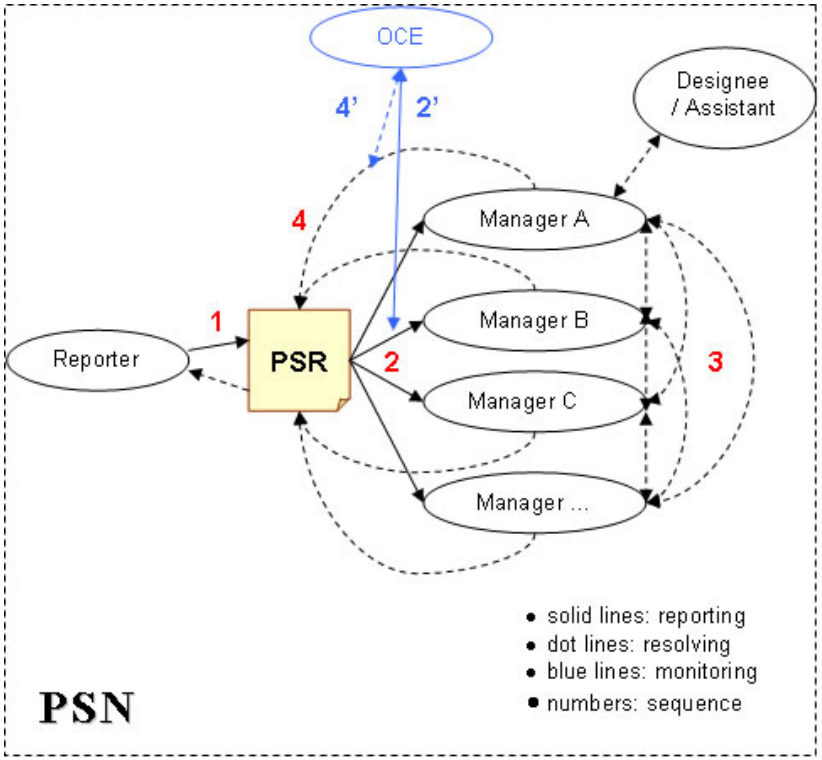
## RECORDING DECISION TREE




RECORDING DECISION TREE

| Positive interdependence | | |
|---|---|---|
| **Definition** | Individuals feel like inked with others in a way that one cannot succeed unless they all do and/or that one must coordinate one's efforts with the efforts of others to complete tasks. They understand that they sink or swim together through the outcome (goal and reward) or means (resource, task, and role) interdependence. | |
| **PSR Indicator(s)** | System perspective & impacts in the organization | Individuals recognize the interdependent relationship with others. They aware a safety event can't be solved merely by themselves and believe in reporting an event can bring positive impacts to the organization as a whole. |
| | Organization Reporting Expectation | Patient safety expectation of reporting from the organization or management. |
| **Accountability** | | |
| **Definition** | It is a sense of responsibility for contributing one's efforts to accomplish the common goals. | |
| **PSR Indicator(s)** | Anonymity | An event report is disclosed with a reporter's identify and profession. |
| | Event Description | An event is provided with accurate and complete information that expedites resolutions. |
| **Promotive interaction** | | |
| **Definition** | Efforts are used to encourage and facilitate each other to complete tasks and reach the common goal, such as providing help, exchanging information or resources, using other's opinion for decision making, achieving mutual benefits, etc. | |
| **PSR Indicator(s)** | Tone of Reporter | An event is neutrally and objectively described using facts without blame. |
| | Constructive Suggestions | Constructive and reasonable suggestions to an event are provided. |
| **Social skills** | | |
| **Definition** | Skills needed for high quality cooperation where members must mutually trust each other, communicate accurately and unambiguously, accept and support each other, and resolve conflict constructively. | |
| **PSR Indicator(s)** | Proper & congruence of Resolution | Reporter's perspective and opinions are valued and adapted to make fair judgments for leading resolution. |
| | Shared Resolution | Clear and sufficient resolution and information details are shared with others. |
| | Narratives of Resolvers | Resolvers recognize and acknowledge the efforts |

| Group processing | | |
|---|---|---|
| **Definition** | A group functions and supports the effectiveness of the members. | |
| **PSR Indicator(s)** | Actions Taken | The types of resolution actions taken by resolvers |
| | Resolution Process | The resolution time and efforts by resolvers. |



## Appendix E

## Organizational Learning Survey adapted from Goh & Richards (1997)

Appendix E: Organizational Learning Survey adapted from Goh & Richards (1997)

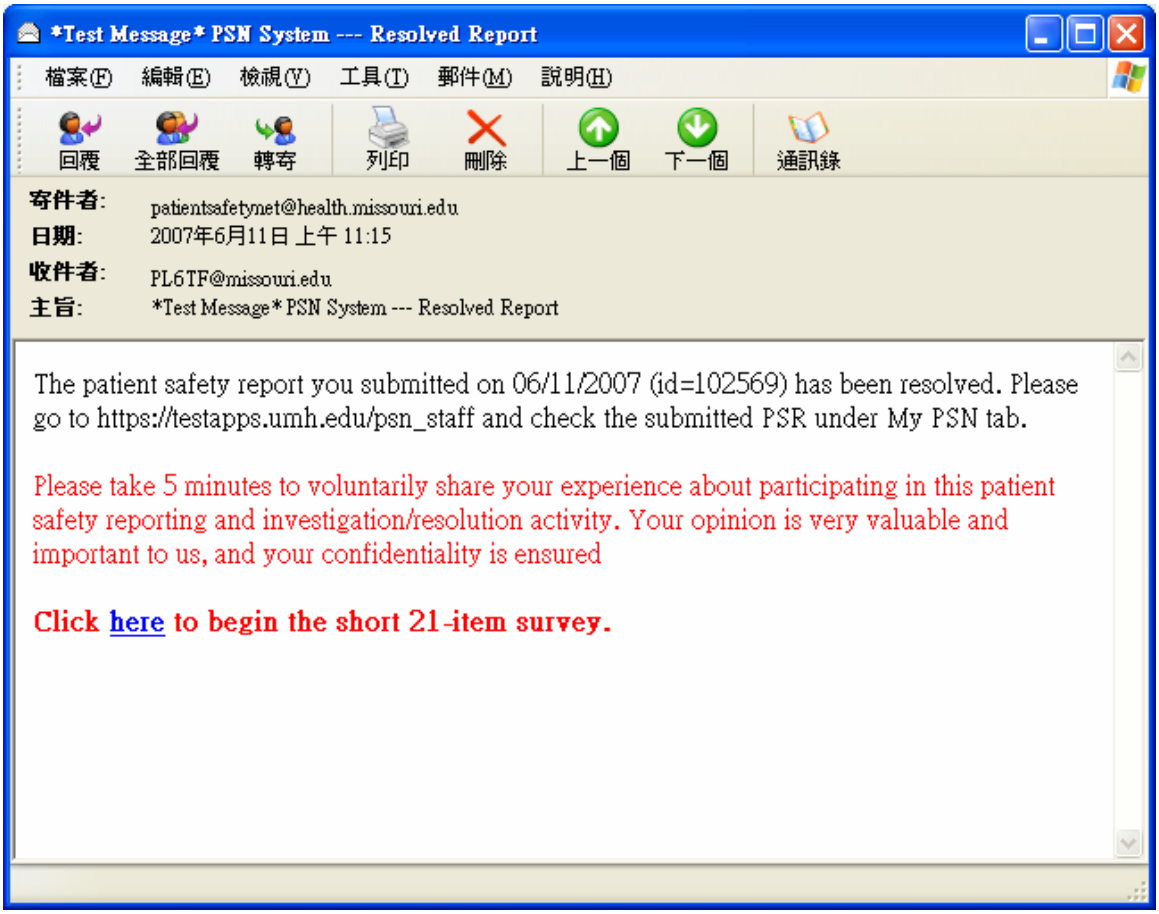
| Dimension | # | Original Items | Study Items |
|---|---|---|---|
| **Clarity of Mission and Vision** | 1 | There is widespread support and acceptance of the organization's mission statement. | There is widespread support and acceptance of the UMHC's mission statement for improving quality of patient safety. |
| | 2 | I do not understand how the mission of the organization is to be achieved. | I do not understand how the UMHC mission of improving quality of patient safety is to be achieved. |
| | 3 | The organization's mission statement identifies values to which all employees must conform. | The UMHC's mission statement in quality/patient safety identifies values around event reporting in which all employees must conform. |
| | 4 | We have opportunities for self assessment with respect to goal attainment. | I have opportunities for self assessment with respect to the UMHC goal for patient safety through event reporting. |
| **Leadership Commitment and Empowerment** | 5 | Senior managers in this organization resist change and are afraid of new ideas. | Top management in UMHC resist change and are afraid of new ideas that are obtained from event reporting. |
| | 6 | Senior managers and employees in this organization share a common vision of what our work should accomplish. | Top management and employees in the UMHC share a common vision of work to be accomplished in patient safety through event reporting. |
| | 7 | Managers in this organization can accept criticism without becoming overly defensive. | Managers in UMHC can accept criticism without becoming overly defensive for issues related to patient safety reports. |
| | 8 | Managers in this organization often provide useful feedback that helps to identify potential problems and opportunities. | Managers in UMHC provide useful feedback that helps to identify potential problems and opportunities in patient safety and event reporting. |
| | 9 | Managers in this organization frequently involve employees in important decisions. | Managers in UMHC frequently involve employees in important decisions related to patient safety and event investigation/resolution. |

| Dimension | # | Original Items | Study Items |
|---|---|---|---|
| Experimentation | 10 | I can often bring new ideas into the organization. | I can often bring new ideas into UMHC through patient safety reporting. |
| | 11 | From my experience, people who are new in this organization are encouraged to question the way things are done. | From my experience, people who are new in UMHC are encouraged to question the way things are done for patient safety improvements. |
| | 12 | Managers in this organization encourage team members to experiment in order to improve work processes. | Managers in UMHC encourage team members to try new ideas in order to improve work processes related to patient safety and event reporting. |
| | 13 | Innovative ideas that work are often rewarded by management. | Innovative ideas in event reporting are often rewarded by management. |
| | 14 | In my experience, new ideas from employees are not treated seriously by management. | In my experience, new ideas raised from event reporting are not treated seriously by management. |
| Transfer of Knowledge | 15 | I often have an opportunity to talk to other staff about successful programs or work activities in order to understand why they succeed. | After a safety event, I often have an opportunity to talk to other staff about successful experiences or work activities in order to understand why they succeed. |
| | 16 | Failures are seldom constructively discussed in our organization. | Patient Safety reports are seldom constructively discussed in UMHC. |
| | 17 | New work processes that may be useful to the organization as a whole are usually shared with all employees. | New work processes related to enhancing patient safety that may be useful to UMHC as a whole are usually shared with all employees. |
| | 18 | We have a system that allows us to learn successful practices from other organizations. | We have a system that allows us to learn successful practices related to patient safety events from other organizations. |
| Teamwork and Group-Problem Solving | 19 | Current organizational practice encourages employees to solve problems together before discussing them with a manager. | Current organizational practice encourages employees to solve problems related to patient safety and event reporting together before discussing them with a manager. |
| | 20 | We cannot usually form informal groups to solve organizational problems. | We cannot usually form informal groups to solve organizational problems related to patient safety and event reporting. |
| | 21 | Most problem solving groups in this organization feature employees from a variety of functional areas. | Most problem solving groups or committees related to patient safety in UMHC feature employees from a variety of functional areas. |

## Appendix F

## Email Notification for a Resolved Report with Survey URL

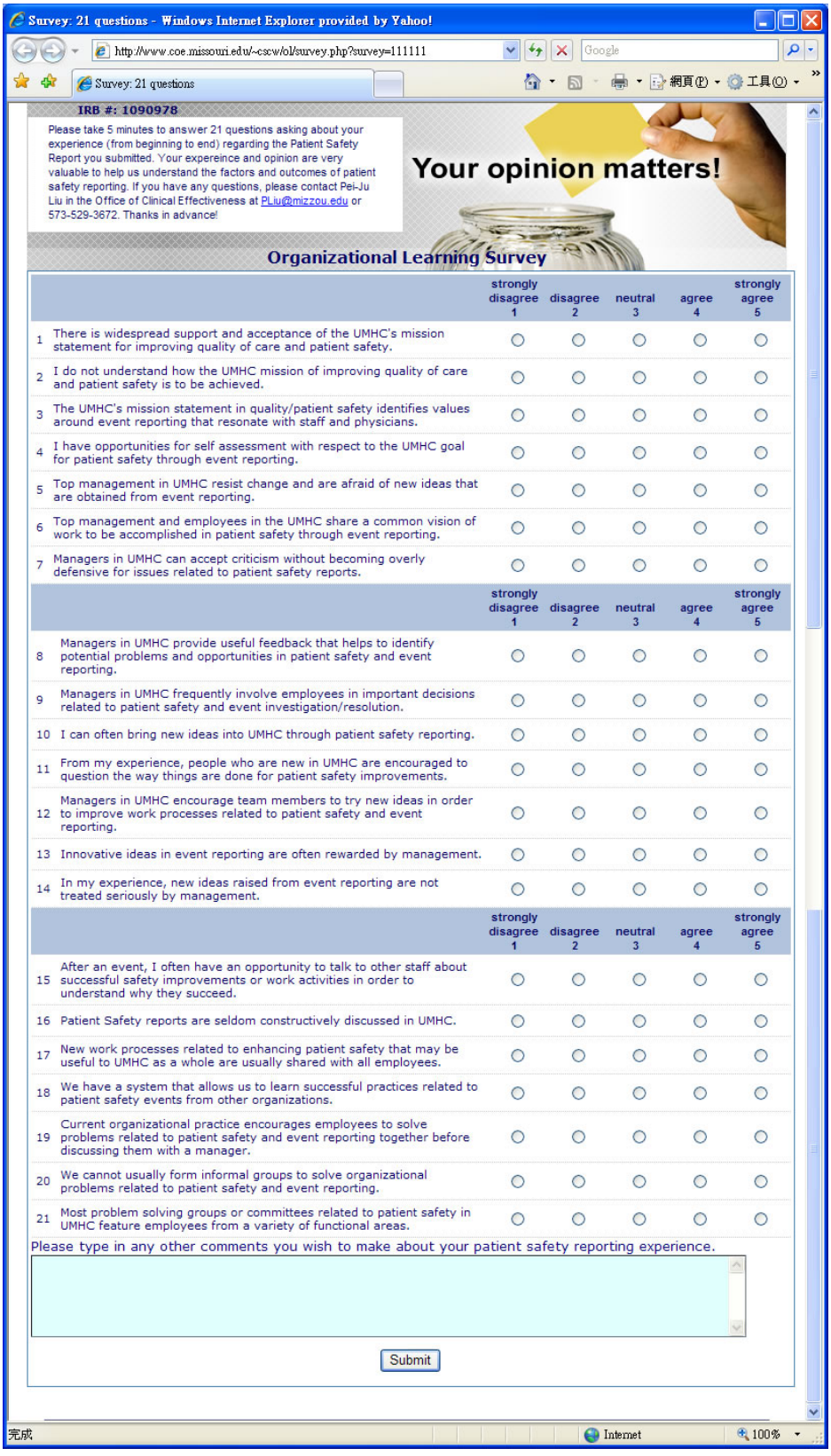
Appendix F: Email Notification for a Resolved Report with Survey URL



## Appendix G

## Organizational Learning Online Survey

# Appendix G: Organizational Learning Online Survey



## Appendix H

## Example of Technology Use of a Patient Safety Report

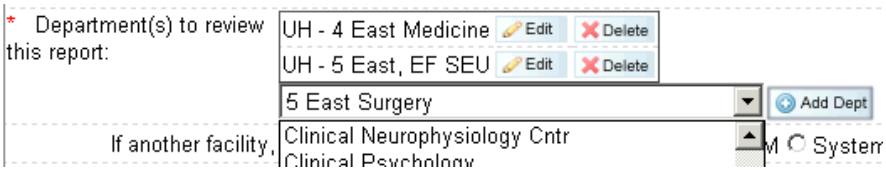
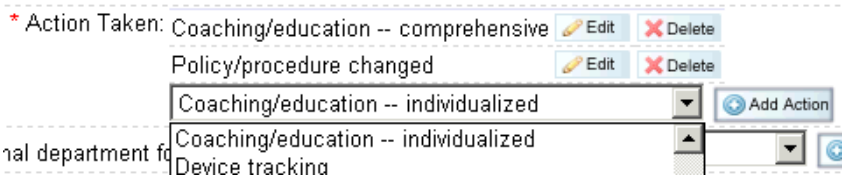
Appendix H: Example of Technology Use of a Patient Safety Report

| Symbol | Description | Formula | Example |
|---|---|---|---|
| TT | Time spent on reporting | The time spent on reporting an event in minutes. | 18 |
| TR | Time to resolution | The number of days to complete and close a PSR | 10 |
| ND | Number of departments selected | The number of responsible department(s) selected by the reporter to review and resolve the event. | 3 |
| NA | Number of total actions taken | The number of actions-taken selected for an event. | 2 |
| NH | Number of total history records | The number of history records in the history log | 7 |
| WE | Number of total characters in event details | The number of characters used in describing the event details | 542 |
| WS | Number of total characters in suggestion | The number of characters used in providing suggestion “how you would do to fix this problem”. | 139 |
| WA | Number of total characters in additional info | The number of characters used in additional information to this event. | 0+0+0=0 |
| WR | Number of total characters in resolution | The number of characters used in describing resolution details | 145+27+52=224 |
| SR | Number of total characters in both resolution & additional information | The number of characters used in describing resolution details and additional information to this event. | |
| RE | Ratio of optional fields used during reporting | The total umber of optional fields used during reporting divided by the total number of possible optional fields in the reporting process. | |
| RS | Ratio of optional fields used during resolution | The total number of optional fields used divided by the total number of possible optional fields in resolution. | |

# Appendix I

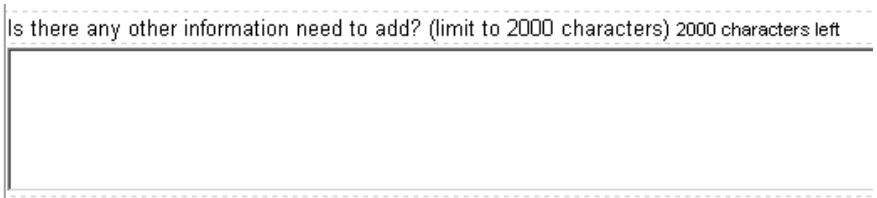
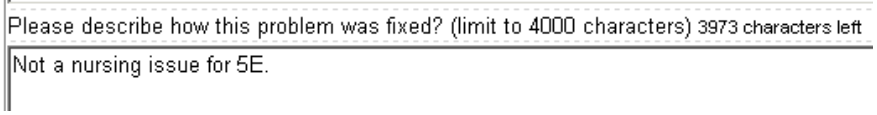
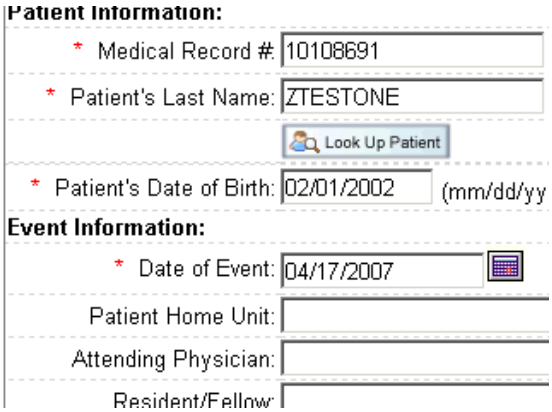
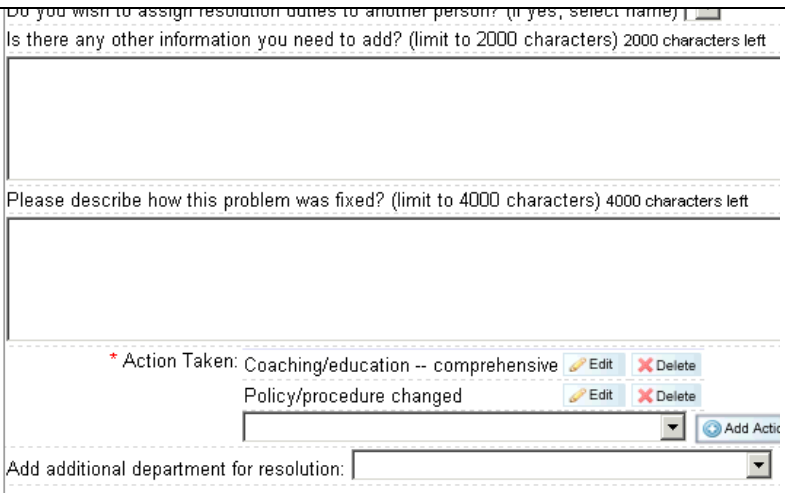
## Examples of Detailed Users' Actions in Action in PSN

Appendix I: Examples of Detailed Users' Actions in Action in PSN

| Indicators | User Actions in Action in PSN |
|---|---|
| TT (Time spent on reporting) | Obtained from the query of history log table in the database |
| TR (Time spent on total resolution) | |
| ND (Number of departments selected) |  |
| NA (Number of total actions taken) |  |
| NH (Number of total history records) | History Log: |

| Change By | Change Date | Field | Old Value | New Value |
|---|---|---|---|---|
| managerA | 9/30/2005 9:09:24 AM | STATUS | New | Resolved |
| managerA | 9/30/2005 9:09:25 AM | DEPT | | 5 East, EF SEU |
| managerA | 9/30/2005 9:09:25 AM | DEPT | | Radiology Dept of (SOM) |
| managerB | 9/30/2005 1:37:16 PM | STATUS | New | In progress |
| managerB | 10/3/2005 7:22:00 AM | STATUS | New | In progress |
| managerB | 10/14/2005 9:03:09 AM | STATUS | In progress | Resolved |
| managerC | 10/20/2006 1:46:08 PM | STATUS | In progress | Resolved |

| | |
|---|---|
| WE (Number of total characters in event details) | * Please describe the details of the event: (limit to 4000 characters) 3458 characters left.<br>Doctor fluored patients back to locate the correct vertebral body(T12). Doctor then marked patients back with two X's where he thought the correct vertebral was. He then continued with procedure and placed spike like device in pedicle of the vertebra. When doctor took a better look he realized he was in L2, the incorrect vertebra. At this time he realized he was in the wrong location and removed the device. He then continued with the procedure and did a kyphoplasty of T12. The exam was completed and the patient was returned to her room. |
| WS (Number of total characters in suggestion) | What would you do to fix this problem: (limit to 2000 characters) 1861 characters left.<br>Double checking the location of the vertebra and being sure you are in the right location. Never be to cautious and double check your work. |

| | |
|---|---|
| WA (Number of total characters in additional information) |  |
| WR (Number of total characters in resolution) |  |
| RF (Ratio of fields used) | The "*" indicates a required field that must be filed before move on to the next step. In this type of event, there are total 13 required fields and 13 optional fields.<br>  |
| RS (Ratio of optional fields used during resolution) |  |

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# VITA

Pei-Ju Liu received her Bachelor degree in Applied Psychology in 1998 and her Master of Educational Technology with emphasis on Network Learning Systems in 2003. Pei-Ju has been teaching multimedia and web design and development courses for the Digital Media ZONE in the School of Information Science and Learning Technologies since 2004. She designed, developed, and delivered course materials and activities as well as evaluation and student performance assessments through various online learning platforms. She also participated and conducted several research projects to investigate the social nature of online learning as well as the effect of instructional strategies. She has been working on design research since 2005 when she started working as the interface designer and user experience researcher for the Office of Clinical Effectiveness in the University of Missouri Health Care. Besides design methodologies and user center design processes, she conducted several research projects to studying how cooperative technologies support cooperative work as well as their influence on organizational learning and culture in the workplace. Her professional goal is to study the use of technologies that support cooperative work and to develop high quality learning environments that make cooperative work and learning universally accessible at anytime and in any place – in schools, in work environments and at home.