A DESCRIPTIVE STUDY OF THE THEMES THAT EMERGE WHEN EXPERT EMPLOYEES KNOWN AS MYUNGJANGS ACQUIRE, UPDATE, AND SHARE THEIR DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS

BY

YOOMIN LEE

DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Human Resource Education
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2019

Urbana, Illinois

Doctoral Committee:

Professor Ronald L. Jacobs, Chair
Professor Elizabeth A. L. Stine-Morrow
Associate Professor Sonali K. Shah
Assistant Professor Eunjung Grace Oh

ABSTRACT

While the literature provides useful insights into the nature of experts, much less attention has been paid to how individuals become experts in their jobs in the first place and what they do with their domain-specific information over time.

The purpose of the study was to describe the following areas: (1) what expert exployees do to acquire domain-related knowledge and skills related to their occupations; (2) what they do to update thoese domain-related occupational knowledge and skills; (3) the extent to which they have engaged in sharing domain-related occupational knowledge and skills with others to improve their and others' domain-related occupational knowledge and skills.

The study focused on the experiences of 20 selected individuals who have been formally designated as experts in their occupations, known as DaehanmingukMyungjangs, by the president of the Republic of Korea. The data was gathered using a combination of in-depth open-ended interviews and the critical incident technique.

The study yielded a set of themes that advances an understanding of expert employees' learning approaches. When acquiring domain-related occupational knowledge and skills, the study respondents seek a learning opportunity on the job and repeat given tasks on the job. When updating them, they create a learning opportunity within an extended boundary of work, review the process and the results of work, and master the task. When sharing them with others, they give or receive advice in a non-working situation and provide direct help on the job.

This study concludes with the model for becoming a Myungjang based on the findings from the data analysis and the implications for further research and practice.

ACKNOWLEDGEMENTS

I would here like to acknowledge with deep gratitude the individuals who made contributions to this dissertation.

I would first like to thank my advisor, Dr. Ronald Jacobs, whose support and encouragement during the whole period of the doctoral program enabled me to grow into a better person and a scholar.

I would like to thank Dr. Yeonhong Kim for his support and friendship.

I would like to thank my dissertation committee, Dr. Elizabeth Stine-Morrow, Dr. Sonali Shah, and Dr. Eunjung Grace Oh for feedback that was invaluable in the formulation of the dissertation.

I would like to thank my colleagues and friends, soon-to-be doctors Debbie Hrubec and Sam Seokwon Hwang, Dr. Andrew Sanghyun Lee, and Dr. Candace Flatt, who spent a great amount of time in discussion, sharing ideas, and laughter.

I would lastly like to thank my parents, my wife, and my children for their love.

This dissertation is dedicated to my father, Bongjo Lee, my mother, Kihyang Kim, my wife, Eun Young Seo, and my children, Arjun, Ana, and Aiden, whose unyielding love, support, and encouragement have inspired me to accomplish this research.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

CHAPTER 1: INTRODUCTION

The literature continues to assert the importance of having expert employees in organizations and society (Fletcher, 2009; Gobet, 2016). An expert is a person who has a comprehensive and special knowledge or skills derived from extensive experience with subdomains (Hoffman, 1998). There are some ways to identify experts, including years of domain-specific experience, reliable superior performance, social criteria including graduate degrees, training experience, publication record, and licensing (Ericsson, 2006; Mullin, 1989). According to the levels of human competence (Jacobs, 2003), an expert is a person who possesses expertise—that is, the knowledge and skills to meet or even exceed the requirements of performing a particular unit of work.

Expertise is combining *knowing that* and *knowing how*—in other words, what experts know and can do (Winch, 2010). Expertise is considered not as a simple matter of fact, but rather as a complex construct of adaptations of cognition and behavior, which include self-monitoring and self-control mechanisms, to the given environments of a domain (Feltovich, Prietula, & Ericsson, 2006). A process of experience that is a sequence of mastered challenges as levels of difficulty increase in specific areas of functioning defines expertise as well (Ericsson, 2003). Being an expert or having expertise is often judged by operationalizable criteria embracing experiential, social, cognitive, and performance-related factors (Hoffman, Shadbolt, Burton, & Klein, 1995).

High-quality performance of experts becomes the standard of performance and product. Experts produce best practices that most employees need to follow as well, since employees must constantly gain skills and knowledge to keep the organization competitive in the industry.

Experts can provide the kind of skills and knowledge that are necessary to learn and adapt. Also, the performance standards presented by experts are helpful in employee development programs (Jacobs, 2003; Rowland, 1992).

Researchers insisted that experts' tacit knowledge, as well as explicit knowledge and skills, are a critical source for effective job performance, so the organization needs to focus on the effective acquisition and utilization of their expertise (Baumard, 1999; Davenport & Prusak, 1998; Sternberg et al., 2000). Well-designed training programs are effective for improving the quality of employee behavior and decreasing error rates (Morey et al., 2002). Experts can also design knowledge management systems that accelerate the knowledge transfer process (Woo et al., 2004).

Experts usually contribute to proposing ways of applying knowledge that differ from traditional approaches (Muzio, Ackroyd, & Chanlat, 2008). For example, artificial intelligence (AI) based on expert knowledge enables machines and computers to make decisions and carry out actions as experts do. The link between expertise and AI has focused on the role of knowledge in computer systems, which are known as expert systems (Gobet, 2016). Such contributions are key to organizations in a rapidly changing high-tech sector and whose competitiveness, created through knowledge and innovation, largely relies on the design skills of experts (Blackler, Crump, & McDonald, 1999).

The advances occur when expert employees are engaged in continuous learning and improvement. The drive for improvement involves continuous search and experimentation at the threshold of understanding at the highest levels of expert performance (Ericsson, 2006). Woo et al. (2004) suggested that reusing the tacit knowledge of experts in the architecture, engineering and construction industry is helpful to achieve a higher-quality project. Chiêm et al. (2014)

proposed a simulation model of case management in a clinical setting for enhancing elicitation of expert knowledge. Woldesenbet and Klay (2016) shed light on the role of local experts in learning to use technology in public organizations and helping others to master it. Freedman (2016) discussed the potential benefits and opportunities of bringing retired experienced workers back into work in an aging society.

There are characteristics of experts that make them distinctive and useful. The literature has highlighted key characteristics of experts (e.g., Chi, Glaser & Farr, 1988; Hoffman et al., 2014). Although some characteristics are not generalizable across diverse domains of expertise, there are common characteristics shared with experts across different domains (Ericsson, 2006). For example, the performance of experts is reliably superior to that of non-experts on standardized tasks, almost regardless of the domain (Ericsson & Smith, 1991). The performance of experts is higher in terms of accuracy, consistency, speed, strength, and endurance (Allard & Starkes, 1991). Experts are those who have invested more amount of time mastering domain-specific knowledge and skills than others; as Bryan and Harter (1899) argued; a person needs a decade of experience to become a professional telegrapher.

Statement of the Problem

As stated, previous studies have discussed the characteristics of experts. The characteristics of experts have been discussed from various standpoints including problem-solving, cognitive process, planning, goal-setting, reflection, self-observation, self-evaluation, and decision-making (Soylu & Bruning, 2016; Winne, 1997; Zimmerman, 2006). Experts apply a more diverse repertoire of approaches and methods for solving domain-specific problems than

non-experts (Chi, 2006; Ericson et al., 1993). Experts spend more time analyzing a problem and find solutions with fewer errors (Chi et al., 1988; Wenning, 2002). Experts organize knowledge better than non-experts (Stubbart & Ramaprasad, 1990). Experts are better at using self-regulating processes including planning, goal-setting, having task-related strategies, and reflecting on their thoughts (Soylu & Bruning, 2016; Zimmerman, 2002). Industrial experts outperform non-industrial experts in terms of creating value and anticipating outcomes of activities (Custódio & Metzger, 2013).

While much attention has been given in the literature about the characteristics of being an expert, much less information is available about what experts do to acquire domain-related occupational knowledge and skills, what they do to update their expertise, and what they do to share the expertise with others to improve their and other's domain-related knowledge and skills. That is, the literature does not address how experts continue to learn and process information in common organizational settings.

There are different aspects of the learning of experts. There are studies of the development of expertise that look into giftedness, human extraordinariness, and prodigious performance from a life-long perspective (e.g., Bloom, 1985; Sosniak, 2003; Zuckerman, 1977). Some experiments in the laboratory setting have focused on improvement of information processing skills and multi-tasking skills through training and practice (e.g., Fahle & Poggio, 2002; Goldstone, Schyns, & Medin, 1997; Sanders, 1998). Such studies have mainly investigated stimulus-response relations, response selection processes, the sequential structure of events, and action procedures (Proctor & Vu, 2006). Another stream of study in the learning of experts pays attention to data-driven systems of expert learning through AI (artificial intelligence) and ICT (information and communication technology). Researchers in the area of artificial intelligence

and cognitive science have reproduced some of experts' decision-making behavior using computer models (Dyster, Sheth, & McKhann, 2016; Hung, Lin, & Chang, 2015).

A body of literature on the development of athletic and artistic performing expertise has investigated the learning processes of experts. Decisions about how to accomplish a particular goal involve more technique-oriented strategies and that, in turn, improves athletic and academic learning (Zimmerman & Kitsantas, 1999). Expert female volleyball players set more specific goals individually regarding technique and process enhancement than non-experts (Kitsantas & Zimmerman, 2002). Expert basketball free-throw shooters reported higher self-belief in their capability to perform (self-efficacy) than non-experts. Learners with high self-efficacy have higher goals for themselves (Zimmerman, Bandura, & Martinez-Pons, 1992). Among student instrumental musicians, those who spent a greater amount of practice time performed better in competitions (McPherson & Zimmerman, 2002).

The literature has described how expertise is developed, what is usually required to become an expert, and how experts maintain their abilities over time. Ericson (2003) emphasized the role of deliberate problem solving as a person's attempts to acquire expertise. The role of deliberate problem solving engages a person in intensive cognitive activity to understand the task, apply appropriate techniques or strategies, and evaluate one's effectiveness. Furthermore, self-regulation involves self-generated thoughts, feelings, and actions that are strategically planned and focused on the attainment of personal goals (Bandura, 1986, 1997; Zimmerman, 1989).

Self-regulatory processes explain self-enhancing cycles of learning based on self-motivation (Bandura, 1991; Zimmerman, 2000). Zimmerman and Campillo (2003) proposed three phases of self-regulation that involve task analysis and self-motivation in the initial phase,

self-control and self-observation in the action phase, and self-judgment and self-reaction in the reflection phase. Studies have suggested that activities such as task analysis, goal-setting, strategy choice, self-monitoring, self-evaluation, self-reflection, and feedback are helpful (Boekaerts, Pintrich, & Zeidner, 2000; Feltovich, Prietula, & Ericsson, 2006).

Self-directedness of learners also explains how adults can be continuously engaged in learning. Knowles (1975) described some characteristics of self-directed learning as follows. First, experience enables adults to learn. Second, the self-directed learner himself is a rich resource for learning. Third, the learning usually focuses on a task or a problem. Fourth, learners are engaged in learning because of internal incentives and self-curiosity.

The characteristics of self-directed learning can be linked to the characteristics of experts. First, individuals become experts with a foundation of experience. Second, this experience is one of the core resources for developing expertise. Third, experts use domain-specific knowledge and skills to accomplish tasks and solve problems. Fourth, experts are self-reflective and are continuously engaged in learning. This implies that experts are likely engaged in learning continuously because learning is a process of gaining knowledge and expertise (Knowles, Holton, & Swanson, 2015).

Overall, successful learners can become experts. Successful learners are motivated more by the attraction of positive outcomes than by fear of negative outcomes (Pintrich, 2000). There are positive links between positive outcomes, one's learning competence, and the perceived value of a task (Kitsantas & Zimmerman, 2002). This means that experts are likely more motivated to continue striving even without tangible rewards. Deliberate practice and experience are usually considered as a common foundation to reach a desired level of performance regardless of domains of expertise.

Unfortunately, knowledge about how employees develop expertise in professional and occupational domains is still limited. For example, in some cases, results do not always support a positive relationship between years of experience and performance (e.g., Fujino, Tanaka, Yonemitsu, & Kawamoto, 2015; Sonnentag, 1998), while years of experience is believed to be fundamental to define expert and expertise. Overall, the learning strategies used by expert employees in common organization settings have yet to be explored.

In sum, the literature on expertise has focused mostly on the unique personality characteristics of experts who, because of their relatively high levels of knowledge and skills, often approach tasks differently compared to others. However, while the literature provides useful insights about the nature of experts, much less attention has been paid to how individuals become experts in their jobs in the first place and what they do with their domain-specific information over time. More specifically, it is interesting to learn more about how experts acquire, update, and share domain-related occupational information. Therefore, a study is needed to describe what expert employees have preferably done on those occasions and the contexts of their workplaces that possibly enhanced or hindered such incidents.

Purpose of the Study

The purpose of the proposed study is to describe the approaches used by expert employees in terms of, first, how they first acquire domain-related occupational knowledge and skills; second, how they continue to update the expertise; and third, the extent to which these individuals have engaged in sharing what they know and can do with others that affect the improvement of the knowledge and skills of expert employees as well as others .

Research Questions

In pursuit of this purpose, the research questions are as follows:

1. What are the themes that emerge when expert employees acquire domain-related occupational knowledge and skills?

2. What are the themes that emerge when expert employees update domain-related occupational knowledge and skills?

3. What are the themes that emerge when expert employees share domain-related occupational knowledge and skills with others?

Definition of Terms

Critical incident. A critical incident is a factual account of cases that significantly contribute to a specified outcome (Flanagan, 1954). The factual accounts of behaviors are the 'incident', and being 'critical' of the incidents is based on the degree of significance of the contribution to a specific outcome within the defined criteria. The critical incident in this study refers to occurrences that affect their expertise development significantly, especially when expert employees acquired domain-specific occupational knowledge and skills, continue to update their knowledge and skills, and possibly transfer them to others.

Domain-related information. Domain-related information refers to the knowledge and skills needed to perform an essential task in a domain.

Expert employee. An expert employee refers to an extensively experienced worker who possesses a high level of domain-related information and usually outperforms a task in a domain. In this study, an expert employee is either self-employed or employed by an organization.

Significance of the Study

This study will be significant in the following ways:

First, this study will contribute to enhancing the understanding of expert employees' behaviors in terms of learning. Little is known about how expert employees continuously engage in acquiring, updating, and sharing their domain-specific occupational knowledge and skills. To have a high level of expertise, one must acquire relevant knowledge and skills. Once these are acquired, experts need to refine and update them. Then, the knowledge and skills need to be shared to others to help them grow and to advance the knowledge and skills further. Therefore, this descriptive study will provide detailed information about what expert employees did to acquire, update, and share the domain-specific occupational information.

Second, this study will contribute to expanding the understanding of the nature of expert employees in organizations. To date, studies on expert and expertise have focused on how experts perform tasks in certain domains and how individuals become expert in a certain domain (e.g., Chase & Simon, 1973; Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson et al., 2006; Hatano & Inagaki, 1984; Hoffman et al., 2014). Unfortunately, it is limited in terms of fully understanding how expert employees perform tasks in more common organizational settings in which they deal with more complex tasks and harder-to-control variables. Therefore, this descriptive study will focus on describing what has happened to them in the workplace. The

results of this study will contribute to a deeper understanding of the realities of expert employees in the workplace.

Lastly, this study will provide practical implications for employees, organizations and policy makers as follows. First, the findings will be helpful for non-expert employees to learn how to think and do things like experts. They may use this information to improve their performance. Second, the findings will be helpful for knowledge managers to learn how to manage employees' knowledge and skills as shared resources of the organization. Third, the findings will be helpful for organizational stakeholders to know what kind of circumstances support the learning of employees and the managing of employees' knowledge and skills. Fourth, the findings will suggest the policy makers the ways to support employees to develop expertise.

Overall, this study will contribute to enhancing knowledge about the nature of expert employees. The study will result in a set of themes that will advance an understanding of how expert employees learn and process domain-related occupational knowledge and skills. With this understanding, the study will add knowledge that could be helpful to advance theories of expertise, workplace learning, employee development, and knowledge management. The study will also provide practical information for employee development and expertise management in an organization.

CHAPTER 2: LITERATURE REVIEW

This chapter reviews the literature that supports the study. This chapter consists of six sections. The first section reviews the characteristics of being an expert. The second section reviews acquisition of expertise. The third section reviews retention of expertise. The fourth section reviews transfer of expertise. The fifth section reviews the context of the workplace. The final section synthesizes the areas discussed in this chapter and presents the conceptual framework of this study.

The University of Illinois Urbana-Champaign Library system was used to conduct online searches. The University Library's catalog and the online search engines such as Academic Search Complete PLUS (Ebsco), Business Source Complete, ScoINDEX with Full Text, Education Full Text (H.W. Wilson), and ERIC were used as sources of information. The following keywords were used to guide the searches: expert, expert employee, expert development, expertise, expertise development, knowledge management, adult learning, workplace learning, and learning organization. Books, journal articles and doctoral dissertations relevant to the keywords were reviewed.

The Nature of Being an Expert

This section reviews the nature of being an expert and consists of three parts. The first part reviews the meaning of being an expert. It includes what the term expert means and how individuals are recognized as experts. The second part discusses the personality characteristics of experts. The third part discusses the characteristics of expertise through reviewing the dimensions of expertise.

Meaning of Being an Expert

This part discusses how experts are defined through reviewing the definitions and the criteria, with which individuals are designated. In almost all human activities, some people perform at a higher level than others. Such performance stands out from an ordinary performance, and is exceptional and superior compared to the performance of others. A maestro in music or a brain surgeon whose knowledge and skills are especially outstanding are some examples of experts. The proficiency of a person's domain-specific behavior makes the performance extraordinary (Hoffman et al., 2014). Many words are used to designate such individuals including gifted, talented, expert, and master. The terms are in general used to indicate individuals who demonstrate their abilities that generate outstanding performance (Hoffman, 1998; Jacobs, 2003; Gobet, 2016).

The definition of an expert can vary depending on the areas of expertise. Thus, it could be somewhat different in specifics from each other but similar in general. Overall, an expert refers to a person who has domain-specific knowledge and skills that enable the individual to produce outstanding performance reliably (see Table 2.1). The experts' domain-specific knowledge and skills are expertise.

Expertise refers to an expert's skill or knowledge in a particular field (Oxford Dictionary, 2017), and to some extent, the meaning embraces an expert's know-how and opinion as well (Gobet, 2016). Expertise is something that enables experts to reproduce the outstanding performance of representative tasks (Ericsson, 2006).

Table 2.1. Definitions of expert

Source	Description
Hoffman (1998)	A person who has special skills or knowledge derived from extensive experience with subdomains
Jacobs (2003)	An individual who possesses the knowledge and experience to meet or surpass the requirements of performing a task
Gobet (2016)	Someone whose accomplishments are vastly superior to those obtained by most other people
Google Search (2017)	A person comprehensive and authoritative knowledge and skill in a particular area

Also, expertise can be understood relatively. For example, experts are a relatively more knowledgeable or skillful group of people (Chi, 2006). Overall, experts are persons who have domain-specific knowledge and opinion that is usually recognized and respected by others, or someone who knows how to perform specific activities correctly, and better than others in a reliable manner.

There are processes to identify experts. Chi (2006) suggested that utilizing some measure of performance is helpful in identifying a truly exceptional expert. Examining levels of work-related knowledge and skills can be one way of identifying an expert (e.g., Dreyfus & Dreyfus, 1986; Hoffman, 1998; Jacobs, 2003). There can be various ways of categorizing the levels of work-related knowledge and skills. Dreyfus and Dreyfus (1986) proposed a five-level scale that focuses on the worker's level of procedural knowledge from levels one to five (see Table 2.2).

Table 2.2. Levels of proficiency (adapted from Dreyfus and Dreyfus, 1986)

Level	Description
One	• An individual has declarative or propositional knowledge. • Problem solving relies on general explicit reasoning.
Two	• An individual begins to recognize some repeated problem types and situations automatically. • The declarative knowledge becomes procedural and domain-specific.
Three	• An individual becomes fluent to perform routinized tasks.
Four	• An individual becomes proficient and has a high level of intuitive skill.
Five	• An individual is able to reflect on his or her own intuitions and develop new rules and strategies.

Researchers have categorized the levels of proficiency or human competence as well. For example, Hoffman (1998) and Jacobs (2003) identified expert and master as an individual who possesses the highest level of work-related knowledge and skills (see Table 2.3).

Table 2.3. Levels of human competence (adapted from Jacobs, 2003)

Category	Description
Novice	An individual who is new to a work situation. The person lacks the knowledge and skills necessary to perform the work adequately.
Specialist	An individual who can reliably perform specific tasks without a great deal of supervision. The range of work is limited to the routine ones.
Experienced specialist	An individual who can perform specific tasks with ease and skill.
Expert	An individual who often exceed the requirements of performing specific tasks because the person has the knowledge and experience. The person can deal with non-routine tasks.
Master	An individual whose judgments are highly regarded and looked upon to set the standard for others.

There are other informal methods used for identifying an expert. First, one can determine who is or is not an expert by looking at how well an outcome is received (Kozbelt, 2004). For example, professionals in a domain are usually able to identify peers who are superior, in some

specific knowledge or skill, to others (Hoffman et al., 2014). Second, honorary titles, diplomas, and certificates given by accredited higher educational institutions or official professional organizations can be used to identify experts. Although receiving these things does not guarantee in itself that the person's knowledge or skill is always outstanding, it can be an objective measure of performance based on sociocultural criteria (Gobet, 2016). Third, a concurrent measure identifies experts with a rating system as a result of tournaments or as a result of examinations, or measuring how well the exceptional expert performs tasks (Masunaga & Horn, 2000). For example, rank order as a function of their level of expertise identifies experts (Gobet, 2016). Athletes involved in ranking or record-oriented games (e.g., speed skating, tennis, 100-meter race), or performing musicians or gymnasts participating in a competition in which experts in the respective domains judge the participants' performance.

Characteristics of Experts

This part discusses the characteristics of experts that make them distinctive from others. Numerous behavioral representations of experts have been identified and discussed in the literature (e.g., Chi, Glaser, & Farr, 1988; Ericsson et al., 2006; Hoffman et al., 2014; Gobet, 2016). The discussion includes an understanding of different kinds of knowledge, reasoning strategies, and cognitive information processing capabilities as characteristics of experts. Most of the research has focused on with which characteristics experts stand out, either in comparison to novices or in a concrete context. On the other hand, some scholars (e.g., Chi, 2006; Sternberg, 1996) have discussed the contexts in which experts are not outstanding as well.

Experts have more declarative knowledge and procedural knowledge, which is more operational, experiential, and judgmental knowledge of performance (Buchanan, Davis, &

Feigenbaum, 2006; Crandall, Kyne, Militello, & Klein, 1992; Winch, 2010). The amount of domain knowledge that experts have is enormous (Olson & Biolsi, 1991). Experts not only know more detailed facts, but also have rich internal representations of how things work and how to get things done.

One can develop procedural knowledge as the end state of a learning process for tasks that can be automated with practice (Cianciolo, Matthew, Sternberg, & Wagner, 2006). Also, experts know differently regarding the use of knowledge in practice (Feltovich, Prietula, & Ericsson, 2006). Experts tend to work forward from what is known to the unknowns (Patel & Ramoni, 1997). Experts do not start with generating a set of hypotheses, but they rather rely on their domain knowledge at the initial stage for solving a problem.

The domain-specific knowledge helps experts to learn better materials related to their respective domains than less knowledgeable individuals (Van Overschelde & Healy, 2001). Experts continuously engage in structuring, organizing, and improving their representation of knowledge and procedures for efficient and effective application to the tasks in their domains (Feltovich, Prietula, & Ericsson, 2006). The knowledge of experts in a domain is associated with cognitive processing, including reasoning, problem solving and decision-making (Chi, 1978; Gobet, 2016).

Experts demonstrate skills at a higher level than non-experts. Experts have better situation recognition skills (Ericsson & Simon, 1993), and can recognize and remember more complex patterns. For example, chess masters can recall many more patterns to enable them to choose the appropriate moves in a chess game than less-skilled players (Chase & Simon, 1973). Experts better represent how things work in the domain of practice, that is, representation skill (Rouse & Morris, 1986). The decisions that experts make depend on their skills of recognizing

situations from experience (Klein, 1986). Mental models such as the recognition, metacognition, and situation awareness models explain how experts understand situations more rapidly and accurately (Ross, Battaglia, Phillips, Domesheck, & Lussier, 2003).

Experts using motor skills such as industrial technicians, athletes, dancers, and musicians develop motor and cognitive skills derived from long-term experience in the domain (Allard & Starkes, 1991). Deliberate practice even after reaching a level of proficiency is observed as a common characteristic of experts as well (Ericsson, 2006).

Overall, Chi, Glaser, and Farr (1988) summarized seven key characteristics of experts. First, experts stand out mainly in their domains. Second, experts recognize important patterns, suitable categories, or cognitive representations of a problem while spending less time than novices in a domain. Third, they usually perform a task faster and more accurately than non-experts. Fourth, experts have better short-term and long-term recall. Fifth, experts see and represent a problem in their domain at a deeper and more abstract level than novices who rather tend to represent a problem at a shallower level with concrete contexts. Sixth, experts spend more time making clear a basic representation of the problem situation before searching for a solution. Seventh, experts have better self-knowledge and self-monitoring skills regarding accuracy to detect errors and the status of their comprehension.

In addition to the characteristics introduced in Chi et al., (1988), Chi (2006) adds some more ways in which experts stand out. First, experts excel in coming up with a solution for a task. Second, experts adopt better strategies or procedures for a situation that are often proved to be effective. Third, experts use and manage available sources of information while solving problems better than non-experts. Fourth, experts put less cognitive effort toward retrieving

relevant domain knowledge and strategies. Fifth, experts use their skills with greater automaticity. Sixth, experts can employ greater cognitive control when desirable.

The summary of the characteristics of experts by Hoffman et al. (2014) is similar to that of Chi et al. (1988). Experts have better reasoning skills, including deduction, induction, and goal decomposition. They spend more time than non-experts in reaching a conceptual understanding of a problem. Their reasoning operations are conceptually richer and more organized. They tend to rely on principles and deeper understanding, which is often represented as abstract, while non-experts usually focus on the concrete surface of problems.

Moreover, when experts encounter familiar problems, their responses are derived from mental models that quickly form intuitive and cognitive frameworks to help understand the nature of the problem, reach potential solutions, and predict constraints (Reimann & Chi, 1989; Oliver & Roos, 2005). Their judgments are highly regarded by the public and peers because they are more accurate and reliable (Ericsson et al., 2006). For example, industrial expert CEOs earn more acquisition returns than non-domain expert CEOs due to better predictions of market behavior and negotiation skills (Custódio & Metzger, 2013).

Experts also know that their knowledge is constantly altering and contingent (Stehr & Grundmann, 2011). Experts can think of new procedures and recognize conceptual distinctions to cope with uncommon and difficult cases. It makes experts find opportunities for creating critical changes with relatively less effort (Ross et al., 2002).

On the other hand, there are ways in which experts are not superior to other employees (Chi, 2006; Sternberg, 1996). First, the superiority of experts in their domains is limited to a specific expertise (Müller, McLaren, Appleby, & Rosalie, 2015). Second, experts are sometimes overly confident in judgments related to the areas of expertise (Hoffman, Trafron, & Roebber,

2005). Third, experts sometimes overlook details or miss the surface features of a problem, even though experts surpass novices in terms of deeper understanding of a problem. Fourth, experts tend to be limited when familiar contextual information is not available (Almandoz & Tilcsik, 2016). Fifth, experts might have more biases than others because they tend to generate hypotheses that correspond to their domain of expertise (Hashem, Chi, & Friedman, 2003).

Characteristics of Expertise

This part discusses the characteristics of expertise with which experts can meet or even exceed the requirements of performing a particular unit of work reliably.

The domain-specific knowledge and skills of experts make them distinct from others. The knowledge and skills of experts come out in the course of actions; thus, the meaning of expertise could be derived from either knowledge or skills. One way of understanding expertise is as a function of skill with using a relatively small number of heuristic searches when dealing with a situation (Hayes, 1989). Another approach to understanding expertise focuses on the knowledge-based view of expertise (Salas & Rosen, 2010).

Hatano and Inagaki (1986) stated that the skill-based approach to understanding expertise refers to routine expertise that emphasizes the skill acquisition component of expertise. The experts with the routine expertise achieve superior and reproducible performance regarding accuracy, automaticity, and speed on familiar tasks. This kind of expertise limits experts, as it is hardly transferable to new tasks or problems (Hatano & Inagaki, 1986). When the task changes, the expert may no longer be able to perform at the same level.

Studies have suggested that the domain knowledge is a key factor in expert performance (Chase & Simon, 1973; Ericsson & Lehman, 1996; Schunn, McGregor, & Saner, 2005;

Monchaux, Amadieu, Chevalier, & Mariné, 2015). Adaptive expertise enables experts to adopt different procedures and adjust to variations in the task. A deep conceptual understanding of a task allows adaptive experts to perform variations of tasks. In sum, a conceptual understanding of the domain is a key factor separating adaptive expertise from routine expertise (Barnett & Koslowski, 2002; Feltovich, Spiro, & Coulson, 1997; Hatano & Inagaki, 1986; Salas & Rosen, 2010).

Expertise is cognitive and physiological adaptation to domain-specific tasks. Tasks in various domains require different kinds of expertise (Salas & Rosen, 2010). The dimensions by which experts exhibit superior performance explain the nature of expertise. The dimensions of expertise vary depending on the task. These dimensions include perception (Chase & Simon, 1973), analytical reasoning strategies (Schunn, McGregor, & Saner, 2005), creativity (Simonton, 2003), memory skills (Wilding & Valentine, 2006), decision-making (Morrow et al., 2008), problem solving (Gobet, 2016), tacit knowledge (Cianciolo, Matthew, Sternberg, & Wagner, 2006), situation awareness (Endsley, 2006), and self-regulation (Zimmerman, 2006).

Salas and Rosen (2010) present a framework of expertise that synthesizes some of its general characteristics based on the studies of experts in numerous domains (see Figure 2.1). The framework consists of two major mechanisms that characterize the nature of expertise: 1) mechanisms of performance, and 2) mechanisms of development within the context and task constraints of the domain of expertise. The elements in the framework refer to the factors that enable expert performance. The mechanisms of performance focus on the characteristics of experts, while the mechanisms of development draw attention to continuous learning. The attributes of expertise are the product of experts' efforts to adapt their learning to their specific domains through a long development process with deliberate practice.

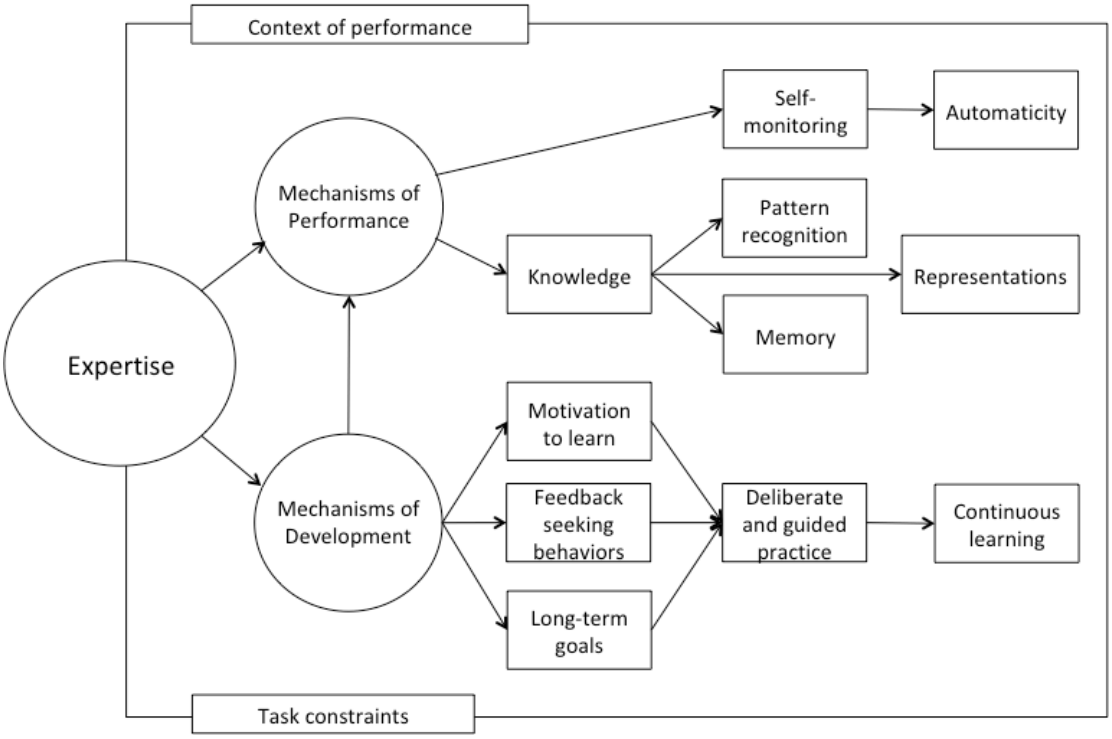

Figure 2.1. A framework of the components of expertise and its development (adapted from Salas & Rosen, 2010, p. 106)

The nature of expertise includes task constraints that are extremely customized adaptations to the required tasks in the domain. Expertise in one domain cannot be transferred to another domain, even when tasks are similar (Eisenstadt & Kareev, 1979). Also, the contextual cue in some domains is an important factor that affects expert performance (Chi, 2006). For example, experts can capture contextual cues and use them to make decisions. Such aspects of context are often correlated with the phenomenon or problem. It implies experts can perform better when a problem occurs within a familiar context (Hobus, Schmidt, Boshuizen, & Patel, 1987). In sum, expert performance is inextricably linked with both task constraints and the context of performance. The following is the review of the individual dimensions of expertise discussed in the literature.

Knowledge. Experts know more about the tasks in their respective domain than non-experts. The sounder foundation of an expert's knowledge affords better expert performance. Knowledge is created and organized by the flow of information based on the beliefs and intention of its holder (Nonaka, 1994), and is an essential aspect that enables human action.

Knowledge is often better understood by a comparison with similar terms such as data, information, wisdom, and insight (Davenport & Prusak, 1998). Among those terms, wisdom and insight are somewhat elusive than the other terms (Jashapara, 2011). Moreover, comparing of the meanings of data, information, and knowledge seems sufficient to understand knowledge clearly (see Table 2.4).

Table 2.4. Differences between data, information, and knowledge

	Davenport & Prusak (1998)	Jashapara (2011)
Data	• A set of discrete, objective facts about events, but by itself has little relevance and purpose	• Known facts or things used as a basis of inference or reckoning but meaningless when taken out of context
Information	• Data that has relevance and purpose created by a sender and a receiver so that it has an impact on the receiver's judgment and behavior.	• Systematically organized data that are endowed with meaning, relevance, and purpose
Knowledge	• A fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. • It derives from human minds.	• Actionable information that allows people to act more effectively and predict future outcomes with a greater ability

Knowledge and practice are mutually constituted in individuals' everyday activities. The knowledge of expert employees can be considered from a practice-based perspective because employees engage in the practice. Their knowledge could be social, situational, and contextual

(Jashapara, 2011). Orlikowski (2002) emphasized that knowing of individuals should be understood based on organizational context because knowing is something they do rather than possess.

From a realist perspective, the underlying structures in a social context, the social processes, and the external behaviors observed at a given time explain social phenomena (Bhaskar, 1978). Jashapara (2007) proposed a knowledge process model at the individual and organizational levels from the realist perspective. In this conception, consciousness and collective consciousness are the components for mediating the main knowledge processes between a memory from the past and knowledge and skills in the present. Actions to solve a problem occur based on the consciousness situated in the context (Gherardi & Nicolini, 2000).

Knowledge enables employees to create, sustain, and change existential conditions (Adolf & Stehr, 2014). Knowledge could be a generalized capacity to act, and human action can effect changes in social and natural reality. Expert employees possess some articulated and some tacit knowledge. A combination of *know-that* and *know-how* guides the actions of skilled agents who aim to achieve a particular practical objective (Sarewitz & Nelson, 2008).

While explicit knowledge is transmittable in formal and systematic language (Polanyi, 1966), tacit knowledge, by contrast, refers to knowledge that is rooted in action and involvement in a specific context (Adolf & Stehr, 2014). It is unstated, since it is difficult to articulate, and sometimes it is taken for granted, untaught, or even unteachable. It often remains in the background and is derived from corporeal experience. Some assert that people usually know more than they can tell (Polanyi, 1966; Polanyi & Sen, 2009). Tacit knowledge is involved in many practical settings including bike riding, other skilled occupations, and mental activity (Collins, 2007; Gascoigne & Thornton, 2013).

Cognitive process. Baddeley (1997) suggested that the knowledge of experts is a semantic network for a particular domain. The knowledge functions as a means to make links between concepts and meanings, and cognitive processing in a domain. While developing a concept map, experts show less fixation of eye movement than novices during the process (Dogusoy-Taylan & Cagiltay, 2014). This fixation indicates cognitive difficulty (Liversedge & Findlay, 2000). This shows that experts have different strategies for cognitive processes than novices. Experts not only have more domain-specific concepts that can be retrieved when needed, but also develop a more effective cognitive process to make links between concepts.

The expert's cognitive process that connects the units of knowledge is quite different from that of novices. The expert's knowledge is organized around deeper conceptual relationships so that necessary information can be accessible in detail (Goldstein, 2005). When experts face a problem, they use the units of foundational knowledge behind the problem, while novices tend to find what involves the problem. Experts tended to develop reasons based on linking diseases by shared symptoms, whereas novices focused on the salient features of the individual disease and could not develop reasons by linking their knowledge of multiple diseases (Feltovich, Johnson, Moller, and Swanson, 1984). Such ways of organizing and connecting units of knowledge enable experts to develop further cross-referencing of their knowledge.

The foundation of the expert's domain-related knowledge is more complex than that of the novice. Experts tend to develop a strongly hierarchical and cohesive framework of related concepts (Mintzes, Wandersee, & Novak, 1998). Experts have developed a greater amount of knowledge, a deeper interpretation of knowledge, and a greater density of networks between concepts (Chi & Ohlsson, 2005). This can hardly happen with novices because they have fewer and weaker links between the units of their knowledge. The foundation of more complex and

robust knowledge helps experts to develop further the ability to learn more task-related knowledge (Hambrick, 2003).

Pattern recognition. Pattern recognition is another component of expertise. The conceptualization of expert performance based on pattern recognition, as well as a sound knowledge foundation, was a core component of the first general theory of expertise (e.g., De Groot, 1946, 1978; Simon & Chase, 1973). The perception of larger and more meaningful patterns plays an important role in expert performance in some domains such as chess and radiology (Hogarth, 2001).

The knowledge generated from the comprehension process is different between expert and novice. Peebles (2013) explained that the manner of attention to detailed information and the degree to which they can symbolize the interpretation underlie the differences between expert and novice. The expertise from pattern recognition helps with rapid perception and response (Gobet & Simon, 1996). Lesgold and colleagues (1988) found that expert radiologists were able to detect patterns and cues of symptoms in X-ray films that novice radiologist rarely saw.

Simon and Chase (1973) asserted that expertise is the outcome of a prolonged experience in a domain as the experience allows individuals to acquire a larger collection of more complex patterns. As the process progresses, the larger collection of more complex patterns helps eliminate the need for an extensive search using memory or analytical reasoning about what move they should make.

Problem representation. Expertise is shown based on the representation of problems. This characteristic of expertise is related to but still distinct from expert pattern recognition and knowledge organization skills. Like the example of the difference between knowledge

classification of experts and novices discussed in an earlier section, there are differences between experts' representation of information and that of novices.

Experts' representation of information reflects deeper meanings whereas novices' representation of information tends to be relatively superficial (Glaser & Chi, 1988). In the same vein, van Gog, Paas, and van Merrienboer (2005) found that experts spend more time developing problem representation than novices. For example, in a prompt decision-making task, expert electronic warfare technicians spend more time analyzing the situation than novices. On the other hand, novices spent more time evaluating choices of following actions. Also, expert representation is more functional and abstract than that of novice (Feltovich et al., 2006). Thus, experts are better at creating representations than novices when problems are ill-defined (Bedard & Chi, 1992).

Once the representation of a situation is made, the expert can use pattern recognition skills and a robust knowledge base to employ mental simulation outcomes and adapt courses of action to the present context. The characteristics of expert problem representation skills provide some advantages, including assisting the recall of relevant information, facilitating the integration of situational cues, selecting the information needed, aiding reasoning, and supporting the evaluation of possible solutions (Zeitz, 1997).

Decision-making. Expertise helps to sort out information and reduce the complexity of that information. Certainty emerges from doing so and, essentially helps in decision-making (Stehr & Grundmann, 2011). The pattern recognition mechanism of expertise discussed in the previous section often helps experts to make quick decisions in realistic settings (Zsambok & Klein, 1997). The experts in domains such as medicine, the military, and firefighting often encounter situations in which formal analysis for making a decision is unrealistic due to

circumstances (Klein, Orasanu, & Calderwood, 1993). Such conditions usually involve high levels of time pressure, an uncertain dynamic environment, ill-structured problems, and shifting goals (Orasanu & Connolly, 1993).

Again, in these cases, experts capture environmental cues from the current situation associated with a single decision that worked in previous similar situations (Klein, 1998). This is called recognition-primed decision-making (RPD) that decision-maker relies on previous experience. Thus, an expert can make a decision based on the information retrieved from the experience of a situation as well as goals and expectations for a decision (Klein, 1998). Hutton and Klein (1999) explained that this is possible because experts can employ mental simulation with the retrieved alternatives while diagnosing the appropriateness of those alternatives for the current situation and ways of modifying it if necessary.

Memory. Memory is one of the featured characteristics of expertise. The complexity of tasks in a domain can easily exceed the basic limitations of human information processing. Thus, representing all the essential information in a situation is challenging for ordinary employees. However, as discussed in earlier sections, experts develop abilities to adapt to these situations by efficiently storing and retrieving information, which becomes possible because experts develop skills for storage and retrieval of information in long-term memory (LTM) that effectively increase the capacity of working memory (Ericsson & Kintsch, 1995).

When dealing with complex cognitive tasks, novices are likely to use short-term working memory because it is more predictive for them, whereas expert can access long-term working memory while using retrieval cues from short-term working memory (Sohn & Doane, 2003, 2004). Oberauer (2006) asserted that individuals develop long-term working memory skills for a

particular task because storing information in short-term working memory that does not increase with practice is limited.

Developing long-term memory skills requires the development of strategies for encoding and retrieving information from the long-term memory (Ericsson & Kintsch, 1995). It requires a comprehensive understanding of the task constraints first, just as individuals must learn the foundational procedures for completing a task. Then, individuals who use long-term memory effectively can anticipate the retrieval demands involved in the task performance (Ericsson & Kintsch, 1995). The memory demands vary with different tasks, and people usually cannot store all the information in memory. Tasks that demand a large amount of information in particular require more elaborative encoding and durable and accessible storage. Therefore, cue-based retrieval is useful because the cues indicate what information is needed and help to find the most recent information available (Ericsson & Kintsch, 1995).

Automaticity. Experts automate some aspects of their performance processes, while novices need to have a special consciousness and effort for performing the same tasks (Gentner, 1988; Sternberg, 1997). Automaticity refers to changes in attentional requirements, conscious and unconscious control, and task performance in terms of speed and accuracy (Moors & De Houwer, 2006). Automated cognitive processes are relatively faster, less effortful and conscious, and more autonomous than non-automated processes. Automated processes of domain-specific tasks usually occur in consistent environments, where environmental cues predictably appear. Thus, responding to stimuli is reliably arranged (Logan, 1988).

To accomplish this level of automation, individuals usually need large amounts of practice designed to increase the speed and smoothness of cognitive processes. As the level of automation increases, the number of cognitive resources required to carry out the processes

decreases (Salthouse, 1991). In other words, automaticity can be a means of overcoming the physiological limitations of human information processing as higher-order cognitive processes.

Moreover, as the more basic elements of a task become automated, the performer does not need the cognitive resources for them. This enables the individual to allocate more cognitive resources to higher-level processes such as self-regulating and more complex aspects of task performance. The examples can be found not only in studies but also in our lives. Expert typists were able to recite nursery rhymes while typing (Shaffer, 1975), and doing other things gets easier while keeping focused on driving for an experienced driver. In this way, complex skill acquisition can become possible through the incremental building of automaticity from the low-level task processes (Salthouse, 1986).

Self-regulation. As experts have more automatized skills, they become more flexible in allocating cognitive resources to higher-level processes. The studies of metacognition cover various topics related to intelligence including memory, awareness, self-monitoring, and self-regulation (Flavell, 1979). Metacognition is a general term encompassing the awareness of one's knowledge, cognitive processes, and performance. The metacognitive skills of experts can be thought of as the level of automaticity in low-level task components increasing so that more cognitive resources are available for self-regulation and self-monitoring (Glaser, 1987).

It is assumed that experts can maintain awareness of domain-specific knowledge while engaged in a task. The ability to maintain the awareness allows the expert to evaluate the understanding of the situation and to monitor whether the available information is appropriate (Cohen, Freeman, & Thompson, 1998). Monitoring performance is necessary to keep the performance processes continuously improving. It enables adjustments and improvements in the performance processes. Therefore, experts are usually better at detecting problems, thinking of

the underlying causes of the problems, and determining when they need to evaluate their solutions (Glaser & Chi, 1988).

Zimmerman (2006) suggested that there is a cycle of self-regulation with three phases: forethought, performance control, and self-reflection (Zimmerman, 2006; Zimmerman & Campillo, 2003). Forethought refers to pre-performance planning, and experts normally engaged in goal-setting in this phase. When involved in goal-setting, experts consider both processes and outcomes of goals, whereas novices strictly focus on the outcomes.

There are three general elements of self-regulation: (1) the environment surrounding task performance; (2) one's internal cognitive and affective states and processes; and (3) the behavioral processes of task performance (Bandura, 1986). Experts utilize self-instruction, use of imagery, managing time, applying their task strategies, seeking help and feedback from others, and designing the environment to facilitate performance. In the self-reflection phase, the experts can more effectively observe, record, and monitor their performance processes. The information gathered in the process feeds into self-evaluation (Kitsantas & Zimmerman, 2002). Experts also select a set of criteria to evaluate their performance in the way that further develops expertise (Locke & Latham, 2002).

This section reviews the nature of being an expert and consists of three parts. The first part reviewed the meaning of being an expert and the criteria, with which individuals are designated as experts, have reviewed. The second part reviewed the characteristics of experts that make them distinctive from others as well as ways in which experts are not superior to others. The third part discussed the characteristics of expertise based on the detailed review of experts' knowledge and skills.

Acquisition of Expertise

This section discusses how experts acquire the knowledge and skills related to their occupations.

Acquiring knowledge and skills related to the occupation is essential for an individual to become an expert. According to Ericsson (2017), particular forms of training and practice that induce cognitive, perceptual, physiological, neurological, and anatomical changes are necessary for acquisition of complex domain-specific skills. It has been controversial which factors between inherent capability and experiential factors such as training should be weighted more in acquiring knowledge and skills (Ericsson & Lehmann, 1996). Although there are advocates for both perspectives, the experience-based view of acquisition of expertise is better for this study. Therefore, the following review will focus on expertise as a function of what develops individuals as experts in a domain.

Deliberate practice

Deliberate practice is an essential element to acquire expertise. Experienced coaches and teachers traditionally develop instructional programs in domains such as sports and performing arts. The training in such domains is often individualized for a trainee or a student and develops the individuals from novice to expert (Ericsson & Charness, 1994). The trainees develop specific aspects of performance by repetition to improve as designed. Such highly structured activity for improving performance using purposefully designed repetition is known as deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993).

Four criteria must be met for an activity to be classified as deliberate practice (Ericsson et al., 1993). First, learners must engage in the repetitive practice of the same or similar tasks with minor variations. Second, the learners should receive immediate feedback from the coach or instructor so that it can be used to modify weak points. Third, the learners should get the task for practice based on the appropriate prerequisites so that the learners quickly understand the feedback. Fourth, the learner should be ready to exert sufficient effort to improve performance.

The theory of deliberate practice has explained expert performance as being limited in some domains such as sports and performing arts, where individuals train extensively for a specific performance, but it has been discussed in the modern organizational environment as well. Sonnentag and Kleine (2000) argued that deliberate practice activities in work settings might look substantially different from those in such disciplines as sports and music. They differentiated activities in the work setting regarding the purpose of engagement.

According to them, there are two types of behaviors: behaviors engaged in to increase immediate task performance and those engaged in practicing on a regular basis. The former behavior is not deliberate practice because the purpose of the activity is not to develop performance in a long-term sense. But the latter behavior can be considered as deliberate practice activities. Another characteristic of deliberate practice in work setting can be tasks for deliberate practice. Since employees perform the tasks in the work setting across a wide range of activities, the deliberate practice activities in such an environment may not comprise extensive rehearsal of specific difficult tasks.

Motivation

Motivation is an important factor that affects acquisition of knowledge and skills. Sternberg (1998) viewed motivation as the force that drives individuals to learn and develop their abilities. Winner (1996) supported that the intense drive to master is necessary to achieve a specific domain of performance.

Glaser (1987) asserted that there are three phases in a learner's progress because the driving force changes as performance improves. The main driving force in the first phase is characterized by external support, including optimal environment settings for learning. When the development reaches a more intense stage, the driving force is replaced with apprenticeship-oriented learning and guided practice that fosters self-monitoring and self-regulation. Finally, self-regulated learning is the last stage of learning progress in which the learner can take control of the other driving forces and engage in deliberate practice and receive feedback on their performance. Self-regulated learning is not possible without a strong motivation to learn. In sum, the driving force is key to sustaining practice activities, and ensuring continuous improvement.

Many scholars have studied the factors that affect the motivation to learn. First, the goal orientation of experts is important for engaging in continuous development (Graham & Golen, 1991; Zimmerman, 2006). Seijts and Latham (2005) suggested that setting an overwhelmingly challenging learning goal would draw the motivation to learn away when the initial acquisition of knowledge and skills is the primary objective. Second, experts tend to focus on the ultimate outcomes of the development process and expect positive outcomes (Pintrich, 2000). Third, beliefs of self-efficacy are important, as higher self-efficacy leads a learner to set and reach higher goals (Cleary & Zimmerman, 2001; Locke & Latham, 2002). Fourth, experts appreciate

the value of the tasks and strive for improvement without immediate reward (Karniol & Ross, 1977; Kitsantas & Zimmerman, 2002).

Self-directedness

Self-directedness is one of the personal attributes that affects individuals in learning. Self-directedness is regarded as an individual predisposition and refers to autonomy in the learning process (Merriam & Bierema, 2014). Self-directedness is also regarded as a learning approach that is controlled by the learner. Self-directed learning refers to deliberate efforts to build knowledge and to develop a skill or to make changes as well (Tough, 1978). According to Knowles (1975), self-directed learning occurs with the following six steps: creating a climate, diagnosing learning needs, setting learning goals, identifying human and material resources for learning, selecting and implementing appropriate learning strategies, and evaluating learning outcomes.

Various factors associated with self-directed learning have been studied. Knowles (1975) claimed that the degree of self-directedness escalates as the age and maturity of an individual learner increase. Brockett and Hiemstra (1991) suggested that self-directed learning correlates with high self-efficacy. Guglielmino (1977) suggested that several psychological attributes predispose learners to self-directed learning including initiative, independence, learning persistence, responsibility taking, self-discipline, curiosity, enjoyment of learning, goal-setting, and a problem-solving orientation. However, Merriam, Caffarella, & Baumgartner (2007) claimed that conclusions about defining attributes are elusive.

Self-directed learning may occur in diverse contexts for different reasons. The continuous lifelong learning in a self-directed fashion is recommended in various professions including

physical therapy (Musolino, 2006), veterinary and medical education (Raidal & Volet, 2009), pharmacy education (Hyunh et al., 2009), and library science (Quinney, Smith, & Galbraith, 2010). Self-directed training is also considered as a strategic means to develop employees in challenging business and organizational settings because it is adaptable and responsive to change (Lee, 2001; Merriam & Bierema, 2014; Oh & Park, 2012).

Long-term goals

Developing expertise requires long-time dedication to a domain. Individuals who become experts go through the process of continuous learning and adaptation to changing task constraints. Seijts and Latham (2005) emphasized that having learning goals promotes learners' attention to continuous development. Individuals engaged in activities for developing knowledge and skills tend to focus on identifying new processes for better performance by modifying existing processes. In other words, when experts acquire knowledge and skills, they focus on process-oriented learning goals rather than near-term performance outcomes.

Feedback seeking

Individuals must receive feedback to develop expertise appropriately. Feedback is an instrument to modify and adjust performance. Experts learn from the successes and mistakes of others by using narratives that are good resources to learn (Fiore, McDaniel, Rosen, & Salas, 2007). Also, experts tend to have self-motivated feedback-seeking behavior when they need to acquire knowledge and skills. For example, experts in some technical domains, including software engineers, seek feedback more actively from colleagues in comparison to ordinary performers (Sonnentag, 2000).

This section reviewed how experts acquire the knowledge and skills related to their occupations. There are some behavioral components that help individuals acquire a high level of knowledge and skills including deliberate practice, motivation, self-directedness, long-term goals, and feedback seeking.

Update of Expertise

This section reviews how experts continuously update their domain-related occupational knowledge and skills.

Maintaining expertise is difficult in any professional domain (Hoffman et al., 2014). To retain expert performance in a domain, extended engagement in domain-related activities is necessary (Ericsson, 2004; Ericsson & Lehmann, 1996). Experience in a specific domain is shown to be necessary to attain superior expert performance in some domains (Ericsson et al., 1993). From the study of radiologists, Lesgold and colleagues (1988) concluded that expert radiologists see human anatomy in radiographic changes, just as children's views of the world change as their experiences accumulate. The expertise of expert radiologists leads them to gradually focus on deeper reasoning about the content rather than superficial facts. Such change is possible as expert radiologists refine their automatic recognition capability.

The retention of knowledge and skills is as critical as the acquisition of knowledge and skills. The experts need special efforts and procedures to update continuously and to maintain core skills. For example, physicians need to be recertified periodically, so participating in continuous medical training programs is required (Davis, 2009). Continuous learning opportunities are necessary for preventing critical errors due to lack of practice. The

development and subsequent maintenance of expertise require continuous and intensive effort viewed as lifelong challenges. Surely, acquiring expertise is never a final product and retaining expertise is also a difficult task that requires effort and attention.

To maintain superior performance, experts need to engage in specifically designed activities to further improve their performance in addition to experience and appropriate training (Hoffman et al., 2014). The specifically designed activity to improve a domain-specific performance is called deliberate practice (Ericsson et al., 1993). Deliberate practice requires the opportunity to find suitable training for effective improvement of performance (Ericsson, 2004; Ericsson et al., 1993). For example, Ericsson et al. (1993) found that the most accomplished violinists among an elite group of violinists had spent more time on specifically designed activities to improve performance, while all expert violinists had spent about the same amount of time per week on music-related activities. Experts can maintain expertise in domain-specific tasks despite normal age-related decline by continuously engaging in deliberate practice. Therefore, continued engagement in deliberate practice is necessary to maintain high levels of performance (Krampe & Charness, 2006; Krampe & Ericsson, 1996).

Experience has positive effects on the continued acquisition and maintenance of an individual's performance in some domains (Ericsson, 2002; Ericsson et al., 1993). However, this might not always be true in other cases. The length of experience is sometimes weakly correlated with job performance beyond the first two years (McDaniel, Schmidt, & Hunter, 1988). There might be little difference between individuals with and without prior experience to exhibit the same level of skill shortly after training (Bahrick, 1979). A study of expert software designers showed that experience is not consistently associated with their performance on some tasks (Sonnentag, Niessen, & Volmer, 2006). When wine experts are asked to detect, describe, and

discriminate characteristics of wine without knowledge of its identity, their performance is not impressively better than those of ordinary wine drinkers (Valentine, Pichon, de Boishebert, & Abdi, 2000).

In general, knowledge and skills increase to some level during instruction or training, but the performance declines immediately after the instruction or the training ends (Arthur et al., 1998; Wixted & Ebbesen, 1991). The decline of skills is positively related to the length of the non-practice of the skills (Arthur et al., 1998). Forgetting acquired knowledge occurs as time passes from the point of instruction (e.g., Bacon & Stewart, 2006; Semb & Ellis, 1994). For example, forgetting curves show that humans in general lose nearly 50 percent of their memory for new information in declarative knowledge learning tasks within a day unless some form of review follows (Wixted, 2004). Thus, expertise declines without the effort of use, practice, and improvement.

The factors that help or hinder the retention of performance seem to be diverse. A few factors that affect retention of performance are as follows. First, the level of performance achieved appears to be an important determiner of retention. For example, having more practice beyond the criterion level of performance, or overlearning, helps to retain expertise and to prevent decline (Arthur et al., 1998; Driskell et al., 1992; Shibata et al., 2017). Second, the contextual similarity of practice to that of the original learning can be helpful in enhancing retention of skills. In other words, when the way in which specific information is encoded is similar to the actual way of doing a task, the probability of skill retention increases (Healy, 2007; Jacobs, 2003). Third, individual learning ability can be another factor affecting retention of expertise. Individuals with higher learning ability seem to retain more knowledge or skills over periods of non-use than individuals with lower learning ability (Farr, 1987). To some extent, it

seems to be related to the first factor that achieving a higher level of performance positively affects retention of performance.

Given this discussion, there are still lots of remaining unknowns regarding retention of expertise. The studies of skill or knowledge retention have focused on single and relatively simple skills situated in the academic laboratory. Researchers (e.g., Bodilly et al., 1998; Hoffman et al., 2014) suggest that more studies are needed to fill the rather large conceptual gap between this laboratory research base and real workplace issues related to retention of knowledge and skill necessary for performing complex jobs.

This section reviewed how experts continuously update their acquired domain-related occupational knowledge and skills. In addition to the behavioral components that help experts acquire high level of knowledge and skills, experts need to engage in specifically designed activities including re-training, overlearning and reviews.

Share of Expertise

This section discusses the extent to which experts engage in sharing their domain-specific knowledge and skills to others.

Many studies have found limitations of share of expertise. For example, experts use more abstract and fewer concrete statements and it hinders share of expertise to novices (Hinds, Patterson, & Pfeffer, 2001). Change in a simple task such as changing the number of steps in a mathematical calculation or changing the context of performance can result in difficulty of transfer (Speelman & Kirsner, 2001). Also, share of expertise outside the domain is quite limited (Haskell, 2001). The experts' knowledge and reasoning strategies are domain-specific, and

highly refined and categorized (Sternberg & Frensch, 1992). Kalish, Lewandowsky, and Kruschke (2004) asserted that experts' knowledge and strategies are context-specific, so they are difficult to adapt in other contexts.

Share of expertise is often considered with the concept, transfer, because sharing of expertise becomes a meaningful activity when the shared knowledge and skills are actually transferred. Hoffman et al. (2014) suggested that it occurs in various contexts (see Table 2.5). Hoffman et al. (2014) emphasized that share of expertise might occur when knowledge, skill, or strategy is learned from one problem or task type and successfully utilized in some other context or for some other problem or task type. The contextual similarity between the training and the actual performance plays an important role in the process of sharing expertise. Thus, well-designed training minimizes the distance from training to the workplace. Healy (2007) suggested several training principles that can promote the sharing of skills including employing deliberate practice, increasing the variability of practice, adding sources of contextual interference, and providing process and outcome feedback in an explicit analysis of errors.

Type of task is one of the factors influencing sharing as well. According to Proctor and Vu (2006), sharing of expertise occurs relatively more salient with motor or procedural tasks than perceptual tasks. The sharing of expertise is sometimes difficult to make, especially with a relatively complex cognitive task. Kluge et al. (2010) found that adaptive transfer does not easily occur, as the cognitive complexity of a task gets greater. A higher level of abstraction used by experts is negatively correlated with novices' performance on an electronic circuit-wiring task (Hinds, Patterson, & Pfeffer, 2001).

Table 2.5. Different senses of transfer (adapted from Hoffman et al. 2014, p. 51)

Context	Description
Content-to-content	applying knowledge in one content domain to aid the learning of knowledge in some other content domain
procedure-to-procedure	using procedures learned in one skill area to work out problems in some other skill area
declarative knowledge-to-procedural knowledge	book knowledge or knowledge of concepts and principles learned about an area aids in the learning of skills, strategies or procedures in that same area
procedural knowledge-to-declarative knowledge	experience with the skills, strategies or procedures in an area aids in the learning of conceptual knowledge in that same area
transfer of self-aware strategic knowledge	knowledge about one's own reasoning or strategies is applied from the original domain of learning to some other domain
cross-subdomain transfer of declarative knowledge	knowledge of a concept or cause is generalized across subdomains (e.g., lighting as a form of electricity)
cross-subdomain generalization (called vertical transfer)	knowledge of a particular is generalized across subdomains (e.g., learning about the cause of a particular war facilitates learning about the causes of war in general)
cross-domain transfer of declarative knowledge	transfer based on analogy
lateral transfer of skill	learning one perceptual motor skill facilitates the learning of some other very similar perceptual motor skill

This section reviewed the extent to which experts engage in transferring the domain-specific knowledge and skills to others. There are limitations and difficulties to transfer expertise in general. Nevertheless, when the individuals engaged in the transfer and the relevant contexts are prepared, it helps the transfer of expertise occur.

The Context of the Workplace

This section reviews the literature to make sense of the context of the workplace in which an expert employee acquires, updates, and transfers their expertise. To the best of the author's knowledge, little is known about the context, which is favored in particular for experts to acquire, update, and transfer their expertise. Based on this limitation, this section will review the

aspects of the context of the workplace that affect the knowledge process between employees in organizations.

Context embraces processes and meanings of phenomena of interest (Maxwell, 2012). Understanding how and why the phenomena are happening and how to make that understanding useful and meaningful is difficult without understanding context. Context refers to "the circumstances that form the setting for an event, statement, or idea, and regarding which it can be fully understood and assessed" (Google Dictionary, 2018). Thus, the context of a workplace refers to the circumstances that form the settings designed for an employee to perform specific tasks.

The importance of the context of a workplace lies on its influence on employee behaviors. The context includes various external factors such as the nature of knowledge, organizational culture, learning climate, and technical factors that affect employees' behavior within the working environment of the organization (e.g., Cummings & Teng, 2003, 2006; Dey & Mukhopadhyay, 2018; Eldor & Harpaz, 2016; Ellinger, Ellinger, Yang, & Howton, 2002).

In the same vein, expert employees acquire, update, and transfer domain-related occupational knowledge and skills within the context of their workplaces and organizations. Thus, the understanding of the context and environment of their workplaces in their respective organizations is essential for understanding how such phenomena occur with expert employees.

Theories, including the social cognitive theory and the role theory, explain the mutual influence between the context of the workplace and employees (e.g., Bandura, 1986; Katz & Kahn, 1978). The social cognitive theory explains that individuals, behaviors, and environment interact with each other in a triadic system of reciprocal causality (Bandura, 1986). The theory

states that an individual's knowledge acquisition and transfer in particular can be directly related to observing others in the context of social interactions, experience, and external influences.

From this learning theory, an employee can complete a behavior correctly, the behavior enables an employee to experience a successful performance, and the environmental factors can be conducive to the employee's mindset to engage in a behavior. From this perspective, it could make sense that experts in some domains are very sensitive to environmental settings, and that selecting or creating the effective environmental settings for learning and performance is part of their self-control processes (Zimmerman, 2006).

The context that might influence expert employees' behavior related to the acquisition, update, and transfer of their expertise can be understood partially through the role theory as well. The role theory states that the norms in a culture determine a social situation, and that the internal and external expectations in a social situation influence social roles as the norm of behavior (Griffin, Neal, & Parker, 2007). Interdependence between the employees and the environment occurs to achieve shared goals in the organizational system (Katz & Kahn, 1978).

Based on this perspective, the behavior of employees in the organization has impact, not only the effectiveness of individuals, but also the effectiveness of bigger entities, including other individuals, teams, and the organization as a whole. The workplace settings influence an individual to contribute to the effectiveness of other entities (Murphy & Jackson, 1999). Such interdependence between the roles of members of the organization is grounded in the social context of the workplace (Griffin, Neal, & Parker, 2007).

The importance of the context of the workplace continues to grab the attention of scholars who are interested in, for example, organizational learning culture, knowledge creation, and knowledge management in the organization. This is because occupational knowledge in

particular is highly dependent on the context, localized in well-defined technical, institutional, regional and industrial situations (Antonelli, 1999). Knowledge is not only one of the key characteristics of expert employees, but also one of the most important intangible resources for organizations in a knowledge-driven economy (Reychav & Weisberg, 2009). This is because successful management of knowledge is a principal means of value creation (Cummings & Tang, 2006).

Organizational elements including the employees, the employees' skills, the technical tools, and organizational systems are involved in the knowledge process (Argote & Ingram, 2000). Cummings and Teng (2006) focused on knowledge internalization as the essential objective of knowledge sharing and the factors affecting knowledge internalization at the organizational rather than the individual level. Knowledge internalization refers to "the degree to which a recipient obtains ownership of, commitment to, and satisfaction with the transferred knowledge" (p. 3).

The ownership of knowledge is derived from the discretion to use it (Cummings & Teng, 2006). The commitment of knowledge is the degree to which an individual sees the value of the knowledge and engages in continuously developing competence in using it. The satisfaction with the knowledge refers to the degree to which the recipient is willing to adapt and use the knowledge. They suggested five contexts that can affect knowledge internalization including the relational context between the source and the recipient, the knowledge context, the source context, the recipient context, and the environmental context. Their categorization is summarized in Table 2.6 and the discussion will be in the following paragraphs.

Cummings and Teng's (2003, 2006) studies discussed the contexts that affect knowledge sharing, including some relevant information. First, knowledge and skills are acquired and

transferred more efficiently in the context in which the source and the recipient are located close to each other. The example of the Boston Harbor tunnel project (Davenport & Prusak, 1998, p. 99) explains this in detail. The Boston tunnellers were not able to adopt knowledge and skills even with memos, detailed descriptions, and manuals from experts in New Zealand until the experts from New Zealand joined the Boston crew. Cummings and Teng (2006) suggested sharing knowledge in face-to-face contexts is superior to other methods.

Second, knowledge and skills are acquired and transferred more effectively in the context in which the knowledge gap between the parties is not too great (Hamel, 1991). Lane and Lubatkin (1998) called this concept relative absorptive capacity, which means that the recipient is less able to assimilate knowledge from the source when the knowledge distance is too great. It is necessary for those acquiring knowledge to have certain knowledge overlap and common areas of expertise (Nonaka & Takeuchi, 1995). On the other hand, the knowledge transfer would not occur when there is too much overlap between the parties.

Third, knowledge and skills are acquired and transferred more smoothly in a context in which the parties have a shared sense of collaboration and social and strategic similarity. Experience of knowledge sharing of both parties is also helpful for collaboration. Social and strategic similarity could facilitate communication between the parties. Also, the source should be free of fear that the activity would be expendable only. Cummings and Teng (2006) suggested that developing deep, extensive, friendly relationship between the parties is critical for knowledge sharing success.

Table 2.6. Contexts of knowledge sharing (Cummings & Teng, 2006)

Context	Sub-context	Description	Example
Relational context	Organizational distance	The governance modes through which the knowledge-transfer conducted (p. 4).	Internal vs. inter-firm transfer
	Physical distance	The physical distance between the parties (p. 4).	Country, region
	Institutional distance	The degree of similarity between the institutional environments facing the two parties (p. 5).	The regulatory environment on the transfer of scientific knowledge
	Knowledge distance	The difference of knowledge base between the source and the recipient (p. 5).	The knowledge gap between a source and a recipient
	Relationship distance	The quality of the experience that the source and recipient have working together (p. 6).	Social similarity
Knowledge context	Knowledge explicitness	The extent to which knowledge can be verbalized, written, drawn, or otherwise articulated (p. 7).	Tacit vs. explicit knowledge
	Knowledge embeddedness	The possible relations of knowledge with people, tools, products, tasks, technology, and sub-networks (p. 8).	Knowledge elements and related sub-networks together with knowledge need to be transferred, absorbed, and adapted by the recipient
Recipient context		The nature of the recipient that affects knowledge transfer (p. 9).	Recipient's motivation, absorptive and learning capabilities, intent, knowledge experience, collaborative experience, retentive capacity and learning culture
Source context		The extent to which the source is prepared for knowledge transfer (p. 10).	Source's knowledge-sharing culture of the source, the credibility of the source with the recipient, strategic intent to complete transfer
Environmental context		The nature of the environment in which knowledge sharing occurs. It may be subsumed within the relational context (p. 11).	Economic, cultural, political, and institutional environments

Fourth, knowledge and skills are acquired and transferred differently to the extent to which knowledge can be verbalized, written, drawn, or articulated, depending on its explicitness or tacitness. Explicitness or tacitness refers to the degree to which the knowledge is closer to either extreme on the continuum (Inkpen & Dinur, 1998). Explicit knowledge codified in a specific product or process is found to be more easily transferable, while tacit knowledge, which relies on personal experience and cognition, is difficult to transfer. Cummings and Teng (2006) asserted that neither a complete codification of knowledge nor great causal ambiguity is ideal for knowledge internalization. Knowledge could be predefined and set the limitation of its adaptability in the former case, and the transfer of knowledge is essentially difficult in the latter case due to the barrier to identifying the related knowledge elements.

Fifth, knowledge and skills are acquired and transferred along with other elements, including people, tools, products, technology, tasks, and sub-networks. Knowledge is usually embedded in people. For example, an expert employee from a different organization can transfer knowledge to other employees in the hiring organization. Knowledge embedded in tools, products or technology needs to be specified by the source to share the knowledge. Organizational tasks and routines are developed for operation but are implicitly embedded in the system. Furthermore, knowledge is embedded in a mix of multiple elements. For example, recognizing who is good at which tasks is based on knowledge embedded in the people-routines network (Argote, 2013).

Lastly, knowledge and skills are acquired and transferred under the influence of the learning environment and learning capability of the recipient and the source. Cummings and Teng (2006) emphasized that the source needs to be capable of managing knowledge-sharing activities in an active and continuous manner and to keep the intent to help a less capable

recipient in their development. Also, the recipient should see the value of the knowledge being shared to complete knowledge internalization. Increasing attention has been paid to the types of environment that promotes knowledge internalization, retention, and further development. The learning environment of a workplace promotes sharing knowledge, encouraging learning feedback, and enhancing the connection between organizational and employee development (Lankau & Scandura, 2002; Lee & Bruvold, 2003; Ng, Eby, Sorensen, & Feldman, 2005).

The learning climate refers to the learning activities in the workplace that employees can benefit to create, acquire, and transfer knowledge to achieve an organization's strategic goals (Argyris & Schön, 1978; Marsick & Watkins, 2003). Employees' perception of the learning climate is closely linked to the capability of their organization to respond to changes by modifying its behavior (Senge, 1990; Watkins & Marsick, 1997). Therefore, the learning climate can be a competitive advantage to an organization when employees know how to gain knowledge, how to share information such as knowledge, skill, and visions, how to meet their challenges, and how to think systematically (Eldor, 2017).

An environment that provides employees with opportunities to develop their knowledge and skills as well as share them with other members of the organization is a critical means of retaining good employees as well (Eldor & Harpaz, 2016). Employees who perceive their work environment as providing meaningful and empowering learning resources feel more valued (May et al., 2004). Employees who perceive their organization as being supportive and providing challenging learning resources tend to more engaged in their work roles (Hobfoll, 2001; Kahn, 1990, 1992). The learning-engaged employees show a desire to share their knowledge, to be more open to change, and to be more involved in creative thinking and problem solving (Eldor & Harpaz, 2016).

Conceptual Framework

A theoretical and conceptual framework is "the underlying structure, orientation, and viewpoint of the research study" (Merriam & Simpson, 2000, p. 23). This section synthesizes what has been discussed throughout the previous chapters based on the suggestion made by Merriam and Simpson (2000) (see Table 2.6). The conceptual framework of this study is presented at the end of this section.

Table 2.7. What is a conceptual framework? (Merriam & Simpson, 2000, p. 23-24)

Theoretical or conceptual framework	Determining research orientation	That depends on particular discipline or theory or philosophy. The particular perspective will be reflected with: • The topic the researcher is interested in • The specific problem the researcher has identified • The purpose of the study • The questions or hypotheses • The methods of data collection, analysis, and interpretation
	Making the orientation explicit	The component of the study must coherently fit together with: • The concepts the researcher is using • The literature and previous research the researcher refers to • The instruments selected to assess the phenomenon By answering the following questions: • How are the variables of interest derived from this orientation? That is, what does the previous literature say? • How do these variables relate logically to each other?
	Providing in-depth information	That tells how the study adds to the framework. The researcher fills it out with: • Raw data that the research has collected • Findings • Discussion of the findings

Extensive research has discussed what is required for expertise in professional and occupational domains. Expertise in medicine requires mastery of diverse knowledge and motor, cognitive, and interpersonal skills (Norman, Evan Brooks, & Hamstra, 2006). From a learning perspective, professionals in medicine need to acquire diverse knowledge and skills including causal knowledge, analytical knowledge, experiential knowledge, diagnostic skills, coordination of knowledge, and technical skills (Coderre, Mandin, Harasym, & Fick, 2003; Coughlin & Patel, 1987; Elstein, Shulman, & Sprafka, 1978). Keeping the expertise up to date is a critical task for practitioners since new technologies and drugs are constantly introduced (Choudhry et al., 2005).

On the other hand, due to the nature of the work, expertise in operating vehicles or aircraft primarily focuses on the interaction between human and technical systems that requires dual-task performance, visual search, hazard detection, situation awareness, and declarative and procedural knowledge (Durso, & Dattel, 2006; Stokes et al., 1997). In the case of software designers, high performers in solving a design problem are usually able to come up with more strategies using highly language-dependent and abstract knowledge, and they perform better in communication and cooperation (Curtis, Krasner, & Iscoe, 1988; Sonnentag, 1995).

Although the rich information about the nature of expert employees in the workplace is available, the learning approaches explaining how experts develop their expertise have often been beyond the research objectives. Therefore, this study investigates the themes that emerge when the expert employees acquire, update, and share the domain-related knowledge and skills with others to better understand their learning approaches.

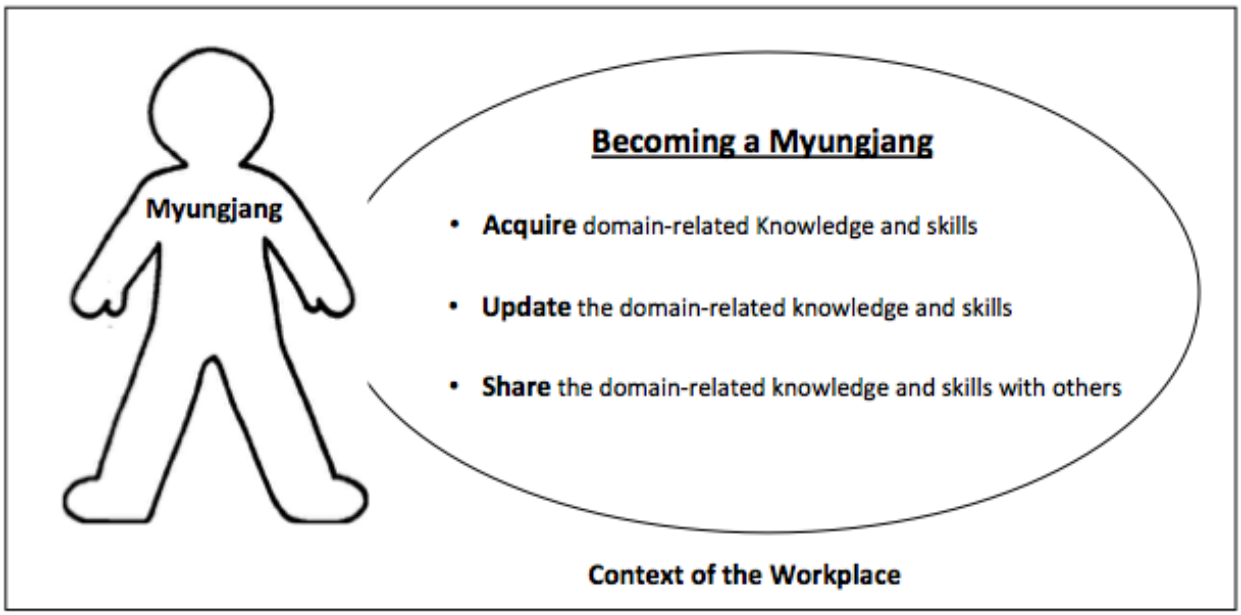

Figure 2.2. Conceptual framework of the study

CHAPTER 3: METHODOLOGY

This chapter describes the methodology employed in this study. Sections consist of nine sections: design of the study, data collection methods, selection of respondents, data collection procedures, data analysis methods, data analysis procedures, trustworthiness of the findings, assumptions of the study, and limitations of the study.

Design of the Study

The study is designed as a descriptive qualitative approach using the Critical Incident Technique (CIT) as the primary method of data collection. The focus of descriptive study is to examine facts about people, their opinions, and attitudes, but not to investigate sets of relationships between events (Merriam & Simpson, 2000). This means that the researcher in a descriptive study does not control the environment in which the study takes place and focuses on describing the facts and characteristics of a given phenomenon. Thus, the description of this study may include a collection of facts that describe existing phenomenon, justification of the conditions of the phenomenon, and comparison of respondents' experiences with a given phenomenon.

This approach was selected for this study by the researcher because the research questions will be better answered this way based on the following reasons. Most importantly, the CIT is "a set of procedures for collecting direct observations of human behavior in such a way as to facilitate their potential usefulness in solving practical problems" (Flanagan, 1954, p. 327). Thus,

the interview respondents are asked to tell what happened (incident) rather than their perception of what happened.

Three criteria were suggested to consider the incidents critical as follows. First, the actions of the participants are sufficiently complete that inferences and predictions can be made about the participants. Second, the intent of the participants' actions is clear. Third, the consequences of the actions are definite enough that there can be little doubt concerning the effects of the actions observed (Flanagan, 1954, p. 327).

Flanagan (1954) suggested that the degree of significance depends on the nature of the activity. In this study, the respondents will be asked to tell stories about their experiences of significant occurrences that were critical to their expertise development. Specifically, the boundary of the significant occurrences is limited by the way they acquired domain-specific occupational knowledge and skills, retained the knowledge and skills, and possibly transferred them to others.

Investigations using a qualitative approach tend to focus on three kinds of questions: questions asked for finding the meaning of events and activities to the people involved in these, questions asked for finding the influence of the physical and social context on these events and activities, and questions asked for finding the processes by which these events and activities and their outcomes occurred (Maxwell, 2013, p. 83).

The questions of this study are developed to better understand what the expert employees do to acquire, update, and share their expertise:

(1) what do expert employees do when they acquire domain-related occupational knowledge and skills?

(2) what do expert employees do when they update domain-related occupational knowledge and skills?

(3) what do expert employees do when they share domain-related occupational knowledge and skills with others to improve their and others' knowledge and skills?

An advantage of a qualitative approach is that it enables the researcher to investigate a problem in-depth and in detail, while a quantitative approach may yield a broad and generalizable result (Patton, 2015). Quantitative methods based on "variance theory" tend to see the word in terms of variables and their statistical relationships. On the other hand, qualitative methods based on "process theory" seek to know the world in terms of people, situations, events, and the processes that connect those in-depth and in detail (Maxwell, 2013, p. 29). Process questions are developed to know about *how* things happen, rather than *whether* there is a particular relationship between variables or how well different variables explain a relationship (Maxwell, 2013, p. 82).

Thus, a qualitative study rarely tests theories, but it seeks to use one or more cases to develop ideas instead. The initial goal of qualitative research, that is, knowing as much as possible about a case eventually gives way to identifying the features of the case, which will be important resources for answering the research questions. In this way, qualitative research advances theory in its emphasis on finding the commonalities that exist among diverse cases (Ragin & Amoroso, 2011).

Creswell (2014) suggested that different forms of qualitative traditions exist and that the design of research within each has distinctive features. He set out the unique dimensions of five major qualitative traditions by looking at the discipline's focus, origin, data-collection methods, data analysis, and narrative forms. Butterfield et al. (2005) summarized the features of the CIT as

follows: (a) focus is on critical events, incidents, or factors that help promote or detract from the effective performance of some activity or the experience of a specific situation or event; (b) discipline origin is from industrial and organizational psychology; (c) data collection is primarily through interviews, either in person (individually or in groups) or via telephone; (d) data analysis is conducted by determining the frame of reference, forming categories that emerge from the data, and determining the specificity or generality of the categories; and (e) narrative form is that of categories with operational definitions and self-descriptive titles.

Data Collection Methods

The data for this study will be collected by the CIT in standardized open-ended interviews with selected respondents.

Critical Incident Technique (CIT)

The CIT is selected as the primary methods of research for the study. The objective of using the CIT for this study is to gain an understanding of the incidents considering cognitive, affective, and behavioral elements from the perspectives of respondents. The critical incidents in this study refer to the occurrences that, from their perspectives, significantly affected their expertise development, specifically in terms of the way they acquired domain-specific occupational knowledge and skills, updated that knowledge and skills, and possibly shared them with others. It is expected that the researcher can look for evidence of commonalities in those themes that relate context, strategy, and outcomes by looking for patterns in experts' ways of acquiring, updating, and possibly sharing expertise by collecting data from multiple respondents.

The CIT is an effective exploratory and investigative tool that has proven both reliable and valid in generating a thorough description of a specific phenomenon (Butterfield, Borgen, Amundson, & Maglio, 2005; Chell, 1998). It was developed primarily to determine the job requirements critical for success in a job across industries (Flanagan, 1954). This method has been widely utilized to identify various job requirements through observing job behaviors including interpersonal skill requirements of supervisors (Jacobs, 1986), communication competence (Query & Wright, 2003), role of facilitators in learning (Ellinger & Bostrom, 2002), learning behaviors in clinical settings (Leone-Perkins, 2000), learning practices and competency development of cybersecurity professionals (McIlmurray, 2008), and social work values and ethics (Papouli, 2016).

Flanagan (1954, p. 335) noted, "the essence of the technique is that only simple types of judgments are required of the observer, reports from only qualified observers are included, and all observations are evaluated by the observer regarding an agreed-upon statement of the purpose of the activity." Therefore, the accuracy and objectivity of the judgments depend on the extent to which the activity is precisely defined and the competence of the observer in interpreting the relevance of the incident observed with the definition of the activity.

In a case of having little relevant theory regarding a specific incident, the classification of the critical incidents is the first step in developing procedures that will be of assistance in gathering facts in an objective manner. This task will be inductive and relatively subjective. On the other hand, the incidents must be studied based on known facts when there are sufficient established principles and inferences explaining the incidents.

Flanagan (1954) delineated five steps to the CIT:

(1) establishing the aim of the activity to be studied,

(2) setting plans, specifications, and criteria for the information to be obtained,

(3) collecting data,

(4) analyzing the data, and

(5) interpreting and reporting the findings

The researcher formulates the design and the investigation plan of this study based on Flanagan's suggestions with steps one and two, and the overall appropriateness of this study will be examined by the committee members of the preliminary examination. To ensure the objectivity of the observations being made and reported, the same set of rules for the data collection and analysis will be explicitly described.

Flanagan (p. 338-339) suggested the following specifications to be established prior to collecting the data:

- delimitating the situation to be observed by including information about the place, the persons, the conditions, and the activities;
- determining whether or not a specific behavior which is observed is relevant to the general aim of the activity;
- deciding the extent of effect of the observed incident on the general aim on both positive and negative sides;
- selecting observers who are familiar with the observed incident and training for making them review of the nature of the general aim of the activity and be well acquainted with the specifications and definitions for the judgments they will make.

Flanagan suggested that the behaviors observed should be fresh in the mind of the observer at the time of collecting data (p. 340). Although direct observations are to be preferred, recalled incident data can provide adequate data as well. Since recalled incident data will be primarily

collected for this study, the procedures of collecting such data need to be discussed in-depth. Flanagan acknowledged that there are four procedures of collecting recalled data in critical incidents: (a) interviews, (b) group interviews, (c) questionnaires, and (d) record forms (p. 340-343). Referring briefly to the general aim of the activity is required at the beginning of implementing the procedure.

The most vital aspect of the data collection procedure by interviews is the questions asked by the observers. Flanagan suggested paying extra attention to the wording used in the questions because "a slight change in wording may produce a substantial change in the incidents reported" (p. 341). Thus, questions need to be tested out with a small number of representatives of typical interviewees before using the questions in earnest. In addition, the interviewer keeps focusing on listening to the observer instead of asking leading questions after the interviewee understands the main question. In this way, unbiased incident data can be collected.

Sample questions and answers for describing an incident of a certain job behavior are available in the literature. For example, the critical incident technique was used in the study of George (1989) to describe effective leader behavior. A sample critical incident reporting form includes the instructions and the interview questions, and the participant's answers was provided (George, 1989, p. 59) (see Table 3.1). According to the critical incident reporting form, the participant was led to describe the situation, the behavior exhibited, and the result of the behavior. It was in particular emphasized that the situation of the incident should be described along with the behavior so that the initial cause of the incident can be correctly understood.

Standardized Open-Ended Interview

The purpose of qualitative interviewing is to capture the complexities of respondents' perceptions and experiences (Patton, 2015). The fundamental principle of qualitative interviewing is that the respondents will express their understandings in their terms when responding to the interview questions within the framework of the study. The standardized open-ended interview requires determining the exact wording and sequence of questions in advance, exactly the way in which they are asked during the interview. The interviewer will ask all interviewees the same questions, which are written in a completely open-ended format in the same way and in the same order.

The reasons for using standardized open-ended interviews are as follows (Patton, 2015, p. 441). First, the exact instrument used in the study is available for inspection by those who will use the findings of the study. Second, variation among interviewers can be minimized when different interviewers must be used. Third, the interview is highly focused so that the interviewee's time is used efficiently. Fourth, the analysis is facilitated by making responses easy to find and compare. Although there will be only one main interviewer (the researcher) for this study, this type of interview has the advantage of increasing comparability of responses while minimizing variation in the questions. Collecting the same information from each person raises no credibility issue when each person is considered as a unique informant with his or her own perspective (Patton, 2015).

Table 3.1. Sample critical incident questions and answers (adapted from George, 1989, p. 59)

Objective	Describing an incident of effective leader behavior
Instructions	Describe a situation in which you have observed what you consider to be an example of effective leader behavior. Please be specific in describing the situation, the behavior, and the result. Please don't name the individuals.
Description of the situation	**Question**: Please describe the situation in which the effective leader behavior occurred (location, time, events surrounding the incident). **Answer**: There was a waiter whose manners and personality couldn't be matched. Unfortunately, he couldn't organize himself when serving several tables at once. This was especially evident when the restaurant was jammed. His coordination went crazy, and so did he.
Description of the behavior	**Question**: Please describe the effective leader behavior (what the leader did.) **Answer**: The manager was aware of the problem. Knowing the employee was a good influence on the other employees and had a personality that impressed the customers, he decided to help this employee instead of firing him. The waiter made some major mistakes on busy nights, so the manager took the time to train this employee personally and help him to manage his time and skills better when serving large numbers of people.
Description of the result of the behavior	**Question**: Please describe the results of the effective leader behavior (what happened as a result of the effective leader behavior). **Answer**: Because of the personal interest the manager took in this employee, he is now not only someone the staff members and customers like, but he is also a good waiter. The employee does not become nervous or discouraged when several tables are occupied at once and has become a valuable asset to the restaurant. The manager saw this employee's potential and helped him to develop it. The employee is now confident and competent, and he has tremendous respect for the manager.

Weiss (1998, p. 154) provided the procedure for conducting the open-ended interview. Open-ended interviewing begins with introducing the interviewee to a list of topics to be covered and ensuring a clear sense of what kinds of information are being sought. The interviewer then tells the respondent to narrate a story related to the topic presented as the respondent wishes. The interviewer follows up with neutral probes, for example, "And then what happened?" or "How come it happened in such way?" until he obtains complete data on the topic. The interviewer will, however, never supply any cues or predetermined phrases or categories that might lead to the answers he prefers. Each respondent answers in his or her own terms and provides information that is personally salient. Recording the interviews is recommended if possible so that there would not be any missing information from the interview.

As designing an interview for a qualitative study, the influence of research subjectivity and research relationship needs to be reviewed (Maxwell, 2012). The influence of researcher subjectivity on the results will be minimal because the study focuses on about the respondents' experiences, *what they did*, rather than about the persons themselves, *who they are*. The data will be exactly what the respondents will say in the interview rather than the researcher's memos of the researcher's direct observation. The researcher's relationship with the respondents in a qualitative study is concerned when the relationship may shape the context in which the research is conducted and have a profound influence on the results. In this study, its influence will be minimal as well because there is no influence of the relationship between the researcher and the respondents on how the respondents will respond.

To develop good interview questions, the researcher understood that simply making the research questions into interview questions does not work in practice. In this regard, Maxwell (2012) discusses how a researcher can develop good interview questions when there is a lack of a

direct logical connection between research questions and interview questions for a study. First, a researcher needs to anticipate, as best he can, how particular questions are answered in practice—that is, how people understand the questions and how they are likely to respond in the actual context of the interview.

Selection of Respondents

According to Maxwell (2012), "the guiding principle in selecting settings and respondents for a qualitative study is, first, to identify groups, settings, or individuals that best exhibit the characteristics or phenomena of interest." (p. 94). This guiding principle refers to the strategic selection of where, when, and from whom the researcher(s) will collect the data based on the purpose of the study.

Respondents can be selected in two ways. Purposive or purposeful sampling is a way to select particular respondents for particular reasons. On the other hand, random sampling is another way based on the laws of probability. Purposive sampling is appropriate when the researcher is interested in particular data on extreme cases. The researcher may seek representatives of a phenomenon at the tails of distribution to capture the experience (Weiss, 1998).

Thus, purposeful selection of respondent was used for this study as well because it best helps the researcher understand the problem and the research questions (Creswell, 2014). Purposeful selection is not a fixed mechanical procedure that a researcher should follow, but its application requires using all of the information available to the researcher to help her or him decide which setting and respondents best meet the study purpose.

In qualitative studies, the number of respondents should be determined by informational needs so that the research question can be sufficiently answered (Krippendorff, 2004; Patton, 2015). It means the researcher needs to select information-rich cases that would provide appropriate data for the research questions in-depth (Patton, 2015). In the CIT study, the number of critical incidents reported and whether the incidents represent adequate coverage of the activity being studied are more important than the number of respondents.

There is no set of rules for how many incidents are sufficient. As Flanagan stated, "if the activity or job being defined is relatively simple, it may be satisfactory to collect only 50 or 100 incidents. On the other hands, some types of complex activity appear to require several thousand incidents for an adequate statement of requirements… For most purposes, it can be considered that adequate coverage has been achieved when the addition of 100 critical incidents to the sample adds only two or three critical behaviors" (p. 343).

DaehanmingookMyungjang

'DaehanmingukMyungjang (대한민국명장, 大韓民國名匠)' is a title given to an expert who possesses the highest expertise in their respective occupation, and such an expert is designated by the president of the Republic of Korea. DaehanmingukMyungjang (Myungjang, hereafter) is translated as renowned master of South Korea. The title is granted to selected masters whose expertise, experience, and contribution to the society meet the following criteria: (a) at least 15 years of work experience in a single occupation, (b) demonstration of the possession of the most advanced knowledge and skills in the respective domain, and (c) explicit contribution to the domain as well as society. The designation is determined through an

evaluation process consisting of document review, on-site investigation, and interview that measure the degree to which the applicant's overall quality satisfies the selection criteria.

Myungjangs who possess particular excellence in their skills often engage in developing apprentices. The apprentices often participate in the WorldSkills Competition. The WorldSkills Competition is "the biggest vocational education and skills excellence event in the world that truly reflects global industry. The competitors represent the best of their peers and are advanced from skill competitions in WorldSkills Member countries and regions. They are all under the age of 23 years (except for four skills that have the age limit of 25). They demonstrate technical abilities both individually and collectively to execute specific tasks for which they study and perform in their workplace" (WorldSkills, 2018).

The WorldSkills competition has been organized since 1950 and is currently held every two years. Since then, South Korea has been one of the top-ranked countries that produce the most skillful technicians across skills areas. At the most recent event, WorldSkills Abu Dhabi 2017, about 1,300 young technicians from 59 countries participated in competition in 51 areas of skills.

A total of 633 Myungjangs from 37 industrial areas, including mechanical engineering, services, and handcrafts, were designated from 1986 to 2018. (Ministry of Employment and Labor, Republic of Korea, 2017).

Selection Criteria

The guidelines that indicate who are eligible for this study as the respondents and to whom the priority of contact is given are as follows.

- Myungjangs who were designated within the last three years will be contacted first and asked about their willingness to participate (11 Myungjangs in 2017, 11 Myungjangs in 2016, 17 Myungjangs in 2015)
- Myungjangs who are currently working in their respective occupations were selected.
- Myungjangs who work with co-workers in an organization were preferred over Myungjangs who are self-employed and work alone.
- Myungjangs who have registered one or more patents were preferred over Myungjangs who do not (Most of Myungjangs have registered multiple patents.)
- Myungjangs who emphasized in their profile that they have continuously been engaged in sharingg their knowledge and skills to others were preferred. (e.g., coaching apprentices who participate in an international competition, teaching students in the vocational schools.)

In summary, the data collection methods are described in this section. The critical incident for this study was defined as the occurrences that, from their perspectives, significantly affected their expertise development, specifically regarding the way they acquired domain-specific occupational knowledge and skills, updated that knowledge and skills, and possibly shared them with others. The respondents were asked to recall the occurrences and described the effective behaviors they enacted to acquire, update, and share knowledge and skills. Through collecting the critical incidents, the data included the outcomes of the behaviors and the context of the

environment in which the incidents occurred. The researcher rigorously followed the steps and procedures outlined by Flanagan (1954) in the collection and analysis of critical incidents.

Data Collection Procedures

The CIT does not consist of one fixed set of rules controlling data collection. Instead, the procedures should be as flexible, so they can be modified and adapted to meet specific research contexts (Flanagan, 1954, p. 335). The following describes the data collection procedures that the researcher undertook.

- After successfully passing the preliminary examination, the researcher contacted the potential subjects via email or social networking service.
- Those who wanted to participate in the research informed the researcher their willingness to participate via email or social networking service.
- The researcher provided the study participants the timeframe for an interview and the study participants selected the date and time as well as places for the interview.
- The researcher went to Korea.
- The researcher and an interviewee met in person for an interview. The interview was voice-recorded based on the interviewee's agreement and understanding that the recording will be used to develop the interview transcripts only.
- The researcher conducted interviews with 20 Myungjangs.

For a comfortable environment for the interviews, the researcher asked the interviewees to select the interview time and notified them that their workplaces were preferred for the interview since it would be natural to describe how they work in the environment. There was

minimal interruptions and words spoken by the researcher during the interview apart from providing the main questions.

Data Analysis Methods

The qualitative data from the interviews encompass the information about how the respondents interpreted their experiences, how they constructed their worlds, and what the experiences mean to them (Merriam & Simpson, 2000). Thus, analyzing the data from the respondents enable the researcher to achieve the primary goal of this qualitative study—that is, understanding of how the respondents make sense out of their experiences and to delineate their meaning-making process.

What Flanagan (1954) suggested describing the data in the light of thier use as preparation for data analysis. A functional description of the activity regarding specific behaviors is to describe and summarize the data in a purposeful manner. The goal of data analysis is to increase the usefulness of the data as much as possible while leaving little room to sacrifice their comprehensiveness, specificity, and validity (p. 344). Flanagan noted the following involving the description of the data: (a) the choice of a frame of reference for describing the incidents that depends on the principal use of the findings; (b) the inductive formulation of categories; and (c) the determination of the optimal level of generality and specificity to use in reporting the data (p.344-345). The art of CIT is that the categories inductively formulated are used as the requirements of an activity.

The usual procedure of data analysis of the CIT is to sort incidents into groups that are related to the frame of reference selected (Flanagan, 1954, p. 344). As many other qualitative

methods share a similar initial approach, the researcher should allow categories to emerge from the data and describe them in an inductive way (Kondracki & Wellman, 2002; Mayring, 2000). It is helpful to develop tentative ideas about rewriting and reorganizing observation notes as well as developing categories and their relationships while transcribing interviews (Maxwell, 2011).

The process of data analysis begins by reading and rereading each transcript and making notes of impression, thoughts, and initial analysis. By reading the entire set of transcripts, the researcher will be getting a holistic picture of the data. As this process continues, multiple thoughts for codes will begin to emerge from the text and then will become the initial coding scheme (Maxwell, 2013). The coding process in content analysis is basically to organize a large amount of data into fewer content categories (Weber, 1990). Morse and Field (1995) suggested that numbers of categories should be between 10 and 15 to keep them broad enough to embody a large number of codes. After this, definitions for the categories, sub-categories, and codes are developed.

According to Maxwell (2013), memos, categorizing strategies such as coding and thematic analysis, and connecting strategies such as narrative analysis are three main analytic options for the researcher after acquiring a complete set of interview transcripts. Memos help the researcher to capture analytical thinking about the data and to facilitate such thinking and analytical insights. Categorizing strategies focused on similarity relations, which can best be identified based on comparison. Connecting strategies focus on contiguity relations, which can be identified based on the actual context, including juxtaposition in time and space and the influence of one on another.

Coding and Categorization

Coding is the main categorizing strategy in qualitative research (Strauss, 1987). While coding in quantitative research deals with a pre-established set of categories of data to count items, coding in qualitative research involves organizing the data into categories that facilitate comparison or identification of broader themes and issues. Coding is a heuristic device and process that enables the researcher to identify and organize meaningful data and prepare the interpretation stage (Miles, Huberman, & Saldana, 2014). Coding begins with the identification of units of data (Maxwell, 2013), which refers to data segments that seem important and meaningful in some way.

Groups of the units of data are labeled as categories, and the units of data are then examined and compared within and between categories. Categories are patterns or themes that are directly expressed in the text or are derived through analysis; then, relationships among categories are identified. In the coding process, researchers using content analysis create or develop a coding scheme to guide coders to make decisions in the analysis of content. A coding scheme is a translation device that organizes data into categories (Poole & Folger, 1981). A coding scheme includes the process and rules of data analysis that are systematic, logical, and scientific. The development of a good coding scheme is central to the reliability of research using content analysis (Folger, Hewes, & Poole, 1984).

Identifying the units of data is based on the researcher's ideas of what is important, or on an inductive attempt to capture new insights. The categories are broad areas that serve as useful ways of ordering data for further analysis. They do not directly help a researcher make sense of the phenomenon because the meanings of each unit of data are not identified. At this stage, the

researcher needs to further divide the categories into substantive categories or theoretical categories.

Substantive categories are descriptive, including description of participants' concepts and beliefs. In contrast, theoretical categories are derived from existing theory or an inductively developed theory. When some ideas do not fit into existing categories, creating substantive categories are used to capture them. Microsoft Excel and Word 2016 were used for coding and categorizing the data for this study. Creating a matrix for displaying and developing the results of qualitative data analysis is useful (Maxwell & Miller, 2008). The matrices are helpful to visualize the result of analysis and when some participants do not represent a particular theme (Miles, Huberman, & Saldana, 2014).

The importance of coding and categorizing the data lies in how the researcher uses that data, not in whether the researcher relies on manually marking and manipulating the data (Coffey & Atkinson, 1996). Due to the nature of categorizing, there might be a chance that the analysis misses the original context (Maxwell, 2013). To overcome such a deficiency, understanding the data in context, or identifying relationships among elements of the data in a holistic way is important (Coffey & Atkinson, 1996).

The analysis focuses on finding relationships that connect events within a context into a coherent whole, rather than looking for similarities to sort the data into categories (Maxwell & Miller, 2008). In other words, codes themselves represent the decisive link between the original data—the interview transcripts in this study—and the researcher's theoretical concepts. Identification of connections among different categories and themes is necessary for building theory.

Content Analysis

Content analysis broadly refers to analyzing text including interview transcripts, diaries, or documents (Patton, 2015). Hsieh and Shannon (2005) defined qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (p. 1278). As a method, content analysis is unique because it can be used in either an inductive or a deductive way (Berg, 2001; Krippendorff, 2004).

In a qualitative content analysis, data are presented in words and themes, which makes it possible to draw some interpretation of the results. The data can be analyzed either in a manifest way or a latent way. In a manifest analysis, the researcher describes the data as they are—for example, what the informants say, stays very close to the text, uses the very words from the data, and describes the visible and obvious in the text. In contrast, the data are analyzed and interpreted to find the underlying meaning of the text (Berg, 2001).

Research using qualitative content analysis pays attention to the content or contextual meaning of the text (McTavish & Pirro, 1990). Text data might have been obtained from, for example, narratives, open-ended interviews, focus groups, observations, or media in verbal, print, or electronic form (Kondracki & Wellman, 2002). The qualitative content analysis examines text data intensely to classify large amounts of text into a smaller number of categories that represent similar meanings (Weber, 1990). The relationship between categories and sub-categories will be identified based on their antecedents, concurrence, and consequences depending on the purpose of study. Through content analysis, a phenomenon under study can be described and understood, and ultimately knowledge can emerge.

Hsieh and Shannon (2005) identified three distinct approaches of qualitative content analysis: conventional, directed, and summative. Although all three approaches are used to interpret text data and require a similar analytical process, they are distinct from each other. The key differences among the approaches lie in their ways of developing codes. In conventional content analysis, categories are derived from data analysis as the researcher gains a richer understanding of a phenomenon in the process. In directed content analysis, the researcher develops the initial coding scheme before the beginning of analysis using existing theory. The initial coding scheme is revised, as it needs additional codes. The summative approach to content analysis is used when the research focuses on single words or particular content in the text rather than the data as a whole.

According to Hsieh and Shannon (2005), conventional content analysis is appropriate for this study for two reasons. First, the purpose of this study is to describe a phenomenon of how experts acquire, retain, and transfer knowledge and skills that has not yet been sufficiently described in the literature. Second, this type of design is usually appropriate when theory or research literature on the to-be-explored phenomenon is limited. The merit of conventional content analysis is gaining information directly from the study participants so that knowledge generated by the analysis reflects the study participants' perspectives.

Once coding is completed, the data need to be systematically explored to generate meaning. Miles, Huberman, and Saldana (2014) argued that the way of displaying the data is a key element of the analytical process. It includes creating codes, organizing the data under a particular code, producing diagrams, matrices, and maps of coding. The data need to be in a form that is accessible for reading, for exploring, and for interpreting (Coffey & Atkinson, 1996). Interpretation involves playing with and exploring the codes and categories, which are used to

make pathways through the data so that a researcher can be in a position to look at the data. The information that does not fit into the codes and categorization, the exceptions, and negative findings should be treated as importantly as the easily coded data (Dey, 1993). Transforming the coded data into meaningful data emphasizes what to look for in the codes and categories.

Data Analysis Procedures

It is suggested that a researcher begins data analysis immediately after finishing the first interview or observation, and that the data analysis should continue while he or she is working on the research (Coffey & Atkinson, 1996; Maxwell, 2013). The data analysis procedures are as follows:

- Verbatim transcriptions of the interviews in Korean were developed from the audio-recordings of the interviews using Microsoft Word 2016. Since all participants' stories were clearly captured by the researcher's cell phone, there was no issue on developing the verbatim transcriptions of the interviews.
- The researcher printed the verbatim transcriptions out and began to find a unit of meaningful data that could be described as the critical incidents.
- Once the initial analysis was completed, the researcher organized the selected units of data using Microsoft Excel 2016. The researcher created separate sheets in Microsoft Excel 2016 for each theme. The data was organized in chronological order of the interviews.
- Once the data from the initial data analysis was completely organized, the researcher numbered each unit of data.

- The researcher began to select the data that contained all three components of the critical incidents including situation, behavior and the result of the behavior. Thus, the units of data from the initial analysis that had insufficient information were eliminated.
- Once the critical incidents for each theme were completely analyzed, the researcher began to translate the data into English.
- Once the translation was initially completed, the researcher revised all data in English in similar length each other.
- Once the revision of the data in English was completed, the researcher sent the translated data to two doctoral students in human resource development at the University of Illinois Urbana-Champaign who are fluent in both Korean and English to review the translation.
- Based on their feedback, the researcher corrected the translation.
- The researcher created separate sheets for categorization of critical incidents for each theme. The researcher reviewed each critical incident and created a category.
- Once a category was identified, the researcher put the number of the respective critical incident under the category. As a number of critical incidents were reviewed, they began to be categorized under the already-created categories.
- During the process of the categorizing the critical incidents, a few of the critical incidents were further identified as irrelevant data and they were eliminated.
- Once the categorizing was completed, the researcher reviewed each category and the critical incidents under the category several times until all categories are mutually exclusive and describe things at the same level.

- The researcher sent the categorized data to two native English speakers. One person earned a Ph.D. in human resource development at the University of Illinois Urbana-Champaign and another person is a doctoral student in human resource development at the University of Illinois Urbana-Champaign.
- The researcher revised the categories and wording based on their feedback.

Trustworthiness of the Findings

To establish the trustworthiness of the study, the researcher has to provide sufficient details of data collection and the processes of analysis so that consumers of the research can judge the quality of the results (Patton, 2015). Flanagan (1954) suggested a thorough interpretation of biases that could be introduced in the preceding steps of data collection and analysis. According to his suggestion, the limitations and the nature of judgments made in the collecting and analyzing the data must be carefully reviewed and reported. This needs to be done as clearly as possible so that the degree of credibility of the results can be attached to the findings.

The statement of requirements can be ready to be used properly in practice through the interpretation and report process. Qualitative analysis relies on the capabilities of individual analysts, including their insights, conceptual capabilities, and integrity (Patton, 2015). One challenge of qualitative content analysis might occur when there is a lack of complete understanding of the context. When failing to identify key categories accurately, the findings do not represent the data as they are (Hsieh & Shannon, 2005). Thus, the analyst's capacity for sharp pattern recognition is crucial for qualitative analysis from beginning to end. One challenge

to credible qualitative findings is rooted in the possibility that the analyst's predispositions and biases can shape the findings (Patton, 2015).

Lincoln and Guba (1986) posited constructivist criteria that are parallel to as well as distinct from traditional reality-testing inquiry frameworks (see Table 3.2).

The researcher will follow Butterfield et al.'s (2005) suggestions for trustworthiness of the findings of CIT studies:

- Extracting the critical incidents using independent coders;
- Cross-checking by participants;
- Having independent judges place incidents into categories;
- Tracking the point at which exhaustiveness is reached;
- Eliciting expert opinions;
- Calculating a participation rate of 25 percent for a category to be considered valid calculated by determining the number of participants who cited a specific incident, then dividing that number by the total number of participants;
- Checking theoretical agreement by stating the study's underlying assumptions and by comparing the emerging categories to the relevant scholarly literature;
- Audio-recording interviews to ensure participants' stories are accurately captured;
- Checking interview fidelity by getting an expert in the CIT method to listen to a sample of interview recordings.

For fulfilling the last suggestion, the researcher will develop the first interview transcript in English as soon as the interview is conducted and send it to the dissertation chair, Dr. Ronald Jacobs, who is an expert in the CIT method to verify the interview fidelity.

Table 3.2. Methods to ensure the trustworthiness of a qualitative study

Trustworthiness criteria[1]	Methods for ensuring trustworthiness of the findings of a qualitative study[2]	Methods for ensuring trustworthiness of the findings of a qualitative study using the CIT[3]
Credibility	• Extended engagement in the field • Triangulation of data types • Peer debriefing • Member checks	• Extracting the critical incidents using independent coders • Cross-checking by participants • Having independent judges place incidents into categories • Tracking the point at which exhaustiveness is reached • Eliciting expert opinions on the categorization • Checking interview fidelity by getting an expert in the CIT method to listen to a sample of interview recordings • Calculating a participation rate of 25 percent for a category to be considered valid
Transferability	• Thick description of: - Concepts and categories - Structures and processes	• Following the same set of clear and specific rules for collecting data • Presenting evidence regarding the accuracy of reporting by describing full and precise details
Dependability	• Purposive and theoretical sampling • Securing informants' confidentiality • Inquiry auditing of data collection, management, and analysis processes	• Checking theoretical agreement by stating the study's underlying assumptions and by comparing the emerging categories to the relevant scholarly literature
Confirmability	• Separating 1st order and 2nd order findings • Scrupulous data recording: - Verbatim transcription of interviews - Careful notes of observation - Clear description of theoretical and methodological decisions	• Audio-recording interviews to ensure participants' stories are accurately captured

[1] Lincoln and Guba (1985)
[2] Shah and Corley (2006, p. 1830)
[3] Butterfield et al. (2005)

Assumptions of the Study

There are assumptions upon which this study was based.

- The respondents possess general characteristics of experts.
- The experiences of the respondents are exemplary so the results of this study can be shared resources for employees and organizations.
- The researcher is a qualified instrument to conduct this study successfully.

Limitations of the Study

There are limitations associated with the research study.

(1) This study has sampling limitation. The selected respondents for this study will not be able to represent the entire groups of experts across industries or countries.

(2) Another limitation involves the collection, analysis, and interpretation of data. Although the researcher will strictly follow the procedures of collection, analysis, interpretation of data as described in the previous section, there is always a chance that the researcher might not be able to follow them as planned.

CHAPTER 4: FINDINGS

This chapter presents the findings from the data analysis. The chapter consists of four sections. The first section describes the experts who participated in the study and the interviews that were conducted with them. The second through fourth sections present the findings from the data analysis for each of the research questions addressed in the study. To support the findings, representative quotes from the respondents have been provided.

Description of the Study Respondents and the Interviews

Table 4.1 presents the list of Myungjangs who participated in the study and the details of the interviews that were conducted with twenty Myungjangs in May and June 2018 at either their workplaces or cafés near their residences. Three interview respondents were designated in early 2000 and 17 interview respondents were designated as Myungjang after 2010.

The average duration of the interview was one hour and 45 minutes, while the duration of each interview varied from one hour to three-and-a-half hours. The respondents reported how they acquired, updated, and shared domain-related occupational knowledge and skills in a narrative manner.

Table 4.1. Information of the interviews and the study respondents

Respondent			Interview		
Indication	Field of Expertise	Year of Designation	Location	Date	Duration
A	Air Conditioning Refrigeration Machinery	2015	Daejeon	5.20.2018	1 h 40 m
B	Boiler	2001	Daejeon	5.21.2018	1 h 15 m
C	Boiler	2002	Daejeon	5.21.2018	1 h 50 m
D	Seal Crafts	2003	Daejeon	5.21.2018	1 h
E	Machinery Assembling	2017	Ulsan	5.23.2018	1 h 35 m
F	Machinery Maintenance	2015	Pohang, North Gyeongsangdo	5.23.2018	1h 15 m
G	Dangerous Substances Safety Control	2015	Ulsan	5.24.2018	1 h
H	Chemical Engineering	2015	Ulsan	5.24.2018	1 h 40 m
I	Baking Confectionery	2014	Ilsan, Gyeonggido	5.25.2018	2 h 10 m
J	Beauty Industry	2016	Gwangju	5.29.2018	2 h
K	Fashion Design	2014	Gwangju	5.29.2018	1 h 40 m
L	Cooking	2016	Seoul	6.12.2018	2 h 10 m
M	Gas Treatment	2017	Goyang, Gyeonggido	6.12.2018	1 h 15 m
N	Air Conditioning Refrigeration Machinery	2011	Gwangju, Gyeonggido	6.14.2018	1 h 30 m
O	Electronics	2015	Seoul	6.14.2018	1 h 20 m
P	Ceramic Crafts	2017	Icheon, Gyeonggido	6.15.2018	3 h 30 m
Q	Wooden Crafts	2017	Seoul	6.15.2018	1 h 40 m
R	Computer Numerical Control Machinery	2017	Anyang, Gyeonggido	6.18.2018	2 h 30 m
S	Beauty Industry	2015	Suwon, Gyeonggido	6.18.2018	1 h 30 m
T	Baking Confectionery	2016	Seongnam, Gyeonggido	6.25.2018	2 h 30 m

Table 4.2 summarizes the list of the themes that emerge when the study respondents acquire, update, and share domain-related knowledge and skills. The themes were identified by the critical incidents of the behaviors that the study respondents described. The respondents reported 40, 74, and 73 incidents respectively. The identified incidents were grouped into a few robust themes.

Table 4.2. Themes that emerged from the data analysis

Occasion	Theme
Acquire	Seeking a learning opportunity on the job
	Repeating given tasks when on the job
Update	Creating a learning opportunity within an extended boundary of work
	Reviewing the process and the results of work
	Mastering the task
Share	Giving or receiving advice in a non-working situation
	Providing direct help on the job

Question 1: What Are the Themes that Emerge When Expert Employees Acquire Domain-Related Occupational Knowledge and Skills?

This section presents the findings from the data analysis for the first research question: What are the themes that emerge when expert employees acquire domain-related occupational knowledge and skills? Two themes, including seeking a learning opportunity on the job and repeating given tasks when on the job, emerged when the study respondents acquired domain-related occupational knowledge and skills.

Seeking a Learning Opportunity on the Job

Seeking a learning opportunity on the job refers to the learning approach to acquiring domain-related knowledge and skills by actively engaging in finding an occasion of learning objectives while doing the assigned work. A few sample incidents that describe this theme are as follows:

> I built a parking control system at Incheon International Airport. I visited many airports in Japan, Hong Kong, Germany, etc. for benchmarking to make the airport with the best parking control system in Asia or the world. When I went to benchmarking, I also contacted the companies who supplied the equipment to the airports and was able to receive advice from them. – Respondent O

> The team leader taught me one-on-one about the theories and operating skills. When he taught me one day, he let me explain to him what I had learned on the next day. When it was my turn to explain to him, I couldn't do it logically because I didn’t understand it completely. As I was better able to explain him what I learned on the previous day, I began to know about the concentrator and how it is operated. – Respondent A

There was a public bath downstairs, and a non-certified boiler engineer was studying for getting a certificate for oil handling so he could become a chief engineer. One day he asked me to verbally ask him questions from his book. So I looked at the book and asked him questions. While asking questions of him, I could memorize knowledge about the oil and boiler mechanisms. Because I also got interested in the subject, I also took the examination for the certificate. As a result, he failed but I passed. – Respondent C

My teacher was the best chef in the field at the time. One day he told me that I should try to take a skill's master certificate exam in five years and be ranked within 100th. It became my goal to achieve this since then. I planned for learning and practicing. I passed the exam after two years. Since then, it has become my habit to plan something two to three years ahead to accomplish the goal. – Respondent I

Repeating Given Tasks When on the Job

Repeating given tasks on the job refers to the learning approach to acquire domain-related occupational knowledge and skills by actually exercising the target task in the workplace. A few sample incidents that describe this theme are as follows:

I painted 50 sheets in one night for finding one right line. Now CAD is used, but I still like to hand-draw with a note ring pen rather than using a CAD because you can actually feel and see that there is a difference between the lines in precision. While I drew a line, I've been looking at it many times until the printed lines were almost faded and I've been fixing it dozens of times. I got the skills, as I understood how to transform the clothes with different lines. Such experience had been accumulated in the process. – Participant K

I was an agricultural vocational school graduate, not from an industrial vocational school. From my perspective, there was little difference between the industrial vocational school graduates and I. But the industrial high school graduates were assigned to do more professional work and the agricultural high school graduates had to do chores. It hurt my pride so I thought I should make my skills better than them. From that time, I spent 30 more minutes at work everyday. This has been a part of my working life for nearly 30 years and I believe it made me become a Myungjang. – Participant H

In terms of time, I did a lot of work quantitatively and qualitatively. Now I cannot imagine how I could do like that. It's not just doing work like a workaholic, but I spent all time given to me for work except the time for meals and sleeping. I now have room for me on weekends so I sometimes leave works to my employees, but in the past I worked seven days a week. But it was no problem because I enjoyed it. I did it as my hobby. – Participant R

When I went to the casting process department, I could not read a circuit diagram of the hydraulic system because it was complicated. Thus, I made my own note and drew each valve with numbers on the circuit diagram and compared it with actual valves. I do not know how others learned but it was the way I learned. Afterwards, I was able to draw the complicated valves in the head without the circuit diagram. – Participant F

The findings from the data analysis show that two themes, including seeking a learning opportunity on the job and repeating given tasks when on the job, emerged when the study respondents acquired domain-related occupational knowledge and skills.

Question 2: What Are the Themes that Emerge When Expert Employees Update Domain-Related Occupational Knowledge and Skills?

This section presents the findings from the data analysis for the second research question: What are the themes that emerge when expert employees update domain-related occupational knowledge and skills? Three themes, including creating a learning opportunity within an extended boundary of work, reviewing the process and the results of the work, and mastering the task, emerged when the study respondents updated domain-related occupational knowledge and skills.

Creating a Learning Opportunity within an Extended Boundary of Work

Creating a learning opportunity within an extended boundary of work refers to the learning approach to update domain-related occupational knowledge and skills by actively engaging in taking incoming information that is related to the domain as learning sources. A few sample incidents that describe this theme are as follows:

> The idea remains just an idea without further development. With an idea, we think about how we can apply it to the facility onsite and make a link with each idea. We select five ideas out of a hundred other ideas by giving a score to each idea. Based on the selected five ideas, we come up with other ideas. From there, we use our expertise. For example, let's increase it to sixty mm more here because of this or that reason. There was tremendous progress made by doing so. – Respondent E

> There are a lot of SMEs with really special skills, so I often visit them after work. One day I went to a small company that delivers the painted product to us. I found they were using a little tool developed by them. The paint was sprayed like air and the result was very good.

So I learned and brought it to my factory to improve results. People develop such things for their own work because they experience inconvenience while working. – Respondent H

The customers asked me why the bakery did not bake baguettes or naturally leavened bread, which did not contain sugar. At that time, there was no sugar-free bread like naturally leavened bread. It was a sign that the consumers' appetites were beginning to change. I thought that my bread-baking skill was not high enough. I asked senior chefs to teach me how to bake baguette bread properly, but they did not know well. I read a book on baguettes. I found out that the author of the book did not go to France to learn it, but wrote the book by taking a little excerpt from here and there. I thought this was not right. I decided to go to France to study it correctly. – Respondent I

That process is not driven by pure hydraulics, but by electricity. I had to have knowledge of electricity. The easiest way to learn about it is to get a license. I got the electrical certification by studying. By gaining electricity knowledge, I got to know more about hydraulics. The theory is basically foundational, and what people use in the field is somewhat different. So one can apply foundational knowledge for use in the field. Being able to understand things like signals, I came to know how to tune the hydraulics better. – Respondent F

Reviewing the Process and the Results of Work

Reviewing the process and the results of work refers to the learning approach to update domain-related occupational knowledge and skills by assessing the inputs, processes, and outputs of work. A few sample incidents that describe this theme are as follows:

I look at my work by decade. When I see the works I made before, I can realize what I thought at that time or how my temper was. At that time I liked being straight, but now I think that it is not good to be straight. I think it is an asset. I think that seeing such a difference means that I have already upgraded one step. – Respondent P

If you improve something and you get better results, you have a good feeling about it. So, if the quality is getting better and the work gets easier, then the workers are thankful and it is worth the effort. I continue to look for other problems, and there are actually a lot of problems. People just don't think about them. Every piece of equipment has defects. There is no equipment without any defect. No matter what improvements you make, another problem can arise. I have improved something over three years and then I find another problem again. There is no end to finding problems. – Respondent H

Once chefs from France came to do a seminar on baking, and he said that people couldn't make good bread in Korea because water and flour is not good. So I went to France. Bread in France was really different. In Korea, when I ate bread, my stomach hurts. In France I only ate baguettes and honey yogurt everyday for a week. I was still fine. So I went to France again with 30 million won and I registered for a short course. It was a craving. – Respondent T

I have always thought of how to reduce the maintenance cost, and make things more reliable. I got a chance to develop my knowledge and skills through such experiences. Things that still need to be improved are constantly coming out. While I am working in the field, I constantly encounter problems with things. Thus, I keep producing ideas. I think it's infinite to be creative. – Participant F

Mastering the Task

Mastering the task refers to the learning approach to update domain-related occupational knowledge and skills by acquiring complete knowledge and skills for the target task. A few sample incidents that describe this theme are as follows:

> When we do precision machining, we know that the results of cutting come out differently depending on the temperature. In addition to the theoretical principles, there are know-hows to make products better in practice. These are the know-hows that I can use after I know the characteristics of the machine. I have to overcome the machine. Even though I follow everything correctly but the result sometimes comes out incorrectly. It means I stay in theory. It is the know-how that combines the mechanical characteristics and the theoretical principles to produce a product. – Participant E

> The airstrip was built by connecting three islands, and when the construction started, ships transported the trucks. It was a very big project, but there was no suitable equipment in Korea. I used Japanese equipment at first, but the equipment was too small, so then I used German equipment, but the European equipment did not fit well in the domestic situation. So I almost developed new equipment. – Respondent O

> I've been working in many restaurants in our hotels. I participated in Busan Lotte Open Project because I wanted to do it. I knew I should try it. I went there as an open member and experienced everything from kitchen design and kitchen appliances to employee selection. You have to experience it so you can understand and talk about it, so that you can develop. – Respondent L

> Now I have skills that can make clothes to fit any body shapes. The skills that can cope with such a transformation were acquired through experience. I met various customers

such as a person with hunchback or dwarf body shape, etc. Furthermore, people look like having a normal body shape but they often have unbalanced body shapes like one side up and the other side down. I would not know all the differences if I did not experience with the body types with my eyes and hands. – Participant K

The findings from the data analysis show that three themes, including creating a learning opportunity within an extended boundary of work, reviewing the process and the results of work, and mastering the task, emerged when the respondents updated domain-related occupational knowledge and skills.

Question 3: What Are the Themes that Emerge When Expert Employees Share Domain-Related Occupational Knowledge and Skills with Others?

This section presents the findings from the data analysis for the third research question: What are the themes that emerge when expert employees share domain-related occupational knowledge and skills with others? Two themes, including giving or receiving advice in a non-working situation and providing direct help on the job, emerged when the study respondents shared domain-related occupational knowledge and skills with others.

Giving or Receiving Advice in a Non-Working Situation

Giving or receiving advice in non-working situation refers to the learning approach to share domain-related knowledge and skills by giving or receiving from someone guiding information that would be helpful for someone to acquire domain-related occupational knowledge and skills. A few sample incidents that describe this theme are as follows:

I send my employees out for a market research. There is not a single person buying bread that he knows and can make. They buy only the bread they cannot make or they have never seen before. Then I ask whether they can make the bread that they think they can make well. Knowing how to make something new is not the same as having another skill. I know one way of making it, but when I find someone who does it differently, I have to think about why and how that person makes it differently. If someone else's method is better, I need to study why, and this should be the point of learning. – Respondent T

I tell them to keep what they have done in order and keep them organized. That way, one year later, they can feel the difference between the products at that point and the current product. If they do not have a record of the current state, they cannot go back to this point a year later. After a year when they see this again, they can realize what they were thinking about a year ago. This is development. – Respondent P

I know only one way to do it but others do it differently. Then, I share my method and they share what they know. We learn from each other. Sometimes I buy meals to learn their skills. I have developed many skills in that way. – Participant K

Filtering in the painting process is important because the paint has to be free of impurities. But the defect rate was too high because it did not get filtered well. To improve it, I came up with an idea from the experience of growing bean sprout. The water comes down very slowly in the basket. I brought the idea to a company that supplied the filter. I talked to the experts at the company and we thought together about how to develop a product out of the idea. Now it is used in my company and exported to Japan as well. – Participant E

Providing Direct Help on the Job

Providing direct help on the job refers to the learning approach to share domain-related occupational knowledge and skills by providing someone an opportunity to learn domain-related occupational knowledge and skills with the expert in the workplace. A few sample incidents that describe this theme are as follows:

> If they have difficult problems, they bring them to me. Because I know everything, I can present how to do it and coach them to overcome difficult points. The employees learn by watching what I do. – Respondent R
>
> I let my employees experience all the steps, from being a head model to participating in a competition. When one person participates in a competition this year, another person models for her. Then, the person who models participates in a competition in the following year based on experience. When the competition participant comes back with a prize, I introduce that person to a customer to build up skills with field practice. – Respondent J
>
> It is not easy to analyze the exact cause and respond in a short time. In most cases, I cannot conclude that this is the cause of the problem as soon as I see the problem. So I teach others how to diagnose using a step-by-step process. As they become more experienced, they would be able to develop their own problem-solving process. – Respondent F
>
> Knowledge of material science is, for example, essential to making bread. I teach my junior employees the foundations first. The junior workers know how to make their own formulations. Then, it is the foundation not only for making baguettes but also for making any bread. The knowledge aspect of skills is really important. With a skill alone, copying is possible, but without knowledge, it is not easy to be creative beyond that. – Respondent I

The findings from the data analysis show that two themes, including giving or receiving advice in a non-working situation and providing direct help on the job, emerged when the study respondents shared their domain-related occupational knowledge and skills with others.

CHAPTER 5: SUMMARY, DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

This chapter is composed of four sections: summary, discussion, implications, and conclusions. The first section summarizes the findings from the data analysis. The second section discusses the relationships among the research questions and their meanings based on the literature. The third section presents the implications that emerged from the data analysis of the results. The last section proposes the model for becoming a Myungjang as the conclusion of the study.

Summary

This section summarizes the findings from the data analysis.

The findings from the data analysis present two themes that emerged when the study respondents acquired domain-related occupational knowledge and skills as follows:

- Seeking a learning opportunity on the job;
- Repeating given tasks when on the job.

Seeking a learning opportunity on the job refers to the learning approach to acquire domain-related occupational knowledge and skills by actively engaging in finding an occasion of learning objectives while doing the assigned work. Repeating given tasks when on the job refers to the learning approach to acquire domain-related occupational knowledge and skills by doing a same behavior related to the work regularly.

The findings from the data analysis present three themes that emerged when the study respondents updated domain-related occupational knowledge and skills as follows:

- Creating a learning opportunity within an extended boundary of work;
- Reviewing the process and the results of work; and
- Mastering the task

Creating a learning opportunity within an extended boundary of work refers to the learning approach to update domain-related occupational knowledge and skills by actively engaging in taking incoming information as learning sources. Reviewing the process and the results of work refers to the learning approach to update domain-related occupational knowledge and skills by assessing the inputs, processes, and outputs of work. Mastering the task refers to the learning approach to update domain-related occupational knowledge and skills by acquiring complete knowledge and skills for the target task.

The findings from the data analysis present two themes that emerged when the study respondents shared domain-related occupational knowledge and skills with others as follows:

- Giving or receiving advice in a non-working situation;
- Providing direct help on the job

Giving or receiving advice in a non-working situation refers to the learning approach to share domain-related occupational knowledge and skills with others by giving or receiving from someone the guiding information helpful to someone acquiring domain-related occupational knowledge and skills. Providing direct help on the job refers to the learning approach to share domain-related occupational knowledge and skills with others by providing someone with an opportunity to learn domain-related occupational knowledge and skills with the expert.

Discussion

This section discusses the relationships among the research findings and their meanings based on the literature. As stated, themes such as engaging in a learning opportunity and practicing the task appear in common when the study respondents acquire and update domain-related knowledge and skills. Moreover, themes such as doing a routine behavior and practicing given tasks when they acquire domain-related knowledge and skills become the basis of practicing the newly learned task to update them. Consequently, four discussion points were identified as follows: (1) Engaging in a learning opportunity; (2) repeating the target task until mastering it; (3) reviewing the result critically; and (4) sharing expertise.

The first discussion point is that expert employees engage in learning opportunities throughout their careers, seeking and creating these learning opportunities to acquire or update domain-related occupational knowledge and skills. The findings show that expert employees proactively seek human and material resources for learning when they are aware of the need to acquire new domain-related occupational knowledge and skills. Furthermore, as they have expertise in the acquired domain-related occupational knowledge and skills, they are even able to create a learning opportunity to acquire higher-level knowledge and skills in the domain. These findings, including expert employees' continuous engagement in learning as well as increasing ability to learn domain-related occupational knowledge and skills, are well supported in the literature.

These expert behaviors are explained in terms of self-directedness and self-regulation. As stated, expert employees proactively engage in a cycle of being aware of knowledge and skill deficiency, setting learning goals, identifying human and material resources for learning needs,

creating the proper climate when they know what is needed, implementing practices, and evaluating outcomes. This is similar to the six steps of self-directed learning that was proposed by Knowles (1975).

The only difference between the research findings and Knowles' six steps is when creating a climate happens. Although the study respondents are self-directed learners, creating a climate for learning specific domain-related knowledge and skills becomes more realistic when they have expertise so that they know what and how to learn. In addition, Knowles (1975) claimed that the degree of self-directedness escalates as the age and maturity of an individual leaner increase. More specifically, this finding supports that the degree of self-directedness escalates as the domain-related knowledge and skills of an individual learner increase.

Chi and Ohlsson (2005) asserted that experts are able to find a more focused and self-controllable learning opportunities because their knowledge and skills are more connected. This explains the gradual changes in the study respondents' learning approaches when they acquire and further update domain-related knowledge and skills. The study respondents widely seek learning opportunities to acquire domain-related occupational knowledge and skills due to lack of expertise.

On the other hand, they are able to create a focused learning opportunity for improving deficiencies once they have expertise. This is possible because experts become more flexible in allocating cognitive resources to higher-level processes as they acquire more complex skills and robust knowledge (Flavell, 1979; Hambrick, 2003). Such self-control to select or create effective environment settings enables them to enhance learning and performance and intensify the cycle of self-reflection (Zimmerman, 2006).

The second discussion point is that expert employees routinely practice the target task with a clear goal to achieve. As found, expert employees repeat the given tasks on the job and master the newly learned task to acquire and update domain-related occupational knowledge and skills, respectively. The findings show that the study respondents engage not only in practicing the target task routinely, but also in repeating newly acquired knowledge and skills until mastering them. In the process, they consider the task as the learning objective and try to master the task in a consistent manner.

The behavior of expert employees is partially explained by the concept of deliberate practice. A routine exercise performing a target task is essential to acquire and update domain-related knowledge and skills, and continued engagement in deliberate practice is necessary to maintain high levels of performance (Ericsson, 2017; Krampe & Charness, 2006). As stated in the literature, the goal orientation of experts is important for engaging in continuous development (Graham & Golen, 1991; Zimmerman, 2006). The study respondents possess ongoing and intensive drive that enables them to engage in the process continuously (Ericsson, 2004; Sternberg, 1998; Winner, 1996).

In addition, Seijts and Latham (2005) suggested that setting an overwhelmingly challenging learning goal would diminish the motivation to learn. In the cases of the study respondents, the learning goal is more or less naturally set by mastering a task. Therefore, the study respondents seldom experience setting an overwhelmingly challenging learning goal unless the task is actually difficult to master. Furthermore, even when the task is hard to master, they enjoy immersing themselves in the task rather than feeling exhausted by it.

Although the behavior of the study respondents can be to some extent considered as deliberate practice, some differences exist. The criteria of deliberate practice that were proposed

by Ericsson et al. (1993) are as follows: (1) Engaging in the repetitive practice of the same or similar tasks; (2) receiving immediate feedback from the coach or instructor to modify weak points; (3) acquiring appropriate prerequisites so that the learner quickly understands the feedback; (4) being ready to exert sufficient effort to improve performance.

Similarly, the study respondents repeat a task to acquire and update domain-related knowledge and skills, and this occurs in a constructive manner. However, it seems they never need extra energy to be intentionally ready to exert effort, since the practice is their routine, which they enjoy and immerse themselves in. Furthermore, although they sometimes learn domain-related knowledge and skills from other experts and teachers, it is more common for the study respondents to find their own feedback through self-reflection.

For this reason, Sonnentag and Kleine (2000) argued that the practice of expert employees in work settings might look substantially different from the deliberate practice in such disciplines as sports and music. They explained the difference based on the nature of work in the ordinary work setting of an organization. Employees usually perform the tasks in the work setting across a wide range of activities, and the opportunity for an extensive rehearsal of specific challenging tasks is seldom available to them.

In addition to that, it is almost impossible in the current work setting to have an individual coach or trainer as well as proper curricula to develop domain-related knowledge and skills available to employees. This supports the first discussion point that the expert employees are self-directed and self-regulated enough to acquire and update domain-related knowledge and skills. It is the difference between the learning approach used by the study respondents and deliberate practice that refers to specially designed activities to further improve their

performance in addition to experience and appropriate training (Ericsson, 2004; Hoffman et al., 2014).

The third discussion point is that expert employees review the results of their own work critically. As found, the study respondents acquire and update domain-related knowledge and skills while continuously identifying deficiencies in their performance and try to find ways to improve. They are never satisfied with the result because they perceive that there is always space to improve.

Monitoring one's own performance and using the information from that monitoring for further improvement is one of the notable learning approaches used by expert employees to acquire and update domain-related occupational knowledge and skills. Experts have self-motivated feedback seeking behavior to acquire knowledge and skills (Sonnentag, 2000). The experts in the self-reflection phase can more effectively observe, record, and monitor their performance processes, and the information gathered in those processes feeds into self-evaluation (Kitsantas & Zimmerman, 2002). It enables them to select a set of criteria to evaluate their performance in a way that further develops their expertise (Locke & Latham, 2002). Monitoring their own performance enables adjustments and improvements in the performance processes (Claseer & Chi, 1988).

Although the approach might be more efficient and effective when practiced at the expert level, the study respondents tend to practice this behavior from early in their careers, even when they were novice employees. Therefore, it seems that the behavior of practicing monitoring one's own performance and using the information for further improvement is not a specialized practice of expert employees, but it is a learning approach that naturally emerges in a sequence of

behaviors practiced by anyone who is self-motivated to acquire and update domain-related occupational knowledge and skills, regardless of level of expertise.

The fourth discussion point is that expert employees share their domain-related knowledge and skills using different strategies depending on the level of expertise of those with whom they share. When the counterparts are also experts who possess a similar level of expertise, the expert employees learn from other experts through sharing their domain-related occupational knowledge and skills. When the counterparts are mid-level experienced employees, sharing their domain-related knowledge and skills usually occurs as a form of coaching on the job. When the counterparts are novices or students, sharing usually takes the form of mentoring.

Studies have shown consistent findings about learning through interactions with others, which is well addressed with the concept Communities of Practice (CoPs), which is central to Wenger's (1998) social theory of learning framework. Communities of Practice (CoPs) are groups of people with common interests and goals that form to share their expertise to learn from one another in order to develop and extend their expertise by interacting on an ongoing basis (Brown & Duguid, 1991; Wenger, McDermott, & Snyder, 2002). The study respondents have directly or indirectly engaged in CoPs, in which they have opportunities to meet other experts in the same or similar domains of expertise to share and learn from each other. According to the study, respondents who are advocates for CoP initiatives between experts are critical to knowledge-based organizations and societies because knowledge is advanced in a constructive way.

In the cases of the study respondents, their expertise is shared as a form of coaching or mentoring when the counterparts are not experts in a domain. Coaching focuses on improving some aspects of an individual's work in most applications, while mentoring is associated with

much broader and holistic development aspects such as career progress (Clutterbuck, 2008). When the counterparts are mid-level experienced employees, sharing domain-related occupational knowledge and skills mostly occurs on the job as a form of coaching. Mid-level experienced employees usually have mastered appropriate prerequisites that are required to perform a specific task. Thus, they can understand the experts' explanations using domain-specific knowledge and skills and thereby absorb the experts' know-how.

On the other hand, when the counterparts are novices or students, sharing domain-related occupational knowledge and skills of the expert employees occurs as a form of mentoring. Studies have found that expertise sharing is limited because experts use more abstract and fewer concrete statements, which hinders transfer of expertise to novices (Hinds, Patterson, & Pfeffer, 2001). In the case of the study respondents, a direct transfer of knowledge and skills rarely occurs due to the gap in expertise as well. Instead, they emphasize attitude-related aspects such as occupational consciousness with novice employees and students.

Implications

This section suggests implications for research and practice drawn from the results of this study. The implications include establishment of a system that documents the process of knowledge and skills development of expert employees, establishment of communities of experts, and further research on behaviors and personalities of expert employees.

In a knowledge economy, knowledge is a key factor in advancing the industry and society. Experts create new knowledge and develop advanced skills based on their existing knowledge and skills. In this context, the role of experts is more important than ever, and the

competitiveness of any organization or country depends on their expertise. Regardless of the field, experts' knowledge and skills cannot be developed in a short period of time. In this regard, having Myungjangs is a great asset for South Korea. Unfortunately, institutional arrangements that promote the development of experts through transferring the expertise of Myungjangs to the next generation of workers are still limited. Therefore, the researcher proposes the following suggestions to the stakeholders including students, workers, researchers, practitioners, and policymakers in regard to workforce development.

First, establishment of a system that documents the process of knowledge and skills development of expert employees is suggested. According to the study respondents, there are still many unrecognized experts in the field due to lack of documentation that demonstrates their expertise. Consequently, their expertise is seldom shared with others. Thus, the expert knowledge and skills management system should be created to enable accessing experts' knowledge and skills. Although experts might often experience trial and error in the process of expertise development, the novice can learn more effectively to master the current level of expertise in a field.

Second, establishment of communities of experts (CoEs), in which expert employees from the same or different fields can share their expertise and ideas, is recommended. New knowledge, skills, and technologies are created based on those existing. In today's knowledge economy, new knowledge, skills, and technologies are often created across various fields. Sharing domain-related occupational knowledge and skills or ideas with others at a similar level of expertise helps people greatly to develop their expertise further. Thus, CoEs function as an incubator for creating new ideas or advancing expertise by providing experts opportunities to exchange expertise with other experts.

Third, more concrete understanding of Myungjangs' behavioral and personality characteristics in the workplace is needed. Important questions to better understand Myungjangs still remain unanswered. For example, the study respondents were consistent in developing expertise over a lengthy period of time. It is still unknown how Myungjangs have developed such behavioral characteristics, and the findings of the study will be a good source to develop training programs for employees.

In conclusion, the expert employees are assets to the organization and the society because this knowledge and skills are the coordinates that establish a new benchmark for advancement of domain-related occupational knowledge and skills. Advancing knowledge and skills is directly linked to the competitiveness of organizations and societies.

Conclusions

This study opens a door for readers to meet a very distinct group of workers called Myungjang in the Republic of Korea and to get a close look into how they become who they are. This section concludes with a proposal of the model for becoming a Myungjang, which is the revised conceptual framework of the study based on findings from the data analysis and implications for further research and practice (See Figure 5.1).

Myungjangs develop expertise while acquiring, updating, and sharing their domain-related knowledge and skills with others, which are all interdependent. When acquiring domain-related knowledge and skills, the study respondents seek learning opportunities on the job and repeat given tasks on the job. When updating them, they create a learning opportunity within an extended boundary of work, review the process and the results of the work, and master the task.

When sharing them with others, they give or receive advice in a non-working situation and provide direct help on the job. The behavioral and personality characteristics that seem to affect greatly their behaviors when they acquire, update, and share the domain-related knowledge and skills still need to be investigated.

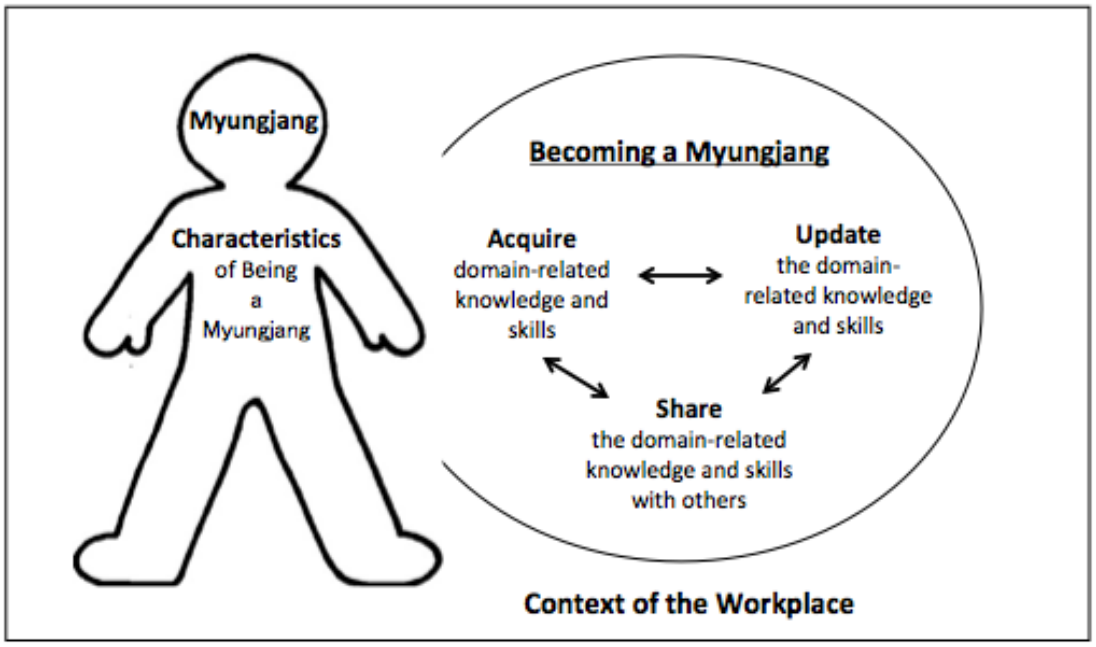

Figure 5.1. The model for becoming a Myungjang

REFERENCES

Adolf, M., & Stehr, N. (2014). *Knowledge*. New York: Routledge.

Allard, F., & Starkes, J. L. (1991). Motor-skill experts in sports, dance, and other domains. In K. A. Ericsson & J. Smith (Eds.), *Toward a general theory of expertise* (pp. 126-152). Cambridge, MA: Cambridge University Press.

Almandoz, J., & Tilcsik, A. (2016). When experts become liabilities: Domain experts on boards and organizational failure. *Academy of Management Journal, 59*(4), 1124-1149.

Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*, 369-406.

Anderson, J. R. (1983). Methodologies for studying human knowledge. *Behavioral and Brain Sciences, 10*, 467-505.

Antonelli, C. (1999). The evolution of the industrial organization of the production of knowledge. *Cambridge Journal of Political Economics, 23*, 243-260.

Argyris, C. (1976). Theories of action that inhibit individual learning. *American Psychologist, 31*(9), 638-654.

Argyris, C*., &* Schön, D. (1978)*. Organizationanl learning: A theory of action perspective. San Francisco, CA: Jossey-Bass.*

Arthur, W., Bennett, W., Stanush, P. L., & McNelly, T. L. (1998). Factors that influence skill decay and retention: A quantitative review and analysis. *Human Performance, 1*, 57-101.

Bacon, D. R., & Stewart, K. A. (2006). How fast do students forgot what they learn in consumer behavior? A longitudinal study. *Journal of Marketing Education, 25*, 181-202.

Baddeley, A. (1998). *Human memory: theory and practice* (Rev.ed.). Boston, MA: Allyn and Bacon.

Bahrick, H. P. (1979). Maintenance of knowledge: Questions about memory we forgot to ask. *Journal of Experiment Psychology: General, 108*(3), 296-308.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1991). Self-regulation of motivation through anticipatory and self-reactive mechanisms. In R. A. Dienstbier (Ed.), *Perspectives on motivation: Nebraska symposium on motivation* (Vol. 38, pp. 69-164). Lincoln, Nebraska: University of Nebraska Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.

Barnett, S. M., & Koslowski, B. (2002). Adaptive expertise: Effects of type of experience and the level of theoretical understanding it generates. *Thinking and Reasoning, 8*(4), 237-276.

Bédard, J., & Chi, M. T. H. (1992). Expertise. *Current Directions in Psychological Science, 1*(4), 135-139. DOI: 10.1111/1467-8721.ep10769799

Blackler, F., Crump, N., & McDonald, S. (1999). Managing experts and competing through innovation: An activity theoretical analysis. *Organization, 6*(1), 5-31.

Bloom, B. S. (1985). *Developing talent in young people*. New York: Ballantine Books.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (Eds.) (2000). Handbook of self-regulation (pp. 13-39). San Diego, CA: Academic Press.

Bordage, G., & Zacks, R. (1984). The structure and knowledge in the memories of medical students and general practitioners: Categories and prototypes. *Medical Education, 18*, 406-416.

Borman, W. C., & Motowidlo, S. M. (1993). Expanding the criterion domain to include elements of contextual performance. In N. Schmitt and W. C. Borman (Eds.), *Personnel selection in organizations* (pp. 71-98). San Francisco: Jossey-Bass.

Brockett, R. G., & Hiemstra, R. (1991). *Self-direction in adult learning: Perspectives on theory, research, and practice*. New York: Routledge.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Towards a unified view of working, learning, and innovation. *Organization Science, 2*(1), 40-57.

Bryan, W. L., & Harter, N. (1899). Studies on the telegraphic language: The acquisition of a hierarchy of habits. *Psychological Review, 6*(4), 345-375.

Buchanan, B. G., Davis, R., & Feigenbaum, E. A. (2006). Expert systems: A perspective from computer science. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 87-103). New York: Cambridge University Press.

Butterfield, L. D., Borgen, W. A., Amundson, N. E., & Maglio, A. T. (2005). Fifty years of the critical incident technique: 1954-2004 and beyond. *Qualitative Research, 5*(4), 475-497.

Cambridge English Dictionary, 2017

Charness, N. (1991). Expertise in chess: The balance between knowledge and search. In K. A. Ericsson & J. Smith (Eds.), *Toward a general theory of expertise* (pp. 39-63). Cambridge, MA: Cambridge University Press.

Chase, W. G., & Simon, H. A. (1973). The mind's eye in chess. In W. G. Chase (Ed.), *Visual information processing* (pp. 215-281). New York: Academic Press.

Chell, E. (1998). Critical incident technique. In G. Symon & C. Cassell (Eds.), *Qualitative methods and analysis in organizational research* (pp. 51-72). London: Sage Publications, Inc.

Chi, M. T. H. (1978). Knowledge structure and memory development. In R. Siegler (Ed.), *Children's thinking: what develops?* (pp. 73-96). Hillsdale, NJ: Erlbaum.

Chi, M. T. H. (2006). Two approaches to the study of experts' characteristics. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 21-30). New York: Cambridge University Press.

Chi, M. T. H., Feltovich, P. J., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science, 5*, 121-152.

Chi, M. T. H., Glaser, R., & Farr, M. J. (Eds.) (1988). *The nature of expertise*. Hillsdale, NJ: Erlbaum.

Chi, M. T. H., & Ohlsson, S. (2005). Complex declarative learning. In K. J. Holyoak & R. G. Morrison (Eds.), *The Cambridge handbook of thinking and reasoning* (pp. 371-399). New York: Cambridge University Press.

Chiêm, J. C., Durme, T. V., Vandendorpe, F., Schmitz, O., Speybroeck, N., Cès, S., & Macq, J. (2014). Expert knowledge elicitation using computer simulation: the organization of frail elderly case management as an illustration. *Journal of Evaluation in Clinical Practice, 20*, 534-453.

Chiesi, H., Spilich, G. J., & Voss, J. F. (1979). Acquisition of domain-related information in relation to high and low domain knowledge. *Journal of Verbal Learning and Verbal Behavior, 18*, 257-283.

Choudhry, N. K., Fletcher, R. H., Soumeral, S. B. (2005). Systematic review: The relationship between clinical experience and quality of health care. *Annals of Internal Medicine, 142*(4), 260-273.

Cianciolo, A. T., Matthew, C., Sternberg, R. J., & Wagner, R. K. (2006). Tacit knowledge, practical intelligence, and expertise. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 613-632). New York: Cambridge University Press.

Cleary, T. J., & Zimmerman, B. J. (2001). Self-regulation differences during athletic practice by experts, non-experts, and novices. *Journal of Applied Sport Psychology, 13*(2), 185-206.

Clutterbuck, D. (2008). What's happening in coaching and mentoring? And what is the difference between them? *Development and Learning in Organizations, 22*(4), 8-10.

Coderre, S., Mandin, H., Harasym, P. H., & Fick, G. H. (2003). Diagnostic reasoning strategies and diagnostic success. *Medical Education, 37*(8), 695-703.

Coffey, A., & Atkinson, P. (1996). *Making sense of qualitative data: Complimentary research strategies*. Thousand Oaks, CA: Sage Publications, Inc.

Cohen, M. S., Freeman, J. T., & Thompson, B. B. (1998). Critical thinking skills in tactical decisionmaking: A model and a training strategy. In J. A. Cannon-Bowers & E. Salas (Eds.), *Marking decisions under stress: Implications for individual and team training* (pp. 155-190). Mahwah, NJ: Erlbaum.

Coughlin, L. D., & Patel, V. L. (1987). Processing of critical information by physicians and medical students. *Journal of Medical Education, 62*, 818-828.

Crandall, B. W., Kyne, M., Militello, L., & Klein, G. A. (1992). *Describing expertise in one-on-one instruction*. Fairborn, OH: Klein Associates.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Cummings, J. L., & Teng, B. S. (2003). Transferring R&D knowledge: The key factors affecting knowledge transfer success. *Journal of Engineering and Technology Management, 20*(1), 39-68.

Cummings, J. L., & Teng, B. S. (2006). The keys to successful knowledge-sharing. *Journal of General Management, 31*(4), 1-18.

Custódio, C., & Metzger, D. (2013). How do CEOs matter? The effect of industry expertise on acquisition returns. *The Review of Financial Studies, 26*(8), 2007-2047.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge*. Boston, MA: Harvard Business School Press.

De Groot, A. (1978). *Thought and choice in chess*. (Original by published in 1946). The Hague, the Netherlands: Mouton.

Dey, T., & Mukhopadhyay, S. (2017). Linkage between contextual factors, knowledge-sharing mediums, and behavior: Moderating effect of knowledge-sharing intentions. *Knowledge Process Management, 25*, 31-40.

Dogusoy-Taylan, B., & Cagiltay, K. (2014). Cognitive analysis of experts' and novices' concept mapping processes: An eye tracking study. *Computers in Human Behavior, 36*, 82-93.

Dreyfus, H. L., & Dreyfus, S. E. (1986). *Mind over machine: The power of intuition and expertise in the era of the computer*. New York: The Free Press.

Driskell, J. E., Copper, C., & Willis, R. P. (1992). Effect of overlearning on retention. *Journal of Applied Psychology, 77*, 615-622.

Durso, F. T., & Dattel, A. R. (2006). Expertise and transportation. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 355-372). New York: Cambridge University Press.

Dyster, T., Sheth, S. A., & McKhann, G. M. (2016). Ready or not, here we go: Decision-making strategies from artificial intelligence based on deep neural networks. *Neurosurgery, 78*(6), 11-12.

Eby, L. T., Butts, M., & Lockwood, A. (2003). Predictors of success in the era of the boundaryless career. *Journal of Organizational Behavior, 24*(6), 689-708.

Eldor, L., & Harpaz, I. (2016). A process model of employee engagement: The learning climate and its relationship with extra-role performance bahaviors. *Journal of Organizational Behavior, 37*(2), 213-235.

Ellinger, A. D., & Bostrom, R. P. (2002). An examination of manager's beliefs about their roles as facilitators of learning. *Management Learning, 33*(2), 147-179.

Ellinger, A. D., & Cseh, M. (2007). Contextual factors influencing the facilitation of others' learning through everyday work experiences. *Journal of Workplace Learning, 19*(7), 435-452.

Ellinger, A. D., Ellinger, A. E., Yang, B., & Howton, S. W. (2002). The relationship between the learning organization concept and firm's financial performance: An empirical assessment. *Human Resource Development Quarterly, 13*(1), 5-21.

Elstein, A. S., Shulman, L. S., & Sprafka, S. A. (1978). *Medical problem solving: An analysis of clinical reasoning*. Cambridge, MA: Harvard University Press.

Endsley, M. R. (2006). Expertise and situation awareness. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 633-651). New York: Cambridge University Press.

Ericsson, K. A. (2003). The acquisition of expert performance as problem solving. Construction and modification of mediating mechanisms through deliberate practice. In J. E. Davidson & R. J. Sternberg (Eds.), *The nature of problem solving* (pp. 233-262). New York: Cambridge University Press.

Ericsson, K. A. (2004). Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. *Academic Medicine, 10*, S70-S81.

Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 683-703). New York: Cambridge University Press.

Ericsson, K. A. (2017). Expertise and individual differences: The search for the structure and acquisition of experts' superior performance. *WIREs: Cognitive Science, 8*, 1-6. doi: 10.1002/wcs.1382

Ericsson. K. A., & Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychology, 49*, 725-747.

Ericsson, K. A., Charness, N., Feltovich, P. J., & Hoffman, R. R. (2006). *The Cambridge handbook of expertise and expert performance*. Cambridge, MA: Cambridge University Press.

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review, 102*, 211-245.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychol.Rev.* 100,363–406. doi:10.1037/0033-295X.100.3.363

Ericsson, K. A., & Lehman, A. C. (1996). Expert and exceptional performance: Evidence on maximal adaptations on task constraints. *Annual Review of Psychology, 47*, 273-305.

Ericsson, K. A., Nandagopal, K., & Roring, R. W. (2005). Giftedness viewed from the expert performance perspective. *Journal for the Education of the Gifted, 28*(3), 287-311.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data*. (Rev. ed.). Cambridge, MA: The MIT Press

Ericsson, K. A., & Smith, J. (1991). Prospects and limits in the empirical study of expertise: An introduction. In K. A. Ericsson and J. Smith (Eds.), *Toward a general theory of expertise: Prospects and limits* (pp. 1-38). Cambridge, MA: Cambridge University Press.

Ericsson, K. A., & Ward, P. (2007). Capturing the naturally occurring superior performance of experts in the laboratory: Toward a science of expert and exceptional performance. *Current Directions in Psychological Science, 16*(6), 346-350. doi: 10.1111.j.1467-8721.2007.00533.x

Fahle, M., & Poggio, T. (Eds.) (2002). *Perceptual learning*. Cambridge, MA: MIT Press.

Farr, M. J. (1987). *The long-term retention of knowledge and skills: A cognitive and instructional perspective*. New York: Springer-Verlag. (Originally, Memorandum Report M-205 to the Office of the Under Secretary of Defense for Research and Engineering, Institute for Defense Analysis, Alexandria, VA)

Feltovich, P. J., Johnson, P. E., Moller, J. H., & Swanson, D. B. (1984). The role and development medical knowledge in diagnostic expertise. In W. J. Clancey & E. H.

Shortliffe (Eds.), *Readings in medical artificial intelligence: The first decade*. Reading, MA: Addison Wesley.

Feltovich, P. J., Prietula, M. J., & Ericsson, K. A. (2006). Studies of expertise from psychological perspectives. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 41-67). New York: Cambridge University Press.

Feltovich, P. J., Spiro, R. J., & Coulson, R. L. (1997). Issues of expert flexibility in contexts characterized by complexity and change. In P. J. Feltovich, K. M. Ford, & R. R. Hoffman (Eds.), *Expertise in context: Human and Machine* (pp. 125-146). Menlo Park, CA: American Association for Artificial Intelligence; Cambridge, MA: The MIT Press.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 327-358.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(1), 906-911.

Fletcher, J. D. (2009). The value of expertise and expert performance: A review of evidence from the military. In K. A. Ericsson (Ed.), *Development of professional expertise* (pp. 449-469). Cambridge: Cambridge University Press.

Freedman, M. (2016). The encore life: A generation of experienced workers is ready to serve. *Journal of the American Society on Aging, 40*(4), 74-78.

Fujino, Y., Tanaka, M, Yonemitsu, Y., & Kawamoto, R. (2015). The relationship between characteristics of nursing performance and years of experience in nurses with high emotional intelligence. *International Journal of Nursing Practice, 21*(6), 876-881.

Gentner, D. R. (1988). Expertise in typewriting. In M. T. H. Chi, R. Glaser, & M. Farr (Eds.), *The nature of expertise* (pp. 1-22). Hillsdale, NJ: Lawrence Erlbaum Associates.

George, R. T. (1989). Learning by example: The critical incident technique. *The Cornell Hotel and Restaurant Administration Quarterly, 30*(2), 58-60.

Glaser, R. (1987). Thoughts on expertise. IN C. Schooler & W. Schaie (Eds.), *Cognitive functioning and social structure over the life course* (pp. 81-94). Norwood, NJ: Ablex.

Glaser, R., & Chi, M. T. H. (1988). Overview. In M. T. H. Chi, R. Glaser, & M. Farr (Eds.), *The nature of expertise* (pp. xv-xxviii). Hillsdale, NJ: Lawrence Erlbaum Associates

Gobet, F. (2016). *Understanding expertise: A multi-disciplinary approach*. New York: Palgrave Macmillan Education.

Gobet, F., & Simon, H. A. (1996). Templates in chess memory: A mechanism for recalling several boards. *Cognitive Psychology, 31*, 1-40.

Goldstone, R. L., Schyns, P. G., & Medin, D. L. (1997). Learning to bridge between perception and cognition. *Psychology of Learning and Motivation - Advances in Research and Theory, 36*(C), 1-14. DOI: 10.1016/S0079-7421(08)60279-0

Griffin, M. A., Neal, A., & Parker, S. K. (2007). A new model of work role performance: Positive behavior in uncertain and interdependent contexts. *Academy of Management Journal, 50*(2), 327-347.

Guglielmino, L. M. (1977). *Development of the self-directed learning readiness scale*. Unpublished doctoral dissertation, University of Georgia.

Hambrick, D. Z. (2003). Why are some people more knowledgeable than others? A longitudinal study of knowledge acquisition. *Memory and Cognition, 31*(6), 902-917.

Hashem, A., Chi, M. T. H., & Friedman, C. P. (2003). Medical errors as a result of specialization. *Journal of Biomedical Informatics, 36*, 61-69.

Haskell, R. E. (2001). *Transfer of learning: Cognition, instruction and reasoning*. San Diego, CA: Academic Press.

Hatano, G., & Inagaki, K. (1984). Two courses of expertise. *Research and Clinical Center for Child Development Annual Report, 6*, 27-36.

Hatano, G., & Inagaki, K. (1986). Two courses of expertise. In H. Stevenson, A. Azuma, & K. Hakuta (Eds.), *Child development and education in Japan* (pp. 262-272). San Francisco: Freeman.

Hayes, J. R. (1989). *The complete problem solver*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Healy, A. F. (2007). Transfer: Specificity and generality. In H. L. Roediger, III, Y. Dubai, & S. M. Fitzpatrick (Eds.), *Science of memory: Concepts* (pp. 271-275). New York: Oxford University Press.

Hinds, P. J., Patterson, M., & Pfeffer, J. (2001). Bothered by abstraction: The effect of expertise on knowledge transfer and subsequent novice performance. *Journal of Applied Psychology, 86*(6), 1232-2343.

Hobus, P. P., Schmidt, H. G., Boshuizen, H. P., & Patel, V. L. (1987). Contextual factors in the activation of first diagnostic hypotheses: Expert-novice differences. *Medical Education, 21*, 474-476.

Hoffman, R. R. (Ed.) (1992). *The psychology of expertise: Cognitive research and empirical AI*. New York: Springer-Verlag.

Hoffman, R. R. (Ed.) (1998). How can expertise be defined? Implications of research from cognitive psychology. In R. Williams, W. Faulkner, & J. Fleck (Eds.), *Exploring expertise* (pp. 81-100). New York: Macmillan.

Hoffman, R. R., & Lintern, G. (2006). Eliciting and representing the knowledge of experts. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 203-222). New York: Cambridge University Press.

Hoffman, R. R., Shadbolt, N. R., Burton, A. M., & Klein, G. (1995). Eliciting knowledge from experts: A methodological analysis. *Organizational Behavior and Human Decision Processes, 62*, 129-158.

Hoffman, R. R., Trafton, G., & Roebber, P. (2005). *Minding the weather: How expert forecasters think*. Cambridge, MA: MIT Press.

Hoffman, R. R., Ward, P., Feltovich, P. J., DiBello, L., Fiore, S. M., & Adnrews, D. H. (2014). *Accelerated expertise: Training for high proficiency in a complex world*. New York: Psychology Press.

Hogarth, R. M. (2001). *Educating intuition*. Chicago: University of Chicago Press.

Hsieh, H., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288.

Hung, Y. H., Lin, C. F., & Chang, R. I. (2015). Developing a dynamic inference expert system to support individual learning at work. *British Journal of Educational Technology, 46*(6), 1378-1391.

Hutton, R. J. B., & Klein, G. (1999). Expert decision making. *Systems Engineering, 2*(1), 32-45.

Illeris, K. (2004). *Adult education and adult learning*. Malabar, FL: Krieger.

Jacobs, R. L. (1986). Use of the critical incident technique to analyze the interpersonal skill requirements of supervisors. *Journal of Industrial Teacher Education, 23*(2), 56-61.

Jacobs, R. L. (2003). *Structured on-the-job training: Unleashing employee expertise in the workplace*. San Francisco, CA: Berrett-Koehler.

Jacobs, R. L. (2017). Knowledge work and human resource development. *Human Resource Development Review, 16*(2), 1-27.

Jashapara, A. (2011). *Knowledge management: An integrated approach* (2nd ed.). Essex, England: Pearson Education Limited.

Kahn, W. A. (1990). The psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal, 33*(4), 692-724.

Kahn, W. A. (1992). To be fully there: Psychological presence at work. *Human Relations, 45*(4), 321-349.

Kalish, M. L., Lewandowsky, S., & Kruschke, J. K. (2004). Population of linear experts: Knowledge partitioning and function learning. *Psychological Review, 111*, 1072-1099.

Karniol, R., & Ross, M. (1977). The effects of performance-relevant and performance-irrelevant rewards on motivation. *Child Development, 48*, 482-487.

Kitsantas, A., & Zimmerman, B. J. (2002). Comparing self-regulatory processes among novice, non-expert, and expert volleyball players: A microanalytic study. *Journal of Applied Sport Psychology, 14*, 91-105.

Klein, G. (1998). *Sources of power: How people make decisions*. Cambridge, MA: MIT Press.

Klein, G. (2015). A naturalistic decision making perspective on studying intuitive decision making. *Journal of Applied Research in Memory and Cognition, 4*, 164-168.

Klein, G., Orasanu, J., Calderwood, R., & Zsambok, C. E. (Eds.) (1993). *Decision making in action: Models and methods*. Norwood, NJ: Ablex.

Kluge, A., Sauer, J., Burkholter, D., & Ritzmann, S. (2010). Designing training for temporal and adaptive transfer: A comparative evaluation of three training methods for process control tasks. *Journal of Educational Computing Research, 43*, 327-353.

Knowles, M. S. (1975). *Self-directed learning: A guide for learners and teachers*. New York: Association Free Press.

Knowles, M. S., Holton, E. F. III., & Swanson, R. A. (2015). *The adult learner* (8th ed.). New York: Routledge.

Kondracki, N. L., Wellman, N. S., & Amundson, D. R. (2002). Content analysis: Review of methods and their applications in nutrition education. *Journal of Nutrition Education and Behavior, 34*(4), 224-230.

Krampe, R. T., & Charness, N. (2006). Aging and expertise. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 723-742). New York: Cambridge University Press.

Krampe, R. T., & Ericsson, K. A. (1996). Maintaining excellence: Deliberate practice and elite performance in young and older pianist. *Journal of Experimental Psychology: General, 125*, 331-359.

Lankau, M. J., & Scandura, T. A. (2002). An investigation of personal learning in mentoring relationships: content, antecedents, and consequences. *The Academy of Management Journal, 45*(4), 779-790.

Lee, C. H., & Bruvold, N. T. (2003). Creating value for employees: Investment in employee development. *The International Journal of Human Resource Management, 14*(6), 981-1000.

Lesgold, A., Rubinson, H., Feltovich, P., Glaser, R., Klopfer, D., & Wang, Y. (1988). Expertise in a complex skill: Diagnosing X-ray pictures. In M. T. H. Chi, R. Glaser, M. J. Farr (Eds.), *The nature of expertise* (pp. 311-342). Hillsdale, NJ: Erlbaum.

Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *Evaluative Thinking, 30*, 73-84.

Liversedge, S. P., & Findlay, J. M. (2000). Saccadic eye movements and cognition. *Trends in Cognitive Science, 4*(1), 6–14.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*(9), 705-717.

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95*(4), 492-527.

Marsick, V. J., & Watkins, K. E. (1990). *Informal and incidental learning*. London: Routledge.

Marsick, V. J., & Watkins, K. E. (2003). Demonstrating the value of an organization's learning culture: The dimensions of the learning organization questionnaire. *Advances in Developing Human Resources, 5*(2), 132-151.

Masunaga, H., & Horn, J. (2000). Expertise and age-related changes in components of intelligence. *Psychology & Aging, 16*(2), 293-311.

Maxwell, J. A. (2011). *A realist approach for qualitative research*. Thousand Oaks, CA: Sage Publications, Inc.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Maxwell, J. A., & Miller, B. A. Miller (2008). Categorizing and connecting strategies in qualitative data analysis. In P. Leavy, & S. Hesse-Biber (Eds.), *Handbook of emergent* methods. New York: Guilford Press.

May, D. R., Gilson, R. L., & Harter, L. M. (2004). The psychological conditions of meaningfulness, safety and availability and the engagement of the human spirit at work. *Journal of Occupational and Organizational Psychology, 77*, 11-37.

Mayring, P. (2000). Qualitative content analysis. *Forum: Qualitative Social Research, 1*(2), Art. 20.

McTavish, D. G., & Pirro, E. B. (1990). Contextual content analysis. *Quality and Quantity, 24*(3), 245-265.

McPherson, G. E., & Zimmerman, B. J. (2002). Self-regulation of musical learning: A social cognitive perspective. In R. Colwell & C. Richardson (Eds.), *The new handbook of research on music teaching and learning* (pp. 327-347). New York: Oxford University Press.

Merriam, S. B., & Bierema, L. L. (2014). Adult learning: linking theory and practice. San Francisco, CA: Jossey-Bass.

Merriam, S. B., Caffarella, R. S., & Baumgartner, L. M. (2007). *Learning in adulthood* (3rd ed.). San Francisco: Jossey-Bass.

Merriam, S. B., & Simpson, E. L. (2000). *A guide to research for educators and trainers of adults* (2nd ed.). Malabar, FL: Krieger Publishing Company.

Mieg, H. A. (2001). *The social psychology of expertise: Case studies in research, professional domains, and expert roles*. Mahwah, NJ: Erlbaum.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Ministry of Employment and Labor, Republic of Korea (August 29, 2017). MOEL and HRD Korea select 11 master craftsmen of Korea, 47 outstanding skilled technicians, 1 skilled craft master and 4 outstanding enterprises in encouraging skills. News. Retrieved from https://www.moel.go.kr/news/enews/report/enewsView.do?news_seq=7960

Mintzes, J., Wandersee, J. H., & Novak, J. D. (1998). *Teaching science for understanding*. San Diego, CA: Academic Press.

Monchaux, S., Amadieu, F., Chevalier, Al, & Mariné, C. (2015). Query strategies during information searching: Effects of prior domain knowledge and complexity of the information problems to be solved. *Information Processing & Management, 51*(5), 557-569.

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin, 132*(2), 297-326.

Morey, J. C., Simon, R., Jay, G. D., Wears, R. L., Salisbury, M., Dukes, K. A., & Berns, S. C. (2002). Error reduction and performance improvement in the emergency department through formal teamwork training: Evaluation results of the medteams project. *Health Services Research, 37*(6), 1553-1581.

Morse, J. M., & Field, P. A. (1995). *Qualitative research methods for health professionals* (2nd ed.). Thousand Oaks, CA: Sage.

Müller, S., McLaren, M., Appleby, B., & Rosalie, S. M. (2015). Does expert perceptual anticipation transfer to a dissimilar domain? *Journal of Experimental Psychology:*

Human Perception and Performance, 41(3), 631-638. http://dx.doi.org/10.1037/xhp0000021

Muzio, D., Ackroyd, S., & Chanlat, J. (Eds.) (2008). *Redirections in the study of expert labour: Established professions and new expert occupations*. London: Palgrave.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company: How Japanese companies create the dynamics of innovation.* New York: Oxford University Press.

Norman, G., Eva, K., Brooks, L., & Hamstra, S. (2006). Expertise in medicine and surgery. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 339-353). New York: Cambridge University Press.

Oberauer, K. (2006). Is the focus of attention in working memory expanded through practice? *Journal of Experimental Psychology: Learning, Memory and Cognition, 32*(2), 197-214.

Oh, J. R., & Park, C. H. (2012). Self-directed learning in the workplace. *Proceedings of the Adult Education Research Conference*, USA, pp. 265-271.

Oliver, D., & Roos, J. (2005). Decision making in high velocity environments: The importance of guiding principles. *Organization Studies, 26*, 889-913.

Olson, J. R., & Biolsi, K. J. (1991). Techniques for representing expert knowledge. In K. A. Ericsson & J. Smith (Eds.), *Toward a general theory of expertise* (pp. 240-285). Cambridge, MA: Cambridge University Press.

Orasanu, J., & Connolly, T. (1993). The reinvention of decision making. In G. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds.), *Decision making in action: Models and methods* (pp. 3-20). Norwood, CT: Ablex.

Papouli, E. (2016). Using the critical incident technique (CIT) to explore how students develop their understanding of social work values and ethics in the workplace during their final placement. *The Journal of Social Work Values and Ethics, 13*(2), 56-72.

Patel, V. L., & Ramoni, M. F. (1997). Cognitive models of directional inference in expert medical reasoning. In P. J. Feltovich, K. M. Ford, & R. R. Hoffman (Eds.), *Expertise in context: Human and machine* (pp. 67-99). Menlo Park, CA: American Association for Artificial Intelligence; Cambridge, MA: The MIT Press.

Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Peebles, D. (2013). Strategy and pattern recognition in expert comprehension of 2 x 2 interaction graphs. *Cognitive Systems Research, 24*, 43-51.

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology, 92*, 544-555.

Polanyi, M. (1966). *The tacit dimension* (Reprinted in 1983). Gloucester, MA: Peter Smith.

Polanyi, M., & Sen, A. (2009). *The tacit dimension*. Chicago: The University of Chicago Press.

Proctor, R. W., & Vu, K. L. (2006). Laboratory studies of training, skill acquisition, and retention of performance. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 265-286). New York: Cambridge University Press.

Query, J. L. Jr., & Wright, K. (2003). Assessing communication competence in an online study: toward informing subsequent interventions among older adults with cancer, their lay caregivers, and peers. *Health Communication, 15*(2), 203-218.

Quinney, K. L., Smith, S. D., & Galbraith, Q. (2013). Bridging the gap: Self-directed staff technology training. *Information Technology and Libraries, 29*(4), 205-213.

Raidal, S. L, & Volet, S. E. (2009). Preclinical students' predispositions towards social forms of instruction and self-directed learning: A challenge for the development of autonomous and collaborative learners. *Higher Education, 57*, 577-596.

Randel, J. M., Pugh, H. L., & Reed, S. K. (1996). Differences in expert and novice situation awareness in naturalistic decision making. *International Journal of Human-Computer Studies, 45*(5), 579-597.

Reimann, P., & Chi, M. T. H. (1989). Expertise in complex problem solving. In K. J. Gilhooly (Ed.), *Human and machine problem solving* (pp. 161-192). New York: Plenum Press.

Rowland, G. (1992). What do instructional designers actually do? An initial investigation of expert practice. *Performance Improvement Quarterly, 5*(2), 65-86.

Salas, E., & Rosen, M. A. (2010). Experts at work: Principles for developing expertise in organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations*. New York: Routledge.

Salo, M., & Frank, L. (2017). User behaviors after critical mobile application incidents: The relationship with situational context. *Information Systems Journal, 27*(1), 5-30.

Salthouse, T. A. (1986). Perceptual, cognitive, and motoric aspects of transcription typing. *Psychological Bulletin, 99*(3), 303-319.

Salthouse, T. A. (1991). Expertise as the circumvention of human processing limitations. In K. A. Ericsson & J. Smith (Eds.), *Toward a general theory of expertise: Prospects and limits* (pp. 286-300).

Salthouse, T. A. (2012). Consequences of age-related cognitive declines. *Annual Review of Psychology, 63*, 201-226.

Sarewitz, D., & Nelson, R. P. (2008). Progress in know-how. Its origins and limits. *Innovations, 3*, 101-117.

Sawchuck, P. H. (2008). Theories and methods for research on informal learning and work: Towards cross-fertilization. *Studies in Continuing Education, 30*(1), 1-16.

Schunn, C. D., McGregor, M. U., & Saner, L. D. (2005). Expertise in ill-defined problem-solving domains as effective strategy use. *Memory and Cognition, 33*(8), 1377-1387.

Seijts, G. H., & Latham, G. P. (2005). Learning versus performance goals: When should each be used? *Academy of Management Executive, 19*(1), 124-131.

Semb, G. B., & Ellis, J. A. (1994). Knowledge taught in school: What is remembered? *Review of Educational Research, 64*, 253-286.

Senge, P. M. (1990). The fifth discipline: The art and practice of the learning organization. New York: Doubleday/Currency.

Shaffer, L. H. (1975). Multiple attention in continuous verbal tasks. In P. M. Rabbitt & S. Dornic (Eds.), *Attention and performance* (Vol. 5, 157-167). London: Academic Press.

Shah, S. K., & Corley, K. G. (2006). Building better theory by bridging the quantitative-qualitative divide. *Journal of Management Studies, 43*(8), 1821-1835.

Shibata, K., Sasaki, Y., Bang, J. W., Walsh, E. G., Machizawa, M. G., Tamaki, M., … Watanabe, T. (2017). Overlearning hyperstabilizes a skill by rapidly making neurochemical processing inhibitory-dominant. *Nature Neuroscience, 20*, 470-475. doi: 10.1038/nn.4490

Simon, H. A., & Chase, W. G. (1973). Skill in chess. *American Scientist, 61*, 394-403.

Simonton, D. K. (2003). Expertise, competence, and creative ability: The perplexing complexities. In R. J. Sternberg & E. L. Grigorenko (Eds.), *The psychology of abilities, competencies, and expertise* (pp. 213-239). Cambridge, UK: Cambridge University Press.

Sohn, Y. W., & Doane, S. M. (2003). Roles of working memory capacity and long-term working memory skill in complex task performance. *Memory and Cognition, 31*(3), 458-466.

Sohn, Y. W., & Doane, S. M. (2004). Memory processes of flight situation awareness: Interactive roles of working memory capacity, long-term working memory, and expertise. *Human Factors, 46*(3), 461-475.

Sonnentag, S. (1995). Excellent software professionals: Experience, work activities, and perceptions by peers. *Behaviour & Information Technology, 14*, 289-299.

Sonnentag, S. (1998). Expertise in professional software design: A process study. *Journal of Applied Psychology, 83*, 703-715.

Sonnentag, S. (2000). Expertise at work: Experience and excellent performance . In C. L. Cooper & I. T. Robertson (Eds.), *International review of industrial and organizational psychology* (pp. 223-264). Chichester, England: Wiley.

Sonnentag, S., & Kleine, B. M. (2000). Deliberate practice at work: A study with insurance agents. *Journal of Occupational and Organizational Psychology, 73*, 87-102.

Sonnentag, S., Niessen, C., & Volmer, J. (2006). Expertise in software design. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 373-387). New York: Cambridge University Press.

Sosniak, L. A. (2003). Developing talent: Time, task and context. In N. Colangelo & G. Davis (Eds.), *Handbook of gifted education* (3rd. ed.) (pp. 247-253). New York: Allyn & Bacon.

Soylu, M. Y., & Bruning, R. H. (2016). Exploring self-regulation of more or less expert college-age video game players: A sequential explanatory design. *Frontiers in Psychology, 7*:1441

Speelman, C. P., & Kirsner, K. (2001). Predicting transfer from training performance. *Acta Psychologica, 108*, 247-281.

Stehr, N., & Grundmann, R. (2011). *Experts: The knowledge and power of expertise*. New York: Routledge.

Sternberg, R. J. (1996). Costs of expertise. In K. A. Ericsson (Ed.), *The road to excellence: The acquisition of expert performance in the arts and sciences, sports and games* (pp. 347-354). Mahwah, NJ: Erlbaum.

Sternberg, R. J. (1997). *Successful intelligence*. New York: Plume Books.

Sternberg, R. J. (1998). Abilities are forms of developing expertise. *Educational Researcher, 27*, 11-20.

Sternberg, R. J., & Frensch, P. A. (1992). On being an expert: A cost-benefit analysis. In R. R. Hoffman (Ed.), *The psychology of expertise: Cognitive research and empirical AI* (pp. 191-203). New York: Springer Verlag.

Sternberg, R. J., Forsythe, G. B., Hedlund, J. Horvath, J. A., Wagner, R. K., Williams, W. M., Snook, S. A., & Grigorenko, E. L. (2000). *Practical intelligence in everyday life*. Cambridge, UK: Cambridge University Press.

Strauss, A. (1987). *Qualitative analysis for social scientists*. Cambridge, England: Cambridge University Press.

Stubbart, C. I., & Ramaprasad, A. (1990). Comments on the empirical articles and recommendations for future research, in *Mapping Strategic Thought*, ed A. S.Huff (Chichester:Wiley), 251–288.

Tough, A. (1978). Major learning efforts: Recent research and future directions. *Adult Education, 28*(4), 250-236.

Valentine, D., Pichon, M., de Boishebert, V., & Abdi, H. (2000). What's in a wine name? When and why do wine experts perform better than novices? *Abstracts of the Psychonomic Society, 5*, 36.

Van Gog, T., Paas, F., & Van Merrienboer, J. J. G. (2005). Uncovering expertise-related differences in troubleshooting performance: Combining eye movement and concurrent verbal protocol data. *Applied Cognitive Psychology, 19*, 205-221.

Van Overschelde, J. P., & Healy, A. F. (2001). Learning of nondomain facts in high- and low-knowledge domains. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27*(5), 1160-1171.

Vessey, I. (1986). Expertise in debugging computer programs: An analysis of the content of verbal protocols. *IEEE Transactions on Systems, Man, and Cybernetics, 16*, 621-637.

Watkins, K. E., & Marsick, V. J. (1997). *Dimensions of the learning organization*. Warwick, RI: Partners for the Learning Organization.

Weber, R. P. (1990). *Basic content analysis* (2nd ed.). Newbury Park, CA: Sage Publications, Inc.

Weiss, C. H. (1998). *Evaluation* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall, Inc.

Wenger, E. C. (1998). *Communities of practice: Learning, meaning, and iden*tity. Cambridge: Cambridge University Press.

Wenger, E. C., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston, MA: Harvard Business School Press.

Wilding, J. M., & Valentine, E. R. (2006). Exceptional memory. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 539-552). New York: Cambridge University Press.

Winch, C. (2010). *Dimensions of expertise: A conceptual exploration of vocational knowledge.* New York: Continuum International Publishing Group.

Winner, E. (1996). The rage to master: the decisive role of talent in the visual arts. In K. A. Ericsson (Ed.), *The road to excellence: The acquisition of expert performance in the arts and sciences, sports and games* (pp. 271-301). Mahwah, NJ: Lawrence Erlbaum Associates.

Wixted, J. T. (2004). The psychology and neuroscience of forgetting. *Annual Review of Psychology, 55*, 235-269.

Wixted, J. T., & Ebbesen, E. B. (1991). On the form of forgetting. *Psychological Science, 2*, 409-415.

Woldesenbet D., & Klay, W. E. (2016). The overlooked role of local experts in learning to use technology in public organizations. *Public Administration Quarterly, 40*(4), 693-724.

WorldSkills. (2018). *About the competitions*. Retrieved March 28, 2018 from https://www.worldskills.org/what/competitions/about/

Woo, J. H., Clayton, M. J., Johnson, R. E., Flores, B. E., & Ellis, C. (2004). Dynamic knowledge map: Reusing experts' tacit knowledge in the ACE industry. *Automation in Construction, 13*, 203-207.

Woolsey, L. K. (1986). The critical incident technique: An innovative qualitative method of research. *Canadian Journal of Counselling, 20*(4), 242-254.

Zeitz, C. M. (1997). Some concrete advantages of abstraction: How experts' representations facilitate reasoning. In P. J. Feltovich, K. M. Ford, & R. R. Hoffman (Eds.), *Expertise in context* (pp. 43-65). Menlo Park, CA: MIT Press.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of selfregulation* (pp. 13-39). San Diego, CA: Acadernic.

Zimmerman, B. J. (2002). Achieving academic excellence: a self-regulatory perspective in The Pursuit of Excellence in Education, ed M.Ferrari (Hillsdale, NJ:Erlbaum), 85–110.

Zimmerman, B. J. (2006). Development and adaptation of expertise: The role of self-regulatory processes and beliefs. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 705-722). New York: Cambridge University Press.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal, 29*, 663-676.

Zimmerman, B. J., & Campillo, M. (2003). Motivating self-regulated problem solvers. In J. E. Davidson & R. J. Sternberg (Eds.), *The nature of problem solving* (pp. 233-262). New York: Cambridge University Press.

Zimmerman, B. J., & Kitsantas, A. (1996). Self-regulated learning of a motoric skill: The role of goal setting and self-monitoring. *Journal of Applied Sport Psychology, 8*, 69-84.

Zimmerman, B. J., & Kitsantas, A. (1999). Acquiring writing revision skill: Shifting from process to outcome self-regulatory goals. *Journal of Educational Psychology, 91*, 1-10.

Zsambok, C., & Klein, G. (Eds.) (1997). *Naturalistic decision making*. Hillsdale, NJ: LEA.

Zuckerman, H. (1977). *Scientific elite: Nobel laureates in the United States*. New York: Free Press.

APPENDIX A. INTERVIEW PROTOCOL

Question 1. Tell me a story about when you acquired knowledge and skills, which were critical for your job performance. (Follow-up questions might be needed as follows.)

1.1. Please describe the context when acquiring knowledge and skills was effective.

1.2. Please describe what you did when acquiring knowledge and skills was effective.

1.3. Please describe the results after you acquired knowledge and skills.

Question 2. Tell me a story about when you updated knowledge and skills, which were critical for your job performance. (Follow-up questions might be needed as follows.)

2.1. Please describe the context when updating knowledge and skills was effective.

2.2. Please describe what you did when updating knowledge and skills was effective.

2.3. Please describe the results after you updated knowledge and skills.

Question 3. Tell me a story about when you shared knowledge and skills, which were critical for your job performance, with others. (Follow-up questions might be needed as follows.)

3.1. Please describe the context when sharing knowledge and skills with others was effective.

3.2. Please describe what you did when sharing knowledge and skills with others was effective.

3.3. Please describe the results after you shared knowledge and skills with others.

APPENDIX B. INSTITUTIONAL REVIEW BOARD APPROVAL

ILLINOIS
Office for the Protection of Research Subjects

IORG0000014 • FWA #00008584

Notice of Approval: New Submission

April 17, 2018

Principal Investigator	Ronald Jacobs
CC	Yoo Min Lee
Protocol Title	*A DESCRIPTIVE STUDY OF THE APPROACHES USED BY EXPERT EMPLOYEES KNOWN AS MYUNGJANGS TO ACQUIRE CONTINUE TO UPDATE AND TRANSFER THEIR DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS*
Protocol Number	18741
Funding Source	Unfunded
Review Type	Exempt 2
Status	Active
Risk Determination	no more than minimal risk
Approval Date	04/17/2018

This letter authorizes the use of human subjects in the above protocol. The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) has reviewed and approved the research study as described.

Exempt protocols are approved for a five year period from their original approval date, after which they will be closed and archived. Researchers may contact our office if the study will continue past five years.

The Principal Investigator of this study is reponsible for:

- Conducting research in a manner consistent with the requirements of the University and federal regulations found at 45 CFR 46.
- Requesting approval from the IRB prior to implementing modifications.
- Notifying OPRS of any problems involving human subjects, including unanticipated events, participant complaints, or protocol deviations.
- Notifying OPRS of the completion of the study.

Office for the Protection of Research Subjects
University of Illinois at Urbana-Champaign
(217) 333-2670
irb@illinois.edu

APPENDIX C. CRITICAL INCIDENT REPORTING FORM

I. Knowledge and skills acquisition

Objective	Describing an incident of acquiring knowledge and skills
Instructions	Describe an example of acquiring knowledge and skills effectively. Please be specific in describing the situation, the behavior, and the result.
Description of the situation	Question: Please describe the context including location, time, and events surrounding the incident when acquiring knowledge and skills effectively. Answer:
Description of the behavior	Question: Please describe what you did when acquiring knowledge and skills effectively. Answer:
Description of the result of the behavior	Question: Please describe the results after you acquired knowledge and skills. Answer:

APPENDIX C. CRITICAL INCIDENT REPORTING FORM (continued)

II. Knowledge and skills update

Objective	Describing an incident of updating knowledge and skills
Instructions	Describe an example of updating knowledge and skills effectively. Please be specific in describing the situation, the behavior, and the result.
Description of the situation	Question: Please describe the context including location, time, and events surrounding the incident when updating knowledge and skills effectively. Answer:
Description of the behavior	Question: Please describe what you did when updating knowledge and skills effectively. Answer:
Description of the result of the behavior	Question: Please describe the results after you updated knowledge and skills. Answer:

APPENDIX C. CRITICAL INCIDENT REPORTING FORM (continued)

III. Knowledge and skills share

Objective	Describing an incident of sharing knowledge and skills with others
Instructions	Describe a situation in which you have experienced what you consider to be an example of effective knowledge and skills transfer behavior. Please be specific in describing the situation, the behavior, and the result.
Description of the situation	Question: Please describe the context including location, time, and events surrounding the incident when sharing knowledge and skills with others. Answer:
Description of the behavior	Question: Please describe what you did when sharing knowledge and skills with others. Answer:
Description of the result of the behavior	Question: Please describe the results after you shared knowledge and skills with others. Answer:

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS

Theme	Seeking a learning opportunity on the job
Critical Incident	The team leader taught me one-on-one about the theories and operating skills. When he taught me one day, he let me explain to him what I had learned on the next day. When it was my turn to explain to him, I couldn't do it logically because I didn't understand it completely. As I was better able to explain him what I learned on the previous day, I began to know about the concentrator and how it is operated. – Participant A There was a public bath downstairs, and a non-certified boiler engineer was studying for getting a certificate for oil handling so he could become a chief engineer. One day he asked me to verbally ask him questions from his book. So I looked at the book and asked him questions. While asking questions of him, I could memorize knowledge about the oil and boiler mechanisms. Because I also got interested in the subject, I also took the examination for the certificate. As a result, he failed but I passed. – Participant C The other boiler engineers did not want to teach me about how to operate it properly. I learned it by watching first. As I learned it quickly, they started teaching me little by little. I learned about the boiler like that for about 8 months there. In the spring of '71, I went to the industrial complex in Yeongdeungpo to find a job as a boiler technician. – Participant B In the seventies and eighties, lots of machineries were imported from abroad. At the time of installation, two specialists in mechanical and electrical fields came from abroad and installed, explained and handed over the operation manuals. Some years later, only one person came for the same tasks. I thought that this would happen the same in my country. Thus, I carefully watched how the mechanic handled the electrical parts of the machine that was not within my field of expertise. – Participant B For the first three years, I could not even get a knife but I just had an errand. I practiced at night after I did my hard work during the day. I saw what the chef did during the day and tried to copy it alone at night. – Participant D When I first learned, I did not know anything like theory or jargon used in the field. I tried to learn skills by hand. At that time, I had to learn over the shoulders rather than being trained elsewhere. I watched how others performed. – Participant J

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Seeking a learning opportunity on the job
Critical Incident	When I came here, there were many senior cooks who worked in the US Army in the past. We called them 'can' because they only opened cans there. Many of them could not cook food well. Therefore, the hotel invited foreign cooks and we learned how to cook the food from the countries from them step by step. – Participant L The curriculum of my high school with which we learned at that time was really perfect. When I look at the knowledge level of entry-level employees in my company, today's college graduates have lower level of knowledge than the high school graduates in those days. My school was well equipped and I actively participated in the practices as well. I learned the theory and practice properly in the high school. – Participant R There were broken machines left alone in my high school, and I sometimes volunteered to repair them. The teachers could not fix them all so they gathered some skillful students and fixed those machines together. I've done that a few times and I learned about how those machines were built. – Participant R When the specific facilities, which I wanted to practice with, were not available to use, it meant that I could not experience with them. Then, I tried to find other places in which the facilities were available. If that was not even possible, I searched the newspapers or magazines published by the association of air conditioning refrigeration to find the cases of operating them. I scrapped all the necessary parts by type of machine and by topic. – Participant A It was the time in which personal computers were introduced at my workplace. There were four computers there but they were only available to other employees. I sought to find an opportunity to use them but I couldn’t. Thus, I bought and learned a computer by myself even though it was very expensive for my salary at that time. But as I acquired the computer skills earlier than my colleagues, my skills were sought at work. – Participant B I thought about how to save energy from my portion of work. I realized that I needed to know the boiler operation as well as boiler installation, plumbing, maintenance and so on. So I actually visited a building construction site to learn the boiler piping and equipment. I made notes what I learned on the day. When I came back to work, I applied that to improve the boiler system at my work. – Participant B

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Seeking a learning opportunity on the job
Critical Incident	I did not know about Hydraulics. I couldn't learn about it at school either. When I came into the company, I realized that it was really an important part in this field. So I moved to the hydraulic department to learn this. – Participant F When I joined the company, I worked in the assembling department. But by doing it people could not develop technical know-hows. So I transferred to the painting department in which people could develop the know-hows. Painting is done by a spray gun, but it is liquid, so it is a very sensitive task. When it is a little less, the color gets weaker and when it is a little too much, it runs down. This work really needs people's know-hows. – Participant H In the early days, there was no one who knows about polyethylene. Thus, when a machinery sample was imported from a foreign country, I completely disassembled it as parts and searched for the best people who can build a sample of each part. I modified the parts suitable for the Korean market. I went to places like Cheonggyecheon or Yongsan, and asked people who the best person was for each part. I brought the parts separately made by the experts together and assembled, then tested it in the field. – Participant M When a machine was imported from a foreign country, my boss sent me to the country for 7-10 days to learn how to use or maintain it. I translated the manuals in Korean to operate it. I sometimes went back to the country again to learn more skills and bring the parts. – Participant M I built a parking control system at Incheon International Airport. I visited many airports in Japan, Hong Kong, Germany, etc. for benchmarking to make the airport with the best parking control system in Asia or the world. When I went to benchmarking, I also contacted the companies who supplied the equipment to the airports and was able to receive advice from them. – Participant O There were many places in which such artifacts were detected. When I heard about the new founding on the sites, I went there to collect the fragments of them. Seeing the artifacts in reality is different from seeing them on the picture. Particularly in the case of the fragments, you can see something more realistic that helps the person who makes it. The depth of awareness of ceramics changed as I touched and watched those things. – Participant P

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Seeking a learning opportunity on the job
Critical Incident	If you are interested in something, you go there to see it and you may find out what to do. For example, if I were interested in the form, I would have more attention to the form of the artifacts and think about it. The focus what to see will change each time I go and then build up knowledge systematically. For example, I looked at the shape last time and then I look at the flow of lines this time. My views are getting deeper and wider as I have more experience. – Participant P The C&C machine was introduced in the early '80s when people operated it manually. Of course I did not know how to make a program for the new machine. There was no one to teach me. Then I learned how to make a program by myself. I looked for information and followed the instruction and reviewed my result. – Participant R Workers had different expertise for preparing clay, sculpting, and baking. Thus, they worked in one section only. I tried to watch and copy others in other work sections as much as I could. As I had a goal that I will become the best in the field by making this. So I was able to find out what to learn and how to learn the different works by myself. – Participant P I was an orphan who was left alone when I was going to the junior high school. There was no one I could rely on. I do not have a good physical as others. My knowledge and scholarship were shallow because I left the junior high school. There's nothing I could do. From that time, I could not be sick because I had no one to depend on and I had no money to go to the hospital. I always had a feeling of standing on edge. I thought learning skills was the only way to guard myself. So I only focused on learning skills to guard myself. – Participant I My teacher was the best chef in the field at the time. One day he told me that I should try to take a skill's master certificate exam in five years and be ranked within 100th. It became my goal to achieve this since then. I planned for learning and practicing. I passed the exam after two years. Since then, it has become my habit to plan something two to three years ahead to accomplish the goal. – Participant I

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Repeating given tasks when on the job
Critical Incident	It is just an everyday routine I did. It takes two or three hours to make a round-trip in the entire factory. I do it every day with the inspection sheets. I did it twice a day. After a while, I started seeing the entire factory in my head, for example, how the piping was aligned and where the valve was opened. – Participant A I was an agricultural vocational school graduate, not from an industrial vocational school. From my perspective, there was little difference between the industrial vocational school graduates and I. But the industrial high school graduates were assigned to do more professional work and the agricultural high school graduates had to do chores. It hurt my pride so I thought I should make my skills better than them. From that time, I spent 30 more minutes at work everyday. This has been a part of my working life for nearly 30 years and I believe it made me become a Myungjang. – Participant H I got up at 5 am and worked until 6 pm in the kitchen. After 6 pm, every worker in the kitchen went out for enjoying the free time but I stayed in the kitchen and spent the time to practice some techniques that I really wanted to learn. – Participant I I had to take care of my mind. I left home at 4:30 am and arrived at work at 5 o'clock in the morning, which was an hour earlier before other people came. When I came to the kitchen, I made the kitchen ready for use including signing in releasing devices, gas, etc. About six o'clock, seniors came to work. Also, the kitchen is sometimes left unclean. Then I cleaned during a break. That was what other people did not much care of. – Participant L One day when I came to the company in the morning, all products produced during the night were defected. Because something went in the equipment for measuring the products, the products could not be produced within the required range. Since then, conducting preventive maintenance became my task. That preventive maintenance is very important in the semiconductor industry. – Participant O

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Repeating given tasks when on the job
Critical Incident	Even after drinking a lot of alcohol with my colleagues, I always came back to work afterwards. I wanted to spare time and practiced more. Doing something like that would be hard at first, but if you do it again and keep doing it, it becomes your habit to do that. People misunderstood at first, but as time passed, they realized that I really enjoyed what I did at work. – Participant P When I went to the casting process department, I could not read a circuit diagram of the hydraulic system because it was complicated. Thus, I made my own note and drew each valve with numbers on the circuit diagram and compared it with actual valves. I do not know how others learned but it was the way I learned. Afterwards, I was able to draw the complicated valves in the head without the circuit diagram. – Participant F In the early days shortly after I joined the company, there was a master in quality controlling. In a training session, he talked about how he became a master. He suggested us to have a habit of taking notes. I was so impressed. It's hard to have such habits at first but I kept trying not to break my promise to me. – Participant H You have to invest in improving yourself. If I work 8 hours, sleep 8 hours, play 8 hours a day and then I cannot do better than others. I'm not smart so I have been trying hard. I studied until 2 o'clock in the night, slept for four hours and went to work again. – Participant B I thought I would have to be acknowledged among others in order to grow. I took responsibility for my work and I tried to work a little more like 1% or 2% than others. These things worked well, so I took a role as a field officer at a young age, and I played another role here as well. Those who work hard for their own job are outstanding in the crowd. They don't try to look outstanding among others but I think it's the way they use their energy. – Participant E I painted 50 sheets in one night for finding one right line. Now CAD is used, but I still like to hand-draw with a note ring pen rather than using a CAD because you can actually feel and see that there is a difference between the lines in precision. While I drew a line, I've been looking at it many times until the printed lines were almost faded and I've been fixing it dozens of times. I got the skills, as I understood how to transform the clothes with different lines. Such experience had been accumulated in the process. – Participant K

APPENDIX D. INCIDENT OF ACQUIRING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Repeating given tasks when on the job
Critical Incident	When a new machine was delivered, the panel of the electrical system came together. I got curious and kept looking into it with the assembly plan. Even though I was not a professional electrician, I had to understand how it worked within the machines. Thus, I studied about it by myself or sometimes went over to the electric department to learn how people there worked over the shoulder." – Participant B It took me three years to overcome such painful condition of living and learning. After the period, I was able to learn from my teacher. It was possible because I practiced with my teacher's work after daily work and studied Chinese texts by myself. With the base, I was able to express everything as he taught me. – Participant D When I first met my teacher, he told me to work a lot and draw a lot. I did not know what it meant at that time. I did not see any improvement although I practiced a lot. As a certain time passed, I began to see the same line differently. I could see the development with one line. I felt it. At that time, I finally had an eye for myself to see my skills. To have the eyes, practice is the only way. – Participant K In terms of time, I did a lot of work quantitatively and qualitatively. Now I cannot imagine how I could do like that. It's not just doing work like a workaholic, but I spent all time given to me for work except the time for meals and sleeping. I now have room for me on weekends so I sometimes leave works to my employees, but in the past I worked seven days a week. But it was no problem because I enjoyed it. I did it as my hobby. – Participant R I still practice if I have a shot tomorrow. For tomorrow, I practice it thoroughly three times, once yesterday, once the day before yesterday, and once today. So I am prepared for the shot. – Participant S Korean's hair is usually heavy so the skills learnt in other countries are sometimes not working with Korean customers. Korean's hair is different from non-Korean's hair. It is heavy so you need to have a perm after cutting with scissors. I have to give a volume because the shape of back head is flat. When such a problem arises, I have to think about how I can modify the skills learned in other contexts. I practiced with a wig a lot. I brought world-class skills from outside and then I continuously developed the skills that work for Korean's hair. – Participant S

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS

Theme	Creating a learning opportunity within an extended boundary of work
Critical Incident	Several technologies from different fields are combined in the field of refrigeration. As I know more, I feel that my work gets harder and harder. I need to know not only about refrigeration but also electricity, architecture, environment, workspace, and circulation. I feel like my expertise keeps getting narrower. Thus, I am continuously studying. I try to get more certificates of electricity and control. There are certificates in each field so you can learn the knowledge while preparing for the exams. It's actually helpful on the job because it's linked to what I've actually experienced at work. – Participant A Although I originally started working on boilers, I also studied energy and environment, which are related fields because the company used fossil fuels. Thus, energy and air pollution were always sensitive topics. I got one of the first grade certificates in the field of environment and I also learned about the piping facilities. – Participant B My boss told me to transfer my job location at the factory in Cheongju because I had work experience of a cogeneration plant before. At that time, there was a change of the operation system from fully manual to semi-automatic in the Cheongju factory. As I was involved in the project, I realized that I had to consider potential legal issues in various areas such as energy, environment and safety to build a system in the factory. As a result, I learned a lot from the experience in terms of facility design, construction, installation, and so on. – Participant B I acquired 8 certificates in different areas such as firearms, hazardous materials, and firearms. I got them because the position requires a license by law. Since the company was constantly growing, I also worked hard and grew with it. – Participant B It was my goal to be a top engineer in my field and enhance my value. Then I had to work better than others. When I was trying to work better, I should not only be able to do just one thing in the field of machinery, but also be able to design and manage the whole thing. I thought that I had to do all of those things. – Participant B If I did not learn calligraphy, I would not be able to have my own unique writing. I blended the merit of calligraphy and the merit of seal, and put it together in the seal. It's a unique character. Other people cannot imitate mine. – Participant D

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Creating a learning opportunity within an extended boundary of work
Critical Incident	It was necessary to learn electricity, which is out of my expertise. So I asked the company to support. I went to the technical training center in my company to learn the fundamental theories. And then I visited a company that supplies electric products to learn the principles of control, module development, and operation. As I added knowledge of other fields like electricity on knowledge of my field, it enabled me to widen my coverage of work. – Participant E I did not just learn about the assigned tasks, but enlarged my domain. As I creatively widened the scope of my capability, I became able to see other technologies in the related areas. I did not have a profound knowledge of these technologies, such as machining technology, assembly technology, hydraulic technology, and electric technology, but rather I learned about such technologies through experience. By using those techniques, I acquired the ability to create the tools and devices needed in the field. It's my skills that put them together to make them work together. If it continues to be used on-site, I do my job right. – Participant E I am a mechanical expert, but my expertise and electricity should be fused if I want to provide a total service. It is a mechatronics that combines mechanical and electrical. So I studied electricity and learned it through experience. All the products I make can be categorized in mechatronics. I need to control the machine, so I need to know how to use electricity. – Participant E That process is not driven by pure hydraulics, but by electricity. I had to have knowledge of electricity. The easiest way to learn about it is to get a license. I got the electrical certification by studying. By gaining electricity knowledge, I got to know more about hydraulics. The theory is basically foundational, and what people use in the field is somewhat different. So one can apply foundational knowledge for use in the field. Being able to understand things like signals, I came to know how to tune the hydraulics better. – Participant F I seek new things on the internet or from books, and when I find something necessary to apply into the electronics, I study it by myself. I think about what parts of hardware and software should be incorporated with the technology. I read reports about the new technologies then I sometimes feel that I need to know. For example, in the case of cryptocurrency, it is not the area that I need to do.” – Participant O

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Creating a learning opportunity within an extended boundary of work
Critical Incident	Today is the age of fusion. I need to have some understanding of things in the other fields too. Electronics is connected with communication and machines. Thus, I need to know more about the things in the other fields as well as my field. I have to have various experiences and have to be interested in that. Having such a variety of experiences is helpful for what I am doing because it enables me to have a wider range of thinking. – Participant O At that time, the works in this field were divided by the sectional specialties, so it was difficult to learn things in the other sections. But I thought I would have to know everything if I want to an expert. I learned about those of the other fields when nobody was there. If I have a dream, it becomes possible. Without a dream, things cannot happen because I don't think about it. – Participant P I was thirsty in skills. I went to a college for learning of hair cutting in Japan, and later I went to places like Vidal Sassoon in Britain, the Allan School in England, a cutting specialized school in France and etc. I went those places to observe and experience it. I learned different things from each place. I learned the global trends. I brought them to Korea and gave to my customers. – Participant S Once chefs from France came to do a seminar on baking, and he said that people couldn't make good bread in Korea because water and flour is not good. So I went to France. Bread in France was really different. In Korea, when I ate bread, my stomach hurts. In France I only ate baguettes and honey yogurt everyday for a week. I was still fine. So I went to France again with 30 million won and I registered for a short course. It was a craving. – Participant T I had walked around the whole factory every day for over 10 years. I took pictures of what happened and organized them on CAD and PowerPoint. I reviewed the files from time to time, otherwise I would forget about it after a while. I've collected the resources and notes for 30 years. The machines are sensitive to the temperature, thus the problems with the machines occur differently by seasons. As I have looked at them every day and made note about what happened, I know what would probably happen in the summer or in the winter. – Participant A

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Creating a learning opportunity within an extended boundary of work
Critical Incident	I always took notes, checked them, and recorded when I learned something at work. After 3 to 4 years, I got to know the causes of the problems of the boiler. I did not know how each part of the boiler played at first, but after 3-4 years, I knew everything about them. – Participant C After I worked in the industry of the construction equipment building for 22 years, I had to transfer to the shipbuilding industry. As I started to work in another industry, I felt I would lose my knowledge and skills developed in the industry of the construction equipment building soon. Thus, I collected the resources I have developed and experienced and put together. I made them with binders. After that, I was able to see what kind of things seems to be lacking. My current qualifications such as education and professional activities were visualized and I was able to systematically improve those lacking parts. – Participant E The note from the meetings with other experts became the resources for my creativity. I shared dozens of my ideas and I kept taking notes and reviewed them whenever I had time. It became my own asset. Some of them seemed to be nonsense, but I sometimes got ideas from them. – Participant H It's important to make it as your habit first. It is not easy at first. Even if you do not have anything to write, you may begin to write something really trivial. And when you see something and you write it down. When I spent three months with the practice, it became my habit and I always took a note wherever I went. I always put my notebook in my pocket. Even if you see a problem but don't take a note of it, you may forget about it after 3 days. However, if you write it down, it reminds you sometime later and you can think about it in detail even later. That was how I could think about many things. – Participant H In my experience, it seems that a lot of ideas come out when a person excretes in the bathroom. Even though I try hard to come up with an idea, I sometimes can't. But there is a moment when I come up with an idea all of sudden. Then, I quickly take out my notebook from my pocket and write it down. If I do not write it at the moment, I would not be able to clearly remember it later. – Participant H

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Creating a learning opportunity within an extended boundary of work
Critical Incident	When I'm in bed, sometimes an idea suddenly comes to mind. I get up and take a note even at 2-3 o'clock in the morning. If the time passes without a note, you would forget later. Although I try to remember it later, the original idea might not be so clear. So if an idea comes to mind, then I quickly take a note. I put it together on the next day and think about it with other ideas. At some point there is a moment when the puzzle is organized. – Participant K I learn every day. I made it as a must-to-do for a day. Everything is a habit. I manage my schedule like this and write down every single day. And I sort things out, and write about things that are even trivial. If I read a good phrase from somewhere, I write it down on my note. These things are piled up. I always have to see something new every day. – Participant N When I see something, I watch it carefully. I always keep a note and a pen ready on my bed. When an idea comes to my mind even while sleeping, I draw a picture, sketch or write it down. – Participant S The customers asked me why the bakery did not bake baguettes or naturally leavened bread, which did not contain sugar. At that time, there was no sugar-free bread like naturally leavened bread. It was a sign that the consumers' appetites were beginning to change. I thought that my bread-baking skill was not high enough. I asked senior chefs to teach me how to bake baguette bread properly, but they did not know well. I read a book on baguettes. I found out that the author of the book did not go to France to learn it, but wrote the book by taking a little excerpt from here and there. I thought this was not right. I decided to go to France to study it correctly. – Respondent I

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	I have the answer for a problem if I have experienced of it. But many problems that I've never experienced occur continuously. I've been working in the company for 35 years and there are still some machines I have never touched. When I meet such problems that I've never experienced, I concentrate on solving the problem until I find a solution. I concentrate as intensely as I don't even realize someone comes by. Only that. So many thoughts come in and out in my head during the time. – Participant A I had to build up more because I always thought that my skills were not good enough. Someone who does not have an experience of feeling the joy of acquiring a skill does not know about the feeling. I go into my workshop for research at 11 pm and I do not know how long it passes until 4 or 5 am. When I'm immersed in something, I do not even know when the sun rises. Days and days when I finally find it out, I laugh loud even at 5 am, just like a madman. I enjoyed acquiring new skills while doing like that. – Participant K In this case, I simulate how to make it. When I follow a vague line while drawing various lines, at some point I see some lines that I don't understand. I have to get an answer for that, so I am immersed in it. When I'm immersed, I find clues and solutions one by one. While I am immersed in some thoughts, the thoughts are still remaining in my head even when I fall asleep. Thus, I only see that problem in my sight. – Participant K It is really boring for me when I do other things, but I do not realize how long it passes when I develop a program. When I am doing programing, designing, or soldering, I spend all night doing it without the feeling of tiredness. I feel fulfilled when I accomplish and succeed. – Participant O When I make pottery, miscellaneous thoughts disappear in my head. When I come to the workshop in the morning, I do not know when the outside gets dark. I have spent many years touching the pottery like that. – Participant P It was important to make me think about this wherever I was. When you have other things to do, you easily forget about what you were doing. So I put one part of it in my pocket, one in the car, one on the desk and one on my bed. So wherever I am at, the parts remind me of thinking about it. As a result, it became the best quality product in the world in the field of the laser medical devices. – Participant R

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	Companies in the same industry compete against each other with the similar products. When I involved in a project to develop a machine that maintains the temperature evenly distributed all over the spaces in the machine with 16 sensors. I did not go out and slept in my company for a month while developing it. I discussed with the experts all night and used all my knowledge that I had acquired in the past. Although I did not get a reward because it was not better than the products from other companies, but it has been used in my company since then. I learned a lot while doing such difficult challenges. – Participant A I did not study abroad for a long term. It was easy to acquire new things when I went abroad as a skilled worker. When I saw what others in the foreign countries were doing was similar to what I was doing, you felt confident. Anybody has to see a lot of things that others do. As I see the pros and cons from their works, it becomes the resources to develop my own work. – Participant J I wanted to see what level of skills I had. I wanted to compare my skills with others and to test myself. I participated in contests such as a contest for cutting or a fashion design contest. In Korea, I won awards in a cutting contest after 7 years and in a tailoring contest after 12 years since I learned the skills. – Participant K Although ingredients like oyster or tuna are nowadays delivered as processed, people had to do it all on-site at that time. There were 450 cooks. There were a lot of things to do because the ingredients were just coming in as raw. We did all from the beginning to the end. At that time, we bet on cutting or peeling three boxes of potatoes or fruits or oyster faster with less waste. I had a lot to win. I wanted to be better, thus practiced a lot at home. As a result, my skill was getting better. – Participant L When we bet on peeling apples, we put them on the scale first. Who peeled them faster than others with more remaining win. Otherwise, it's more waste. Thus, even though this would be very simple thing, I had to acquire the skill as a cook. I practiced it while participating in such a competition with my colleagues." – Participant L During a practice for programming, an error occurred continuously. Sometimes I still got an error even when I had programmed accurately. It was a flaw in the machine itself. So then I tried to find an alternative way while avoiding the error. I repeated and modified a little again and again over for a few days. I found a way to deal with it. – Participant R

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	As I said at the beginning, we have to learn more of the advanced hotel system and keep doing it. At that time, I could not think about what I was going to systemize. But I was only able to think that I should do better than others. As the development progresses, such things become systemized and continue to develop better processes. – Participant L I look at my work by decade. When I see the works I made before, I can realize what I thought at that time or how my temper was. At that time I liked being straight, but now I think that it is not good to be straight. I think it is an asset. I think that seeing such a difference means that I have already upgraded one step. – Participant P If you do not study, there is no improvement. I have to look at books, I have to see other's works, and I have to travel around as much as I can. You must be busy to be able to digest new things and combine those things to make a better thing. – Participant P When I brought an item to the store, the owner asked me how much I would ask for it. I called 300,000 won like other expensive items at the time. He did not ask me why I priced it that much but he let me take a look at another product, which was much better than mine. That item was even 50,000 won cheaper than the price I asked for my item. I was so embarrassed when he showed that to me. I only stayed in my world but I did not go out and see the world outside. – Participant Q When I went to the world competitions, I watched the hair shows held by the experts from the other countries. I also liked to subscribe books and magazines from there. I get a request from the central association to present the work once a year. To do that, I have to come up with a new design each time. The indirect experiences can be recreated in my mind so I can create my own design. – Participant S Even though you learn how to make bread based on recipes, you can't bake bread well if you don’t have experience of the originals. You have to go to the original place and feel it yourself. For example, you have to know the taste of baguette in France and learn how people eat it so you can express the taste. Even if you are not studying abroad, you have to eat lots of locally baked bread and then it is appropriate to make and sell French bread. – Participant T

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	Since I have done my best in my field, I have been doing a lot of improvement activities in the company such as energy conservation and introduction of automation facilities. I made some contribution to profit creation through them. Since a staff at the lower end had a lot of improvement activities, I got much recognition from the company and the government. – Participant B I started doing something creative to do my job a little better. The first thing that I focused on was to submit proposals for improvement and development to the company. When I was working, I found many new ways, with which I could make the processes better. It was good to receive some rewards as well when I wrote a technical report about the new ideas. One of the ideas that I submitted to the company was a product that helped the process of assembling the top and bottom parts. Previously, two people had to work together to put the top on the bottom. I thought if there was something to hold the bottom part, only one person could manage the work. So I suggested an idea and it worked. – Participant E There are about 800 different kinds of valves. When the valves malfunctioned, I made a manual about how to disassemble while repairing or periodically checking them. The reason for making the manual was to develop an instruction for a repair for each valve. I have written the process in detail so that people on the job can troubleshoot when problems arise in the field since there was nothing like that before. – Participant F I have always thought of how to reduce the maintenance cost, and make things more reliable. I got a chance to develop my knowledge and skills through such experiences. Things that still need to be improved are constantly coming out. While I am working in the field, I constantly encounter problems with things. Thus, I keep producing ideas. I think it's infinite to be creative. – Participant F I was trained orally from the teacher without learning the foundational theories. And I learned only one standard curve that would be for an ideal body shape. It means all clothes made with the design are the same even for differently shaped people. I had to draw different lines for different shaped bodies over and over and saw how they fit. I figured out how the drawing lines should change depending on the different shaped bodies through my own research" – Participant K

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	If you think a lot about how to make uncomfortable things comfortable while you are doing it, ideas come up and direction is decided. I can refer to other things too. I think about it again and again, compare it with others, imitate them, improve it, modify it and finally develop it. – Participant F I usually have a lot of questions and I cannot bear if I have something unclear to me. Why was this made like this? Why is this round rather than squared? Why is the height like this? Even if something was customary in the field and I did not follow what others did routinely. I did not use a machine just as it came in because it was made uniformly in the factory, not customized for my site. It did not perfectly fit to the work on the site. I thought about how to use it more conveniently to work better and then I modified it. – Participant H Even if a freezer was installed, I did not use it with the original piping system that came with it. I make a lot of corrections. People who do not know about it well may just use it like that. The vendors that supply the equipment do not like it when I ask them to modify something. Although it would be annoying and costly for them, if I do not do it, there is no improvement. That is how technology develops. Better equipment and better quality comes after as the result. – Participant H If you improve something and you get better results, you have a good feeling about it. So, if the quality is getting better and the work gets easier, then the workers are thankful and it is worth the effort. I continue to look for other problems, and there are actually a lot of problems. People just don't think about them. Every piece of equipment has defects. There is no equipment without any defect. No matter what improvements you make, another problem can arise. I have improved something over three years and then I find another problem again. There is no end to finding problems. – Participant H When you do your work, you would be able to see what and how something might be done better. The more you develop and the more you experience, the more know-how you get. – Participant J

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	I continuously tried to find ways to improve my skills further. Over time I got a lot of trainings from famous make-up institutions in Europe. From the '80s, our associations received the periodicals from a French hair institution. With them, I learned about color, design, and style, and I brought the new things into the shop for customers and I used them to teach my juniors. As my skills were continuously upgraded and updated, my customers trusted me and wanted to do their hair with me. – Participant J When I look at something, I cannot ignore even simple things. I think of how I can change that better. Such behavior made me think of registering the patents as well. For example, hooks and yokes are the devices that lock up so do not let it go down. When a person sits, the waist swells. When he stands up, the waist shrinks. So the clothes have to be flexible as shrinking and expanding. Then, there is no pressure on the abdomen. For that, I put a spring in it, and my idea became a patent registered." – Participant K I've always thought how I can do it better and differently. Compared to my colleagues, I was thinking about what I lacked, and I changed the process of working. For example, the tuna has to be melted to some extent to be ready to process. Before I worked with tuna, I went ahead and got it in advance and melt it in advance. I did my own research and improved my skills. – Participant L When I was working in the previous company, I had many ideas that I could develop with. This could be improved if I did this. There was no one in the industry doing it as well as no one was trying to. Thus, I developed it alone since there was no other expert but I knew how to use a machine or electronics. – Participant M I consider that it's the worst point when I'm doing very well. When I reach the top so I can't find anywhere to go higher, I think whether this is my limit. I have to go up for another 10 years, but I do not have enough strength. I need to be refreshed and get motivated to learn something new. That makes me more challenging, more courageous and more propelling. I think that the mind to have such trials is natural. That's good. – Participant N

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Reviewing the process and the results of work
Critical Incident	I make trial and error repeatedly. When I did something, I would see it critically. Then I find out what is lacking and I try to make up for it again. It seems that there would be no improvement if you turn around without your reflection. – Participant P The underlying skill is constantly gained through experience. I learn continuously while I keep touching the customer's hair. While I work, I keep reflecting on the way I do. What I can find is that I do the same thing speedier, or make a change in colors. As I do this constantly, I can make the customer's hair more beautifully. Through the experience, my skills are tuned. – Participant S Even though I can say that I have enough knowledge now, there is still a room to improve so I always have to learn and follow the directions. As mentioned, real skills are not limited within making bread only, but they represent the whole job as a chef. People's taste is constantly changing, so in order to handle it, I study and change materials continuously. – Participant T I had no problem when I ate the bread ten years ago. As I get older, I lose my digestive ability. Sometimes when I test bread and taste it, my stomach becomes very bad. Then, I think again and again about why it is like that, and such process is constantly going through. It takes a lot of time for making a new product. While I continue testing and find out a better way to solve the problem, I go up another step. When good results come out, I graft it all other bread as well. This is how I continue to improve. – Participant T If you just work still, you are an ordinary worker. But I always sought something more. It's self-energy. I wanted to do more and more, but I could not go beyond my work. So I looked for more work within my job, not outside of my job. I started looking for what I lacked. – Participant E I received a proposal from a company to develop a wide-ranged compressor that should bear a wide ranged temperature from -50 degree Celsius to +100 degree Celsius. It is easier if it meets only one condition such as either below or over 0 degree Celsius but the new machine needs to cover both sides. Then the engineer and I made a datasheet while doing trial runs and recorded what's happening each step. This case has not been 100% solved. We've found out the potential problems and now we are close to the development of a solid wide-ranged compressor. – Participant A

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Mastering the task
Critical Incident	When we do precision machining, we know that the results of cutting come out differently depending on the temperature. In addition to the theoretical principles, there are know-hows to make products better in practice. These are the know-hows that I can use after I know the characteristics of the machine. I have to overcome the machine. Even though I follow everything correctly but the result sometimes comes out incorrectly. It means I stay in theory. It is the know-how that combines the mechanical characteristics and the theoretical principles to produce a product. – Participant E The designer delivers a plan to me. But when I bring it in the field, it does not work as it is designed. Then I take it through a process of reproduction. I use my know-hows I have gained from my experience to change the parts suitable in the real setting. That's my skill. – Participant E When people brainstormed while doing the club activity, I did not throw any idea away and wrote all ideas down on my note. There are thousands of ideas in my note. They seem to be useless right now, but as I look at those things one by one, a new idea is sometimes emerged. There are times when some ideas for this equipment are used for another equipment. Even if it is not the same thing, I know what it implies. I have improved my skills in that way. – Participant H I need to listen to the field workers carefully to develop an item, which functions properly in the field. In order to avoid many times of making a trial and error, I sometimes have to experience it myself as well. I made a lot of improvements on the parts, which were broken easily or uncomfortable to use through the way. – Participant M The airstrip was built by connecting three islands, and when the construction started, ships transported the trucks. It was a very big project, but there was no suitable equipment in Korea. I used Japanese equipment at first, but the equipment was too small, so then I used German equipment, but the European equipment did not fit well in the domestic situation. So I almost developed new equipment. – Participant O

APPENDIX E. INCIDENT OF UPDATING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS (continued)

Theme	Mastering the task
Critical Incident	I did not even think about working on the ship but when the company had to reduce the number of employees. I had to switch my field of working from the heavy equipment assembly to the shipbuilding. When I worked in the field of the heavy equipment assembly, I was involved in all the processes of producing so that I could learn everything from the heavy equipment assembling to the test-driving. The various experiences enabled me to learn faster and grow further in the new field. I would not have grown like this if I had just been working in one industry. – Participant E Now I have skills that can make clothes to fit any body shapes. The skills that can cope with such a transformation were acquired through experience. I met various customers such as a person with hunchback or dwarf body shape, etc. Furthermore, people look like having a normal body shape but they often have unbalanced body shapes like one side up and the other side down. I would not know all the differences if I did not experience with the body types with my eyes and hands. – Participant K I've been working in many restaurants in our hotels. I participated in Busan Lotte Open Project because I wanted to do it. I knew I should try it. I went there as an open member and experienced everything from kitchen design and kitchen appliances to employee selection. You have to experience it so you can understand and talk about it, so that you can develop. – Participant L I worked for a semiconductor producing company. I tested equipment and classified the defective products. I had to do the equipment remodeling and reassembly constantly. Thus, I had to know how to operate all the equipment used in various processes of production. I have improved a lot through the practice and experience. – Participant O Wherever I went and saw something new there, I tried to make it by myself no matter how late it was when I came back. If I could not do it, I did it again. If I could not still do it, I tried it again. If I could not do it again, I did it again and again. I think I have only been sleeping 2-3 hours for about 10 years. I am always learning something new. Try, miss, try, miss, try and miss until I can do it. – Participant T

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS

Theme	Giving or receiving advice in a non-working situation
Critical Incident	The idea remains just an idea without further development. With an idea, we think about how we can apply it to the facility onsite and make a link with each idea. We select five ideas out of a hundred other ideas by giving a score to each idea. Based on the selected five ideas, we come up with other ideas. From there, we use our expertise. For example, let's increase it to sixty mm more here because of this or that reason. There was tremendous progress made by doing so. – Participant E Filtering in the painting process is important because the paint has to be free of impurities. But the defect rate was too high because it did not get filtered well. To improve it, I came up with an idea from the experience of growing bean sprout. The water comes down very slowly in the basket. I brought the idea to a company that supplied the filter. I talked to the experts at the company and we thought together about how to develop a product out of the idea. Now it is used in my company and exported to Japan as well. – Participant E There is a painting department in each factory of Hyundai Motors. But each factory has different facilities and processes because every factory produces different products with different raw materials. One day, I met a plumbing expert from another factory in a meeting. I asked him about how to clean the painting facility in his factory, and the way in the factory was different from how it was done in my factory. Their way was a better way. So we adopted their technology and changed the cleaning method in my factory. – Participant E I know only one way to do it but others do it differently. Then, I share my method and they share what they know. We learn from each other. Sometimes I buy meals to learn their skills. I have developed many skills in that way. – Participant K Although my teachers told me to do a task in a certain way, I still don't know why I should do it in that way. When things are explained in detail in my head, I go to test it with others. As the ordinary monks visit the big monk to talk to them because they want to know how much they understand the principles. It's the same. When I know a little bit here, I visit my seniors to talk to them about as much as what I know. What and how much you learn are quantitatively and qualitatively different between when you do not know anything and when you know something. – Participant K

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	I also get advice from junior workers or other experts. My way is neither always right nor the best. I can only think about it in this way because that is what I have experienced. Thus, the know-hows of others could be better than mine. Sometimes, when you hear of an idea, I realize this is better. I am still trying to improve my knowledge and skills. – Participant A The customers asked me why the bakery did not make baguettes or naturally leavened bread, which did not contain sugar. At that time, there was no sugar-free bread like naturally leavened bread. It was a sign that the consumers' preference began to change. I thought that my bread baking skill was not high enough to satisfy it. I asked the senior chefs to teach me how to bake baguette properly but they did not know well. I also read a book on baguettes. I found out that the author of the book did not even go to France to learn about it, but wrote the book by taking little excerpts from here and there. I thought it was not right. Finally, I decided to go to France to study it correctly. – Participant I You should be able to listen to others and be self-judging. When I hear someone's words, some words remain in my head. It becomes my knowledge, direction and guardian. You have to practice a lot of that so you can listen to others." – Participant N Once a French chef in a seminar said that it was impossible to make good bread in Korea. It is because water is not good for making bread and flour is different. So I went to France to taste bread there. It was actually different. In Korea, when I eat bread, my stomach sometimes hurts. However, even though I only ate baguette, honey, and yogurt every day in France for a week and I was still fine. Since then, I have studied the differences. – Participant T There was a senior tailor who succeeded in this industry and became a big rich man in Gwangju. When he visited me and I asked him how he became so successful. He said when he was working hard and he wanted to spare time even for going to the bathroom. He knew he lacked of knowledge on economy so he read a daily economy newspaper thoroughly. He also told me how he treated his customers and more. Although I did not have such experience like he did, I indirectly experienced those through listening to him. – Participant K

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	I need to find something new to improve further from here. Thus, I draw a sketch of ideas and discuss it with my colleagues. Then, we come up with a sample. – Participant M What I am grateful for my teacher was that he sent me to his teacher for further training. I realized that two teachers' teaching methods were different. It's stricter. At that time, I had already been certified as a craft engineer but it was not enough from the teacher's view. So I slept two to three hours a day for eight years and polished my skills. I did everything that the teacher told me to do. – Participant D There are a lot of SMEs with really special skills, so I often visit them after work. One day I went to a small company that delivers the painted product to us. I found they were using a little tool developed by them. The paint was sprayed like air and the result was very good. So I learned and brought it to my factory to improve results. People develop such things for their own work because they experience inconvenience while working. – Participant H In the case of French cuisine, the authenticity of being French must be alive, so you have to learn that. We have to keep in touch with the French chefs, who are doing well, get them to learn, benchmark, and do promotional events with them. We would become better if we keep it up with those things. If you do not do these things and cook foreign cuisine in our own way, you will lose the authenticity. – Participant L When I can't think about a good method by myself, I ask an expert in the field to see if I can improve it or to solve the problem or how to put it into practice by combining it with a good method. I also keep thinking about it. – Participant M When my skill was still not good enough, I visited a person who was an expert on that and asked to teach me. There was a chef who went to study advanced confectionery baking in Japan. When I visited him and it was shocking. He made chocolate so technically that I could not even copy it. I really knelt in the café and begged him to teach me. I was working in Miari and his shop was located in Gangnam. After I finished my work and arrived at his shop at 8 pm, I started to receive a tutoring from him. – Participant T

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	When someone explains it to me, I understand it. On the other hand, it is really hard for me to explain it to someone else. It is different between when you listen to what other explains and when you explain something to someone. When the foundation is built up strongly, it can be finally passed on to others. That's what I still tell the junior workers. If the foundation is strong, they can grow from there. – Participant A Know-how is a very difficult thing to be shared. For example, even if a famous chef tells his recipes to people, what people make has different taste from what the chef makes. My seniors often told me that even if they give me 10, I do not get even 5. I did not understand what it meant. That's my own skills and know-hows. The basic foundation can be shared, but what every person puts on top of it is different. The skills that can be taught is the basics, and the next thing is their own thing. – Participant A There is a difference in the acceptance of each person and the difference is created due to the foundations. Nowadays, there are diverse opportunities to learn the fundamentals systematically. There are people who do not learn the basics properly but it is easier to build techniques based on the sound foundation. – Participant J Making bread is not something to teach. Although I can give you what I know, you have to learn the basics and come up with your own colors and philosophy afterwards. People learn it at the French national school in that way too. – Participant T If you follow the recipe, you can make bread. People think it's all about how to make bread, but it's not. If you learn like that, you cannot understand the basics. You cannot develop your own ability to create something later. In Korea, many chefs do not have the ability to develop their own bread. Although they are supposed to have the ability to develop something their own, they don't even know which ingredients are good or bad for their own bread. If someone says that is good, then the person believes that it's good. People should have the sound base and develop further on top of it. – Participant T

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	I tell the junior employees that it is meaningless to learn the theory without practice. Anyone has to practice by himself with the knowledge. Otherwise, the knowledge will not be his own thing. There is a difference between understanding by listening to someone and understanding with which you can explain. When you have know-hows, then you can explain that to others. If you have experience of disassembling of something from the beginning to the end, you may be able to answer any questions about it. – Participant A Someone who practices a lot gets advanced knowledge and skills faster than others. Although something is easy to do while watching, it is actually not that easy to do when I do it myself. I tell others that no one can be better than someone who practices. If I have a presentation, I cut some wigs before going to the presentation. I also practice a lot. – Participant S I tell the junior employees to make personal notes. They would not be willing to do that because it is not easy to develop it as a habit. It's difficult, but if they do not do it, it's hard to build a foundation, and after two or three years without having a note, they'll forget the basics. I think that it is good to have a note and build one by one in order to establish a foundation properly. – Participant A There was a person who just came in the company but he did not know anything about the machine. I had to train him from A to Z. I trained him like a little child. I put a note on the machine and let him see it every day. And I let him draw things and write down the necessary information on his note. When he drew the drawing on one side, he wrote the necessary materials and tools on the other side. As the information was piled up, he would have a huge amount of know-how. – Participant A I became confident as I learned step by step. I tell the junior employees to do one easy thing everyday. As you become confident of doing it, you would want to do more. Then, you would be able to do two and three.” – Participant A You have to learn systematically so that you can take step after step. If I do not learn something that I have to learn at this level, someday I'll have to come back to learn this again. In the old days, I learned in a very harsh environment without such a thing, so I made a system for my disciples to learn skills step by step. – Participant J

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	Anyone has to step up from the first step and one step after another. It seems to be slow at first, but as you climb the stairs to some extent, the top looks closer. By that time, the person feels how gratifying stepping up from the bottom is. If you skip such steps, it seems to get to a certain point quickly, but you cannot create, apply and develop further. – Participant K The job environment will change a lot toward the 4th industrial revolution soon. I think it is better to learn not only things in my field but also related things in other fields. That's how it can be fusion. Success comes to you when you constantly develop yourself and some day people will need you. If I have something plenty, there would a lot of people who need it. – Participant B Since I have know-hows, I know how people could learn effectively. I have tried to teach a few people, but unfortunately none of them has reached to the expert level. It is because they don't have patience and willingness. No one had such mentality and attitude. One who has such mentality and attitude can only learn skills from others. – Participant D My son is also learning techniques from me and I often talk to him. I have a willingness to pass on to anyone who wants to learn my skills. But even if I want to, this technique cannot be passed on to someone if the person is not self-motivated. – Participant K You need to have personality before you learn skills. I tell my junior employees that if they give away what they have, then they can fill with something new again. I should be able to give mine and then fill my bowl with something else. At first, they do not understand what I mean. I have to take the initiative and behave first. Then, everything comes along. As they understand the philosophy of the leader, and the average personality of the company comes out. It takes several decades.” – Participant N

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	The union does not exist in my company. I am the chairman of the union. I share even small things and have fun by doing it. When it becomes a reverse triangle, it collapses. Because such a person is victorious, I teach them to be a person who can receive and distributed. When I say and act with some mind, somebody learns it. Then another leader can be created, and if that happens, it will be a good company. – Participant N I think every human being has infinite possibilities. It is not that the person can learn and grow as the teacher opens widely. If you want to learn something, then even if I give him a little bit, he can do enough on that basis. The teacher does not have to frame it. It depends on how the learner thinks and how the learner does it. – Participant P Mindset is important. Now our staffs' work clothes are always dry-cleaned and ironed. I tell them to always wear clean and neat work clothes. That's because I have the experience that if I do not wear cleaned work clothes, my self-esteem falls and I end up quitting my job. – Participant R During my 1500 times of lectures, I always took the first 30 minutes to talk about the attitude. I do not think that a lecture is necessary for people who do not have proper attitude and do not know what they are doing. After having appropriate attitude, they can be trained to learn skills with heart. Students has to have personality and attitude first and then they can learn skills. – Participant S If a certain philosophy is given to someone at school, it may limit the person’s ability. The person has to develop his own philosophy towards this work. The person chooses what bread he makes, what path he goes to, and what he wants to do. – Participant T I went to work one day and the staff at the baking department was depressed. I knew why although I did not ask. He burned his bread. He was surprised because I knew. I said it's about the technique. The attitude that makes you happy and makes you sad is the technique. You are happy if your philosophy comes out on bread, and if it does not, you will be sad. – Participant T

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Giving or receiving advice in a non-working situation
Critical Incident	The learners have to be mentally mature. When it is clear what he wants to do, then he will start to move. Words from others are not necessary. I was really crazy learning bread because I had something clear in my mind. People change their behavior according to their minds. Learning the skills is not different. – Participant T I am a professor of baking but I tell my students a lot about life. I often tell students that people break their own promise easily because no one knows about it. Even if he beats 100 people, it's useless because he cannot beat himself and cannot rule for himself. Learning and working in this industry is hard but they have to endure and continue to do it. – Participant T I do not choose a job, but the job can pick me up. I can go further with that way. No matter how much I want to do, if the job will not take me, I cannot do more. The important thing is that when I get my enthusiasm out, the job will hold me. Most of the time, my ego is weak, so I give up and leave. Thus, the objective why I am doing this should be clear. – Participant T I tell my junior employees and disciples to experience a lot. They have to see the changes while they experience. They would be satisfied that they are able to see themselves being expressed, and they become confident. – Participant K I tell them to keep what they have done in order and keep them organized. That way, one year later, they can feel the difference between the products at that point and the current product. If they do not have a record of the current state, they cannot go back to this point a year later. After a year when they see this again, they can realize what they were thinking about a year ago. This is development. – Participant P If you succeed here, then there is a high probability of being successful again in another place. But there is little chance of succeeding elsewhere, if you cannot succeed here. It is because they have such mindset and passion. The successful people know how to take their passion out. – Participant T

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Providing direct help on the job
Critical Incident	When the junior employees notice that energy consumption decreases, they ask me how it happens. I explain it with the materials that I've scrapped, the theory, and my experience. I do not just answer simply, but I explain all the things related to it, so they can fully understand why this is so logically. – Participant C When we get on the ship, there is a control unit in the wheelhouse, a control panel next to the engine module unit, and the actual product is in the machine room at the bottom of the vessel. I need to move around the entire ship to check if everything works fine. It's so inefficient to teach the skills to the junior employees. Thus, I minimized the facilities at one place so that the training of all could occur at one site. It is registered as a patent. – Participant E I cannot do all with the theoretical knowledge of hydraulic only. The knowledge becomes the basics and based on that, I add my experience. Thus, when there is a breakdown and I solve the problem, it becomes my ability. By combining the theoretical knowledge and experience together, I could develop diagnostic equipment, which the new employees can practice with before they go to the field.– Participant F It is said that you may easily forget about what you heard, you may remember a little what you saw, and you may understand what you did. So I always teach theory and practice together when I teach the junior employees. I make them practice based on the theory. I teach the theory that is directly connected to the work in the field. It is much more effective when they practice with the equipment similar to those actually used in the field. – Participant F As I have worked in the lab, the data has been piled up a lot from the small pilot experiments. I wrote a manual with the data about how to use a certain amount of catalyst, how long it last, how much time should be changed, and so on. Based on the manual, I transfer knowledge and skills by demonstrating small pilot experiments. Materials such as gasoline are invisible and moving through pipelines. Thus, I can only transfer knowledge and skills when the data exists. – Participant G I inform what I have experienced or improved with it when another factory installs the same machine. I know how to build the machine more efficiently because of my experience. I tried to improve what currently exists to continuously lower the maintenance costs. – Participant H

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Providing direct help on the job
Critical Incident	When I came in the morning and processed a tuna, it took me 9 hours to do with 100 small tasks. Then I thought about how I could shorten the time down to 8 hours while doing 80 tasks for the same process. I changed the way I did. And then, if it worked, I shared my experience with my colleagues. Then, someone else tried it as well and when it worked, others adapted it. – Participant L I teach what actually happens. I train the people who actually works in the field such as welder or pipe installer. I prepare a presentation based on what happens in the field. I show them actual photos or videos. There must be such consensus of what should be delivered and improved in the field. – Participant M There is a training program in Global Institute For Transferring Skills, Korea and I teach the students. When students practice, I hold their hands and they try to do the same. That way, it is much more effective than letting them just read or see the demonstrations. I can see that the students are growing. They also inform me that they get a certificate after the trainings. – Participant B Hyundai Heavy Industries realized that core skills have to be transferred. Thus, the company has established a program for transferring skills. About 50-100 core technologies or skills are selected and a technician with the skills teaches a junior member through one on one mentoring program. The mentor and mentee have time to teach and learn the skills. The company takes care of time and expenses. – Participant E I let my employees experience all the steps, from being a head model to participating in a competition. When one person participates in a competition this year, another person models for her. Then, the person who models participates in a competition in the following year based on experience. When the competition participant comes back with a prize, I introduce that person to a customer to build up skills with field practice. – Participant J Practical skills are handed down through the OJT in the company. It's all systemized. In our case, we send our employees to overseas offices to learn local cooking techniques. The employees get to experience all updated menus during three to six months. We have demonstration once a week. That's how we do cross-training in all areas, including Korean, Chinese, Japanese, and bakery. – Participant L

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Providing direct help on the job
Critical Incident	Skill transfer is not something that happens overnight. I asked the country to send five talented people to my company. If I teach them here and they go back after 6 months to 1 year of training, they can transfer what they have learned here to people in their country. I make this learning model myself. I donated bakery equipment and taught people there how to use the equipment, repair the equipment, and transfer baking skills step by step. They can demonstrate the production of the equipment now. – Participant N I teach students to make their own and to think based on their experiences. I also make a manual to teach the theory and practice. At first, students do not know anything, but they learn the theory, understand the principles, and pull out the things they designed and assembled and designed. Then the result comes out well as they are intended, and it is experience. It is the technique that can be applied immediately in practice. – Participant O There are a lot of variables in 3D printing. I give feedback right away and let them think about why the product does not come out in a good shape. I give them feedback on what to do about the areas in which the problem occurs and what to check. When they do it again, the quality of the output definitely changes. The students realize when they check the small part carefully, and then the printed item comes out better than they think. They experience how important the person's ability is to control the quality of the outcome. – Participant O New entrants are continuously hired, so we continue to teach. The team leaders take charge directly in the field, and the skilled engineers teach skills one on one. I do the collective training for two hours every two weeks. I teach the basics with my experience. I constantly repeat what they have never experienced yet. So they can have some experience indirectly. – Participant R Others are amazed at how a company only with young people makes a product which needs the highest difficulty level of skills in the world. I've created a process that makes it possible. Another thing is that our company has very few non-production and management positions. I train all employees to do all of these things themselves.” – Participant R

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Providing direct help on the job
Critical Incident	When I teach my junior employees, I refer to a lot of things I experienced in the past. I was studying alone because my senior employees did not teach me much about the principles of electricity. It took me a long time to get to understand it by myself. There are a lot of limitations to teach one by one in the workplace. So I made an internet blog and share a lot of the stuff that I have. I teach them when they ask about what they want to know on the blog. Using such sources, I think it can make easier for my juniors to learn by themselves than I did. – Participant B I make students to think about something by them. For example, there are solar power plants promoted as eco-friendly energy all over the country. However, it is not all about it. Students who are interested in it, they research themselves what is the advantage of it and what is the disadvantage, and then think about what they could do to improve such disadvantages. I help them to find the way that they can develop their curiosity. – Participant B I send my employees out for a market research. There is not a single person buying bread that he knows and can make. They buy only the bread they cannot make or they have never seen before. Then I ask whether they can make the bread that they think they can make well. Knowing how to make something new is not the same as having another skill. I know one way of making it, but when I find someone who does it differently, I have to think about why and how that person makes it differently. If someone else's method is better, I need to study why, and this should be the point of learning. – Participant T When I meet with designers and workers, I learn a lot from listening to them to talk about their know-hows. However, there are many things that do not make sense to the recipient who has little experience or less knowledge and skills. When I teach skills, I have to make sure whether the recipient can take it. It has to be digested. – Participant E In order to know the eye level of the learner when I teach skills, I need to have knowledge about them. I have to give a customized lecture. It should not be all that I teach what I've been doing for 30 years. They should not follow the way I did. – Participant E I teach the basics. Skills are what someone gets from his own efforts. I cannot continue to hold their hands, so all I can do is to help them build the base. I give feedback and help them to build a solid foundation. More than that, they have to learn by having a feeling of what it is. – Participant Q

APPENDIX F. INCIDENT OF SHARING DOMAIN-RELATED OCCUPATIONAL KNOWLEDGE AND SKILLS WITH OTHERS (continued)

Theme	Providing direct help on the job
Critical Incident	It is not easy to analyze the exact cause and respond in a short time. In most cases, I cannot conclude that this is the cause of the problem as soon as I see the problem. So I teach others how to diagnose using a step-by-step process. As they become more experienced, they would be able to develop their own problem-solving process. – Participant F It is the difference between I simply buy fruits for them and I teach them how to plant trees. They can learn to pluck fruits at any time. They better learn how to plant trees and make the trees bear fruit. It is not important now for students to make baguettes. They need to know how to make the ingredients mix, and how to change the ingredients according to the situation. What kind of bread is to be made is decided by learning how to develop the scheme. – Participant I Knowledge of material science is, for example, essential to making bread. I teach my junior employees the foundations first. The junior workers know how to make their own formulations. Then, it is the foundation not only for making baguettes but also for making any bread. The knowledge aspect of skills is really important. With a skill alone, copying is possible, but without knowledge, it is not easy to be creative beyond that. – Participant I If they have difficult problems, they bring them to me. Because I know everything, I can present how to do it and coach them to overcome difficult points. The employees learn by watching what I do. – Participant R The engineers in our field are sometimes lacking the theoretical foundation. The problem with it is serious. Without the foundation, there is a limit to further development while learning techniques. Someone cannot build up fast. Someone has to know the principles of materials, power, mechanics and etc. Thus, I give the trainings focusing on the theories to the employees, and I teach them how to use the knowledge after learning that. As these things are gathered together, the unsolved problems can be solved. – Participant R I tell the junior employees my experience rather than I teach knowledge and skills. I just tell what was good and what was not good when I did that. I rather ask them what they think. I listen to them a lot. I think if I say 100 words at the level of my eyes, they can only get 10 words. I have to talk about something depending on the level of the person. – Participant H