LEARNING SAFETY IN THE WORKPLACE: A CASE STUDY OF PETROCHEMICAL WORKERS

IN SINGAPORE

BY

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A thesis submitted in partial fulfilment
of the requirements for the degree of
DOCTOR OF EDUCATION

GRIFFITH UNIVERSITY, AUSTRALIA

2017

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ABSTRACT

The ability to work effectively, including being able to identify changing circumstances and respond to them efficaciously, is an enduring goal for workers, workplaces, and governments. One key element of the ability to work effectively is working safely. The oil and petrochemical industries are amongst the most hazardous and risky environments where failure to understand and maintain safe practices can lead to potentially disastrous consequences. Hence, workers must engage in continuing learning at work to maintain high standards of safe and effective work practice.

In workplaces, individuals constantly influence and adjust to each other's emerging behaviours, ideas, and intentions, including artefacts and objects through a myriad of complex interactions and fluctuations. Unlike most classroom-based learning which transpires in predefined context, all these social processes in a workplace can have profound impact in shaping learning and practices within the organizational members. In line with such considerations, the primary contribution of this research is to understand how safety is learnt in the context of everyday work circumstances.

This thesis addresses the conundrum faced by high-risk organizations to maintain high levels of safety and avoid workplace accidents. The main research question guiding this study is: How can workplace learning be optimized to develop and sustain occupational competencies for workplace safety and health? This will be explored through three sub-questions:

1. What are the current provisions of learning for safety and health in a process plant?
2. How do workers engage and participate in workplace learning for safety? and
3. How can their workplace learning be optimised?

A case-study approach was adopted for this inquiry to explore how site operators learn to work safely during everyday work at a petrochemical plant in Singapore. The inquiry entailed in-depth interviews with 20 site operators working in various technical roles at the work site, across an 8-week period. The aim was to identify exemplary practices that contributed to and enhanced their learning and performing tasks safely.

Findings from the interviews provided rich insights into an array of institutional, social, and personal contributions and imperatives that serve as important bases for appraising the pedagogical and invitational qualities of the workplace in supporting learning and practice. These salient contributions exemplified how workers mediate their learning through participation in different practice arrangements, utilisation of artefacts and materials, as well as seeking guidance from intermediaries and social agents who provided pedagogically rich

learning. Furthering these, the study posits that learning to work safely in a perilous workplace and trade will need to be contextual, interactional, relational and, more importantly, supported with legitimate and quality guidance.

Drawing on these findings, the study highlights four distinct qualities that characterise how learning for safe work practices is supported and developed during work circumstances.

These include:

1. Considerations for circumstantial and practice requirements
2. Legitimate and appropriate guidance
3. Interactive and informative pedagogies
4. Relational and purposeful alignment with personal and organisational goals.

A learning framework is developed to facilitate these considerations through the intertwined relationship of workplace, agency and safety as a situated form of knowledge. Ways to enhance workplace learning and advance safety practice are proposed. These include advocating the need to leverage the workplace as a learning space to re-contextualise knowledge that will enhance congruency between theory and practice; effective utilisation of those social-cultural imperatives for reaffirming procedures and refine practices; and creating spaces for dialogic exploration (Freire et.al, 1997) and strengthening relational agency (Edwards, 2011) to deepen workers' thinking skill for occupational efficacies and achieve intersubjectivity (Alterman, 2007) consensus for safe working.

Overall, this study enriches understandings of how workers situated in perilous work settings learn to work safely in specific or situational work circumstances. The findings suggest effective interventions to enhance occupational efficacies and organizational performance in safety practice. At a national level, the study contributes to refinement of the continuing education and training (CET) framework, curriculum design and reinforcement of practices that augment individual and organisational learning. Further research is recommended to investigate how the proposed interventions and pedagogical strategies effect learning and practice outcomes in similar high-risk workplaces to draw more conclusive generalisations on ways to enhance workplace learning for safety practice.

STATEMENT OF ORIGINALITY

This thesis has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

This thesis is less than 80,000 words in length, exclusive of tables, figures, references, and appendices.

Kristine Yap

1/12/2017

Date Signed

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DEFINITION OF TERMS

BizSafe Program	A five-step programme to assist companies in developing their workplace safety and health capabilities and improve safety standards at the workplace.
Process Industries	Referring to industries and sectors encompassing companies that are involved in the oil and gas, petrochemical, and specialty chemicals processes, as commonly classified in the context of Singapore.
Workplace Safety and Health (WSH)	It is noted that different terms of references are used internationally such as occupational health and safety (OSH) in the United States, and health, safety and environment (HSE) in the United Kingdom. For the purpose and discussion in this study, the term Workplace Safety and Health (WSH) will be referred to generically as “safety” which encompasses all safety and health-related issues.
Workforce Skills Qualification (WSQ)	A national system set up as a credential framework to enhance the professionalism of safety and health standards, and promote labour market flexibility and skills portability.
Workplace Risk	Generally refers to the likelihood of a hazard that will cause specific bodily injury.
Workplace Hazard	Generally refers to any sources or situations that have the potential to cause bodily injury or ill-health.

ACKNOWLEDGEMENTS

It does not matter how slowly you go, so long as you do not stop.

- Confucius

While this research is undertaken as the researcher's thesis study, it was also a sponsored project by the Institute of Adult Learning (IAL), a government agency in Singapore that is a pioneer in developing capabilities and professionalism of adult educators, and the continuing education and training (CET) sector where the researcher previously worked as a research officer. A special thanks to the Institute for the sponsorship and, more importantly, a placement opportunity to undertake a research career that provided me with valuable learning opportunities and professional experience in research work.

My sincere thanks to my supervisors Associate Professor Sarojni Choy, Professor Stephen Billett, and Dr Helen Bound for their extreme patience in providing valuable guidance, encouragement, and support throughout this journey. I truly appreciate their nurturing thoughts and words to continue walking the path, particularly during those umpteen moments when my perseverance was constantly challenged by personal and work demands.

To my colleagues who have generously shared their valuable perspectives and knowledge on the subject matter and personal experiences of their academic journeys as words of encouragement, I am very grateful.

My deepest appreciation also goes to the company and participants who agreed to participate in this study despite their demanding work schedules. Without their consent and facilitation, this study would not have progressed as planned.

Thanks to my parents (especially Dad) who believes in providing his children with equal opportunities regardless of gender: I was privileged from the pathway with good education that has developed me personally and professionally.

And most of all I extend my thanks to Kee Chong, my husband and critical friend, for the unconditional and unwavering support since I embarked on this difficult journey.

CHAPTER 1: BACKGROUND AND CONTEXT

1.1 THE WORKPLACE SAFETY AND HEALTH CONTEXT

The ability to work effectively, including being able to identify changing circumstances and respond to them efficaciously, is an enduring goal for workers, workplaces, and governments. A key aspect of working effectively relates to safety, including the ability to work safely. Apart from understanding and exercising a set of identifiable practices held to constitute safe working, the ability to understand and work safely when engaging in new tasks or non-routine practices as the circumstances of work change, is also essential. So, more than well-rehearsed procedures, there is a need for the development of principled understanding and honing of practices that can assist safe working in contemporary work circumstances. This is never more important than in occupations where there is high risk to workers themselves or those whose needs they address. Workers in the oil and petrochemical sector are examples of such workers. Major worldwide accidents such as the Chernobyl catastrophe, the Bhopal disaster in India, and the Deepwater Horizon oil spill in the Gulf of Mexico highlighted the importance for workers on site to possess adequate knowledge and skills to perform their tasks safely. For workers in these perilous work environments, failure to understand and maintain safe work practices can have potentially fatal consequences. Hence, enacting and sustaining safe work practices is critical given that a single event could potentially lead to dire consequences for nearby populations.

High-risk workplaces such as petrochemical plants have been an important focus for research into safe ways of working with their distinctly perilous work setting and demanding working conditions (Kane, 2010; Khdair et al., 2011; Mearns & Yule, 2009). According to data from the United States' National Health Institute Survey (NHIS) for occupational health (2015), workers employed in mining, oil, and gas extraction industries were found to experience prevalent exposure to potentially harmful physical and hazardous chemicals (www.cdc.gov/niosh/topics/nhis/mining.html). Many of these workplaces rely on and utilise a large body of regulations and exploit reliable systems or technologies to manage unfamiliar possibilities and accident prevention. These processes involve individuals and groups who are engaged in safe work practices to be provided with the support to manage complex production process and maintenance of the plant. However, different kinds of workers, such as site operators and corporate executives, may have distinct perspectives and knowledge about how this work is done safely. This is because they possess knowledge that is specific to their professional roles and backgrounds (Argote & Ingram, 2000). Yet, their interdependent work relationships warrant the need for collective understanding and the ability to appropriate their practices within the prescribed rules and procedures.

Adequate training to prepare workers with the necessary safety knowledge and skills thus forms an important consideration for these workers and workplaces. However, as the oil and petrochemical industry worldwide has a common practice of contracting construction, maintenance, and drilling work, the precise nature of training or learning in such workplaces and its currency and quality are often difficult to determine and monitor. Contracted or casual employment arrangements mean that workers may be afforded, and experience, different degrees of accessibility to training and learning opportunities. Such disparities became discernible in Singapore where a considerable proportion of the workforce comprises foreign workers from various cultural, ethnic, educational, and language backgrounds. According to the latest Ministry of Manpower figures (Ministry of Manpower, 2016), the number of foreign workers is currently about 1.16 million (excluding those working as domestic helpers) employed in various Singaporean business sectors, as illustrated in Table 1.

Table 1
Breakdown of Foreign Workers in Singapore

Foreign Workforce Numbers					
Pass type	Dec 2012	Dec 2013	Dec 2014	Dec 2015	Jun 2016
Employment pass (EP)	173,800	175,100	178,900	187,900	189,600
S Pass	142,400	160,900	170,100	178,600	179,400
Work permit (Total)	942,800	974,400	991,300	997,100	1,009,300
Work permit (Foreign domestic worker)	209,600	214,500	222,500	231,500	237,100
Work permit (Construction)	293,300	318,900	322,700	326,000	326,700
Other work passes	9,300	11,300	15,400	23,600	26,300
Total foreign workforce	1,268,300	1,321,600	1,355,700	1,387,300	1,404,700
Total foreign workforce (excluding foreign domestic workers)	1,058,700	1,107,100	1,133,200	1,155,800	1,167,600
Total foreign workforce (excluding foreign domestic workers & construction)	731,300	748,100	764,500	780,300	790,800

Notes:

1. Data may not add up to the total due to rounding.
2. "Other work passes" includes letter of consent (LOC) and training work permit (TWP). Training employment pass (TEP) was included in "Other work passes" from March 2014 onwards.

While specific data on the actual number of foreign workers in respective sectors are not public, a press release in 2014 indicated that the top 10 industries that employ most foreign workers include high-risk industries such as construction, marine, and the

petrochemical sectors (The Straits Times, August 2014). A diverse workforce such as this potentially makes workplace practices and communications more challenging, and demands different kinds of pedagogical practices to effectively engage and assist workers in learning and developing their occupational knowledge. It is, therefore, important to understand how best workers can participate in workplace learning to learn through structured and unstructured provisions primarily in and through work that advance their skills and knowledge to safely manage workplace risks and hazards.

Anecdotally, petrochemical companies in Singapore tend to regard training seriously and take pride in promoting best practices in workplace safety and health. Workers from this industry are generally expected to demonstrate high levels of awareness and positive orientations towards enacting safe practices at work. In comparison with the other identified high-risk industries such as the construction sector, workplace fatalities in the petrochemical industry were reported to be comparatively lower in the national workplace safety and health report in 2015 (see Appendix A). This suggests that the industry has effective systems and processes, and workers are well prepared for workplace safety and health risks. However, recent cases of explosions which occurred in different petrochemical plants and gas manufacturing factories between 2011 and 2016 in Singapore (see Appendix B) reinforce the need for workers to appraise their safety competencies to further minimise workplace risks and hazards. Other than systemic processes and practices that could potentially minimise injury and fatality, most workers rely on everyday practice as a primary avenue of learning. It therefore becomes important to understand how such learning can effectively occur through work circumstances (i.e., workplace learning) and how it can contribute to improving workplace safety that will assist in preventing potential injuries and fatalities. Accordingly, learning in the workplace underpins the theoretical foundations of this study.

1.2 THE WORKPLACE AS A LEARNING SITE

Training in safety has a long history in contributing to worker competency and subsequently limiting workplace injury (Belwal & Haight, 2009; Yang et al., 2007). Indeed, training is essential to develop workers' competences in recognising hazards and risks, and their capacity to take necessary precautionary measures to prevent occupational accidents and injuries caused by unsafe practices in workplaces (Belwal & Haight, 2009). It follows, then, that the focus of much current training to improve safety performance centres predominantly on classroom-based teaching that includes standardized approaches to assessment of these capacities. While such training focuses on preparing workers with propositional, technical, and procedural knowledge about compliance standards and effective utilisation of protective instrumentation to mitigate workplace risks and hazards, learning needs to continue in practice settings. Research on

safety has ascribed it as a set of practices materialised through competences which workers learn during their engagement and participation in everyday work life (Baarts, 2009; Lukic et al., 2010). Earlier studies by Gherardi and Nicolini (2002) concluded that the practice of safe working is a social process in which workers, technology, values, and other symbolic forms are embedded in the process of knowledge and competency development. So, beyond training interludes, there are other and salient means for developing the capacities for working safely.

Workplaces are now widely recognized as legitimate sites for learning occupational knowledge, where individuals construct and negotiate their work identities and learn about both personal and collective agencies at work (Eteläpelto, 2008). Hence, vocational learning is seen to occur beyond academic study through everyday practices during work. According to Raelin (2008), such learning can influence interpersonal and team relationships, professional behaviours, and work activities. Appropriate knowledge and competencies are developed through mediation within the social, cultural, political, and ethical contexts of practice thereby making learning occupationally and socially meaningful. Hence, workplaces are increasingly recognized as sites to provide important economic and social outcomes.

Importantly, there is a need for safety practices to be understood in the circumstances of work. This includes understanding the particular set of parameters for such working and the array of potential risks, hazards, and consequences of unsafe working. All of this adds a particular dimension to learning in and through work. Beyond the development of knowledge and procedural competence, there is the need to develop appropriate dispositions for working safely. We need to understand more about how these capacities (i.e., understanding, procedures, and dispositions) can be developed through work-related experiences. For the sake of effective work, including its safe conduct, it is necessary to understand how these capacities can be developed initially and sustained within workplaces. This study provides informed views of how capacities for safe working are developed and acquired through participation in work activities.

Workplace learning also resonates with the theorization about situated learning which posits this learning as situated in a particular context and embedded within a certain social and physical environment (Lave & Wenger, 1991) such as a workplace. While the emphasis is premised on the social process in which knowledge is constructed, another important quality focuses on learning through doing the tasks or activities. As learning to work safely involves the process of physically performing tasks, it also resonates with the importance of contextual and social influences as individuals participate and interact with their practice community that in turn shapes and guides their thinking and action. In other words, learning to work safely can be seen as a form of situated practice.

Essentially, the theoretical considerations advocated in both workplace and situated learning serve important bases that support the intent of this thesis. On one hand, workplace learning theory focuses on (a) examining the different dimensions of learning in relation to the pedagogical qualities and contributions of workplaces as sites for learning; (b) the significance of dispositional and agentic attributes of workers; and (c) their reciprocal relationships in effecting safety learning and practice. Situated learning theory, on the other hand, contributes to understanding how workers act in safe ways through and at work. These theoretical bases underpin the research on how safe working is learnt through everyday practice in workplaces.

1.3 THE PURPOSE AND RESEARCH QUESTIONS

The oil and gas industry all over the world remains a lucrative source of revenue and contributes significantly to economic performance in any economy, primarily by generating high returns of investment to support economic growth, at the same time providing viable and well-remunerated careers for its workers. The oil and gas industry in Singapore is an integral part of the local economy, contributing on an average of about 5% of its gross domestic product. In 2015, the sector was also ranked among the top ten industries by the World Trade Organisation, contributing to a total output dollar of SGD78 billion and creating 25000 jobs locally (Singapore Economic Board, 2016). A centrepiece of the industry is the development of Jurong Island that alone has attracted over S\$30 billion investments and houses more than 95 leading petroleum, petrochemical, and specialty chemicals companies from all over the world. As Singapore continues to actively promote sustainable growth and strengthen the competitive edge of the industry, there is a major focus on about enacting safety practices and standards in these industries.

Recent years have marked many changes to reform in workplace safety and health practices in Singapore. Mitigating and reducing workplace injuries and fatalities has been a strategic goal and a way of improving enterprise productivity. This inevitably led to the attention on developing workers' competencies to work safely. Moreover, the government's devolvement of training functions and imposition of tighter regulations to manage national workplace safety and health now impose individuals and enterprises to take greater ownership in capability building. One critical aspect is to examine how ongoing learning can be supported in workers' everyday work circumstances. Given that working and learning are interwoven, the inquiry presented and discussed here focuses on examining an array of institutional, social, and personal influences that are embedded in those work circumstances, yet make useful pedagogical contributions. In particular, the investigation sought to understand possible tensions that workers experienced in reconciling those social and cognitive influences how they mediated for learning and practice. Key learning imperatives are critically reviewed to

consider their pedagogical contributions and ways to further advance the learning and practice of workplace safety in Singapore.

To address the conundrum experienced by high-risk work organizations in maintaining high reliability and resilience to mitigate workplace accidents, this research examines how safe working is learnt and practised in perilous work environments and trade. It is informed through a case-study approach. The following research question was posed to realize the objective of the study:

How can workplace learning be optimized to develop occupational competencies for workplace safety and health?

The sub-questions serving to guide the investigation are as follows:

1. What are the current provisions of learning for safety and health in a process plant?
2. How do workers participate and engage in workplace learning for safety?
3. How can their workplace learning be optimized?

It is important to highlight that this study is not intended to disrupt, deny, or undermine the important contributions of formal safety training that have traditionally been a popular approach to learning safety. Rather, this research brings attention to how safety learning extends beyond classroom setting. The study seeks to acquire in-depth knowledge of the learning process and outcomes that continue in workers' everyday practice. The view is that understandings can contribute to better provisions and more effective participation in workplace activities to support the learning and practice of safe working.

1.4 METHODOLOGY

A qualitative case-study approach was adopted for this research in a petrochemical plant. The focal point of the phenomenon investigated was centred within a bounded physical and social context of the petrochemical plant. As the selected case site features similar characteristics to other petrochemical plants in terms of its work processes, structural architecture, and production facilities, it is potentially a good representation of a typical petrochemical work setting. Moreover, its exemplary safety performance is well considered to provide insights on good practices that will enhance the investigation and contributions of this study. A study is concerned to gain rich understanding of individual experiences and perspectives of those

working in perilous work settings, it is consistent with the objective of a case-study methodology (Creswell, 2013; Yin, 2009).

The inquiry entailed a series of interviews with 20 site operators to draw on their learning experiences through circumstances of work. The face-to face interviews provided opportunities to investigate possible workplace discourses and idiosyncratic issues that may be covert thus remain unnoticed in workers' everyday practice. The conversational approach also allowed participants to express their views and perspectives. This was instrumental in eliciting insights about their interests and intentionalities that formed the basis of their agency. Details on the design instrumentation, procedural, and subsequent data-analysis processes are fully explained in Chapter 3.

1.5 KEY FINDINGS

Essentially, the case study establishes that a deliberate, controlled and structured pathway of learning safe work practices is critical to meet the demanding situational and practice requirements in high-risk work contexts. The different facets and ways of learning to work safely are organized and discussed based on six broad themes:

1. safety training for skills currency and effective communications
2. appropriateness and quality of expert guidance
3. practice pedagogies for knowledge distribution
4. everyday practice for skills and knowledge refinement
5. artefacts and materials for reinforcing awareness and compliance
6. disposition, values, and goals as agentic impetus.

Building on these six themes, the case study stresses that learning to work safely is grounded in four important dimensions: a) deliberate and structured processes to support learning and practice; b) utilisation of intermediaries and social agents to validate and facilitate knowledge circulation; c) utilisation of artefacts for correct ordering and organisation of information; and d) personal agency as agentic impetus. More specifically, learning to work safely evolves through close supervision, controlled observation, routine practice, problem-solving and self-directing as workers engage in social interactions and goal-directed activities in their circumstances of work. Discussion of these different dimensions of learning and work suggests that they should not be viewed as distinct entities, but as intertwined to reinforce and refine workers' understanding and skills about safety practice.

Overall, the findings from the study established that workers' learning and practice is shaped and transformed by an assemblage of material, social, discursive, and historical

conditions and relations. The findings suggest that learning and practice of safe working in a perilous workplace and trade are characterized by three distinct attributes:

1. Learning is a collaborative process that is co-constructed through a process of social interaction to maintain a shared conception or understanding.
2. Learning is situated within a particular context that is dependent on how individuals cognize and make sense of what they experience within the given context.
3. Individuals construe and construct their own meaning and knowledge based on personal experience and epistemologies as they learn, albeit aligned to the site's expectations and values.

Practical implications of the findings are discussed in consideration of the appraised qualities and attributes of workplace learning to improve safety practice in precarious trade and workplaces. In particular, the findings draw attention to the following imperatives which are critical to shaping and guiding workers' learning and doing:

- Considerations for circumstantial and practice requirements.
- Appropriate and legitimate guidance
- Interactive and informative pedagogies
- Relational and purposeful alignment with personal and organizational goals.

This case study proposes that workplaces can afford rich learning where workers can apply safety knowledge meaningfully to their work that will deepen learning; the need for workers to engage in reflective practice and appropriately align learning with organisational goals; and leverage social-cultural impetuses to reaffirm and refine knowledge and skills. More importantly, rigorous appraisal of learning provisions is essential to achieve the intended learning outcomes, address inappropriate judgment, and extend opportunities for reflective learning. This study reiterates that institutional support plays a critical role in implementing effective interventions. Possible interventions include provision of supportive structural processes, bridging practices and workplace artefacts. As a unified approach, these interventions will provide rich pedagogical contributions that will seamlessly create spaces for knowledge circulation and reaffirmation of practices within the bounded context of the work community.

1.6 SIGNIFICANCE OF THE STUDY

High-risk industries are often governed by a myriad of rules and regulations as precautionary measures to guide and maintain safe work practices. Hence, workers in these industries may

face certain restrictions and limitations in their learning and practice to meet the prescribed standards or practice requirements. As workplaces become important sites for learning, this case study identifies dominant workplace pedagogical qualities, discourses and nuances that are pertinent to provide workers with continuous learning for safe working in their everyday practice and work circumstances.

The learning and ability to work safely is complex as it entails both thinking and acting elements. Hence, a changed behaviour does not necessarily imply that learning has occurred; nor is it a testament that the individual is deemed a “safe” worker and will, therefore, act consistently with the prescribed standards. The change could result from the pressure to conform to regulatory requirements to maintain one’s employment. While the act itself is often the desired outcome that can be visibly assessed as capability to work safely, the change may not necessarily imply that the individual is able to appreciate the importance or to unfailingly act safely in all circumstances. Therefore, it is necessary to understand the quality and outcome of the learning that is shaped and determined by an array of situationally specific factors. The situational factors may not always be apparent and fully appreciated as being critical; rather, they may be seen as routine work requirements or even overlooked because there is much emphasis on particular overt behaviours that demonstrate safe practices rather than the learning process or experience (Machles, 2004). Such situations are more distinct in perilous work settings where the act of doing is constantly monitored, given engaging in unsafe behaviours could have dire consequences.

As foreshadowed, the significance of this study lies in enriching the understandings of how workers in perilous work settings learn to work safely where their learning occurs in specific or situational work circumstances in everyday practice. Unlike in classroom settings that can be pre-defined or replicated, learning that occurs through work circumstances may be incidental. Thus, in workplaces, workers are constantly faced with tensions between compliance and making effective adjustments to meet specific circumstantial requirements.

Three primary contributions of the study are presented. First, the study expands our perspectives to look beyond the conventional approach of didactic and classroom learning as ways to circulate safety knowledge. It reiterates the need to consider competing discourses that may contribute to individual repertoire of safety knowledge, both explicitly and implicitly particularly as workers’ learning continues in circumstances of work. Second, it provides rich insights into how workplaces that are bounded by myriad of rules and regulations can still afford effective pedagogical support for learning and practice through deliberate institutional affordance and interventions. The study informs about those salient workplace discourses and agency issues that impact on workers’ learning and are not readily observed or understood under those social surveillance and control settings in workplaces. Finally, the study provides

insights into personal and agentic influences that form workers' intentionalities to learn and work safely. These attributes may be overlooked or receive little attention because most safety related studies are centred on overt or changed behaviours. In all, understanding these different dimensions of workplace learning can help organisations to develop effective interventions to achieve greater intersubjectivity consensus and realign individual learning trajectories to meet organisational goals for safe working.

1.7 STRUCTURE OF THE THESIS

This thesis comprises six chapters. This first chapter presents an overview of the background and context leading to the purpose of the research on an examination of institutional and systemic imperatives that shape the current workplace safety and health practices in high-risk industries. It then explains how workplace learning can contribute to enhanced safety practice.

The second chapter presents a review of key literature and discusses some of the important theories and concepts surrounding workplace learning and their implications for safety practice. The aim of this chapter is to draw relevant insights from the literature as basis to approach the inquiry and address the research questions underpinning the study. A conceptual framework for the research is then presented.

The third chapter explains why a case study serves as a purposeful methodological approach for the study aiming to capture the rudiments of workplace learning in a perilous work setting. The approach is argued to be appropriate as it explores individuals' learning experiences. Data-collection procedures and analysis are discussed in respect of how the participants are selected and the merits of in-depth interviews. This follows a description of thematic analysis approach used to extract the key findings of the study. The strengths and limitations of the methodological approach and procedures are also addressed.

In the fourth chapter, the key findings from the study are drawn out and discussed in relation to implications for safety practice. The findings suggest six dominant dimensions that contributed to workers' learning. An overall summary outlines key provisions of learning that occur in perilous work settings.

The fifth chapter discusses practical implications for improving safety learning and practice particularly in perilous workplaces and trade. Possible tensions and constraints are also discussed.

The thesis concludes with a summary on contributions to advance current knowledge on workplace learning for safe working.

CHAPTER 2: UNDERSTANDING WORKPLACE SAFETY PRACTICE

2.1 INTRODUCTION

The purpose of this chapter is to elaborate the basis through which to conduct an informed inquiry of learning to work safely. Principally, the research questions were shaped by this literature review on how safety is learnt through individual work circumstances in the workplace. There is a dearth publication of academic research on the application of workplace learning specifically in the context of safety and health practice in Singapore. This review drew insights from a range of literature on safety research, and workplace learning theories to secure a comprehensive and substantive theoretical base to inform learning and work in the field of safety and health.

Conceptualizations of workplace learning vary significantly within the array of diverse literature on different facets of learning in workplaces. While some (Hager, 2004; Engeström, 2004; Wenger, 2000) centre on where learning takes place, others (Billett & Smith, 2007; Fuller & Unwin, 2004; Raelin, 2008) focus on how the process of learning transpires, attributing it to the learning structures, strategies, or idiosyncrasies of the learners. These different theorizations of learning are pertinent to extend our understanding of how safety is learnt and practised in workplaces because they offer different perspectives and accounts of learning as a complex phenomenon.

This chapter comprises two major sections. In the first section, discussions focus on the development of workplace safety and health practices in Singapore. The purpose is to inform and understand how workplaces can provide support for learning and practice of safe work. In the second section, three salient dimensions for understanding this phenomenon that are evident in the literature are discussed. The first dimension pertains to the theorization of safety knowledge with respect to how it is being defined and represented in the context of the study phenomenon. This helps to understand how different forms of safety knowledge are developed, and guide practice and behaviour. With the workplace being an important context for knowledge distribution, the second dimension draws attention to examining its role and pedagogic qualities in contributing and supporting learning and practice. The third dimension illuminates the importance of learner agency to explicate individual decisions and actions in response to the physical and social workplace environment. Learner agency has significance in shaping and realizing learning and performance outcomes.

In Singapore, workers' learning is governed by the National Training and Development framework.

2.2 NATIONAL TRAINING AND DEVELOPMENT FRAMEWORK

Building and sustaining workforce competitiveness is necessary to achieve economic growth in Singapore. Established in 2004, the Workforce Singapore (WSG, formerly known as Singapore Workforce Development Agency) was established to take the lead role in national manpower development. This is being achieved through collaborative efforts with key stakeholders such as employers, industry leaders, unions, and training organizations. Central to its core function is the development of the national continuing education and training (CET) infrastructure that leverages industry engagement and expertise to realize manpower development in various economic sectors. Subsequently, the Workforce Skills Qualification (WSQ) system was introduced as a credential framework based on national standards developed by WSG, the then WDA in collaboration with national industry spokespersons. The aim was to enhance:

- the professionalism of the industry; and
- labour market flexibility and skills portability in growing industries with high demands for skilled workers and professionals (WSG, 2017).

To date, there are about 33 industry-recognized WSQ frameworks in place that are designed to enhance the competitiveness of Singapore's workforce. Respective industry and training councils were set up to provide guidance in validation of the skills standards, assessment strategies, and training curricula under each of these frameworks. An industry competency map, competencies standards, and curriculum as well as the set of recognized qualifications are included in each framework. Apart from building the foundational skills, such as workplace literacy and numeracy, which are generally more generic and portable across all industries, the frameworks also aim at building and developing industry-specific skills. The fundamental principle underpinning the WSQ is to provide a vocational and competency-based training framework that embodies industry-driven standards development and an agreed set of national standards to ensure its relevance as a credentialing system to support the nation's continuing education and training development.

To ensure that workers are competent to carry out their work in a safe manner, a national training framework designed to enhance workplace safety standards and professional development is integrated in the WSQ framework. The development of the Workplace Safety and Health Professional WSQ framework aimed to provide a structured advisory approach to raise the national level of safety practices and competency development at all levels. Many of the programs introduced under the framework are industry specific and delivered through structured training. To date, there are about 40 different programs introduced under the workplace safety and health framework. Specific training provisions are designed to deliver

expected competency outcomes that meet occupational needs of different levels of workplace safety and health personnel. This equips workers with relevant skills to effectively implement safety systems and processes. These competencies are organized into two categories that are broad as well as industry specific. Broad based categories focus on basic skills and management tools that are perceived to be portable across industries. They include basic procedures and identifying hazards. The others are designed to be trade specific and relevant to a particular industry, work condition, or occupation, for example rigging work in construction. Some elements of this training are also mandated to inculcate safety consciousness or ensure quality standards are maintained. The Oil and Petroleum Safety Orientation Course (OPSOC) is one such example which is mandatory requirement for workers employed in the oil and gas and the petrochemical industries. Successful completion of the course ensures workers are adequately trained and prepared with the necessary skills and knowledge when they work in perilous workplaces. For both, personal and organizational safety, they need to continuously upgrade their skills and practices to sustain good practice as well as their employability. However, workers do not have the privilege to engage in learning off site all the time. For this reason, there is a need to understand how workplace learning contributes to developing workers' occupational efficacy for safety at work.

Recent years have seen many changes in the workplace safety training landscape as a result of the government's devolvement of its training function. Safety training is often targeted to develop workers' capabilities to recognize workplace hazards and risks, and take necessary precautionary measures to prevent occupational accidents and injuries resulting from unsafe practices (Dong, Entzel, Men, Chowdhury, & Schneider, 2004; Kinn, Khuder, Bisesi, & Woolley, 2000). Training programs tend to be generic in nature and designed for applications to a broad range of work settings and situations. Hence, to equip workers with site-specific knowledge on process, procedures, and safety requirements, safety practitioners are increasingly introducing in-house training to complement the more generic training on safety and health offered under the national training frameworks. Furthermore, employers prefer workers to learn in the context of work circumstances instead of in training rooms (Billett et.al, 2015).

Prior to the establishment of the national framework in 2006, responsibility was largely on the government to provide direction and regulation of workplace safety practices. While the government remains an important stakeholder, it has come to recognize that the involvement and engagement of other stakeholders as equally important. These stakeholders include workers, employers, safety professionals and specialists, business and industry associations, and unions as well as educational institutions and industry service providers. Under the revised national regulation act, employers are responsible to provide their workers with adequate

instruction, information, training, and supervision as part of the government's initiative to engage greater industry ownership and participation. Workers, on the other hand, are also expected to equip themselves with adequate vocational competencies to carry out their work safely (Workplace Safety and Health Council, 2017). The national aim to reduce the number of workplace fatalities means employers and employees need to have the right skills and capabilities in order to achieve the targeted outcome as a priority.

2.3 WORKPLACE SAFETY AND HEALTH FRAMEWORK

The Singapore government's intent to steer and promote higher standards of safety practices is evident through its dual approach of educational and regulatory strategies. While the emphasis is on training as the key source of competency development, targeted regulatory interventions and enforcement measures were initiated hand in hand through industry outreach to encourage greater industry ownership and self-regulatory framework for compliance. These include active public engagement as a regulatory means to report any unsafe workplace practices that they observe and introducing more severe penalties for those who breach the legislative act. Consequently, these initiatives not only aim to curtail unsafe behaviours but also imply that all safety personnel will need to be equipped with the right skills and capabilities to manage workplace safety issues and performance to meet compliance standards.

In tandem with the revision of the Workplace Safety and Health Act in 2005, which extended the coverage to include a broader spectrum of workplaces such as dental clinics, the increasing attention and emphasis on striving for higher standards of safety practices and awareness in the Singapore workplace safety and health landscape have brought along a prevalence of safety and health programs. There has also been a notable shift in thinking about safety in the last two decades towards an emphasis on psychological, social, and organizational aspects such as the notion of organizational safety culture (Varmazyar, Mortazavi, Arghami, & Hajizadeh, 2016). Such changes imply that learning and development in workplaces are becoming more salient and complex in how they mediate the physical and social settings of the workplaces in which they occur.

For many enterprises, particularly in high-risk industries, training is predominantly seen as necessary for both developing initial vocational preparation and ongoing skill development to address skills gap. More recently, many have also realized how maintaining good safety performance can contribute to a gamut of business and financial benefits which are critical for organisational sustenance (Dingsdag, Biggs, Sheahan, & Cipolla, 2006). Creating a safe workplace helps to improve revenue and increase return on investment by limiting bottom-line losses resulting from workplace injury costs. These positive benefits include

improved workers' morale and well-being which can translate into higher productivity levels (Kimball, & Nink, 2006; Thomas, Sherwood, & Helmreich, 2003; Vinodkumar & Bhasi, 2010).

In Singapore, a major expense for enterprises is attributed to workplace injuries which entail direct costs such as payment for workers' compensation or insurance premiums, and/or the opportunity costs resulting from losses in workers' production and efficiency. A recent report by the Ministry of Manpower indicated an increasing trend of financial losses due to the pay-outs for medical costs and fatalities at workplaces between the years 2012 and 2014. A breakdown of workplace injury compensation is outlined in Table 2, showing payouts have increased from \$51.50 and \$63.00 in 2012 to \$65.99 and \$80.94 in 2014.

Table 2
Amount of Workplace Injury Compensation Awarded (\$million)

Year	Temporary incapacity		Permanent incapacity			Fatal		Total			
	No of Cases	MC Wages	No of cases	MC Wages	PI Compensation	No of Cases	Death Compensation	No of Cases	of MC Wages	PI/Death Compensation	
2012	9083	\$5.02	4112	\$8.64	\$51.50	103	\$11.50	13,298	\$13.66	\$63.00	
2013	9039	\$5.62	4428	\$9.88	\$60.70	115	\$14.68	13,582	\$15.50	\$75.38	
2014	10,126	\$6.22	4494	\$10.96	\$65.99	113	\$14.95	14,733	\$17.18	\$80.94	

Note. Amount of Workplace Injury Compensation Awarded in Singapore.
Retrieved from www.mom.gov.sg (2017)

As part of a national effort to regulate and promote safe work practices in workplaces, a recent review of the statutory requirement to raise employers' liability for worker compensation was introduced into the existing Workmen Compensation Act in January 2015. This means that enterprises are liable to pay higher compensation in the event of any workplace injuries (see Table 3). This will have a profound impact on profits and revenues.

Table 3
Workplace Injury Compensation Limits

Compensation type	Accident before 1 Jan 2016	Accident after 1 Jan 2016
Death	Min: \$57,000 Max: \$170,000	Min: \$69,000 Max: \$204,000
Total permanent incapacity	Min: \$73,000 Max: \$218,000	Min: \$88,000 Max: \$262,000
Medical expenses	Up to \$30,000 or 1 year from date of accident, whichever first	Up to \$36,000 or 1 year from date of accident, whichever first

Note. Raise in Workplace Injury Compensation Limits with effect from 1 Jan 2016.
Adapted from <http://www.mom.gov.sg/workplace-safety-and-health/work-injury-compensation/changes-to-wica-in-2016>

These changes served as important impetuses for enterprises to place greater emphasis on maintaining good safety practices. A safe work environment that allows enterprises to sustain higher levels of productivity by minimising and eliminating workplace risks and injuries (Heymann, 2003) is also seen as a benchmark of a good employer. With its strategic focus in building and developing workforce competitiveness for economic growth, the government is also fully committed to achieving sustainable and continuous improvement in workplace safety and health performance. The introduction of the BizSafe program in 2006 was part of the governmental initiative to promote safety performance and recognise good practices. Such recognition provides an incentive for enterprises to create a safer and healthier work environment for their workers and increase their competitive edge.

The strategies and policies relating to safety training in Singapore remain very much guided and shaped by the state influence. The intentions were reiterated in the more recent launch of the Workplace Safety and Health 2018 national strategy which aims to further strengthen and inculcate good workplace safety culture and practices nationally. The findings from this thesis on how individuals learn to work safely in circumstances of work informs how organizations can support learning and subsequently achieve desired safety performance and outcomes.

2.4 CONSTRUCT OF SAFETY KNOWLEDGE

Safety is a complex and multifaceted phenomenon reflected in the avalanche of literature which presents a variety of propositions and approaches to address safety issues or realize safety performance. Traditionally, the study of safety is associated with minimizing the probability of risk, prevention of harm, and limiting the occurrence of injuries and fatalities (Hoyos & Zimolong, 2014; Zacharatos, Barling & Iverson, 2005) which correspondingly also became the measures for safety competence (Cooper & Phillips, 2004). Safety learning is also equated with the appropriation or acquisition of knowledge to achieve safe outcomes. One way of considering the construct of safety knowledge is by distinguishing between what is considered declarative (or propositional) and procedural forms of knowledge. Declarative knowledge focuses on what to do or what is known. In safety, learning to identify safety symbols, workplace hazards, or purposes of protective equipment is representative of such forms of knowledge, typically manifested in most safety training programs. Such knowledge provides factual and conceptual information, foundational to understanding the subject matter (Eraut, 1994). In contrast, procedural knowledge is characterized largely with hands-on experience which is directly applied to a task and is job dependence (Eraut, 1994). The emphasis is on the know-how to perform certain work processes such as repairing a breakdown or conducting a risk assessment test. Application of procedural knowledge often

involves implicit learning which may or may not be verbalized or even consciously acknowledged by the individuals (Eraut, 1994). Berryman (1999) argued that such knowledge is what individuals use to think, and serves as a basis for action. Whilst declarative knowledge is generally seen as explicit knowledge that can be articulated or expressed in declarative sentences or indicative propositions, the key difference in learning is that procedural knowledge involves more dialectical relations with action and valorisation of practice. As the categorizations are premised largely upon behavioural objectives, both types of knowledge are pertinent to safety practice which tends to be behavioural and outcome based.

The above dichotomy is a simple way of defining and conceptualizing safety knowledge. In his research on professional practice, Eraut (1994) further categorizes propositional knowledge based on three domains which are discipline based, practice principles, and specific propositions required for particular professional actions. In contrast, Eraut describes the other important set of knowledge required in professional practice as process knowledge which is synonymous with procedural knowledge that focuses on the knowing how. However, he suggests that such knowledge is typically manifested in five different forms, through (a) how information is acquired, (b) skills required to translate into professional action, (c) deliberative processes involving decision and judgment making, (d) knowledge transfer, and (e) the activation of meta-cognitive processes to guide behaviours (Harris, 2012). Similar to procedural knowledge, these variations of process knowledge serve as important bases that individuals engage in to mediate or appropriate their professional actions which can be implicit and tacit in nature (Harris, 2012). Fundamentally, the different theoretical assumptions posit procedural (or process) knowledge to be personal, contextual, and distributive rather than aggregated. This means that individual thinking and acting can be largely shaped and influenced by personal histories and experiences with their physical and social worlds.

The concern here is not to appraise which set of knowledge is more critical than the others, but to recognize the interdependency amongst them as they are all necessary to develop workers' vocational competency in safety. While declarative knowledge is required to develop procedural knowledge by providing the factual insights, procedural or process knowledge is critical to reinforce declarative knowledge through the enactment of work and practice (Carter et.al, 2002). In a way, declarative knowledge precedes procedural knowledge to provide the bases of understanding. This also highlighted the need for mandatory training in safety to learn declarative knowledge and prepare individuals to undertake occupational roles.

In safety practice, codification of declarative knowledge provides a salient way to convert tacit knowledge into useable forms for organizational learning. For instance, through procedural and instruction manuals, computer simulation, didactic teaching from

knowledgeable co-workers, or observation of life experiences (Boreham & Morgan, 2004; Wang & Ahmed, 2003). However, in most circumstances, the effectiveness of outcomes or performance may not always be consistently achieved as they can be influenced by an array of physical, social, and personal imperatives that shape individual thinking and action (Billett, 2002a, 2002b, 2010b). For instance, the practice of solving particular safety issues, and how individuals evaluate and develop solutions to rectify risky situations, often entails more than merely knowing and following what is documented in the instruction manual. The worker has to perform the tasks which may involve judgment or adaptation to meet circumstantial requirements. At times, such knowledge and skills may not be clearly verbalized or codified through inscriptions to guide practice. This leads to variations in performance.

Recent interest in knowledge management has heightened concerns about knowledge adaptation. This drew attention to a spectrum of learning issues and conditions with respect to the conversion of knowledge across different contexts, incongruence between theory and practice, and interruptions to progress of skills acquisition from novice to mastery (Dreyfus & Dreyfus, 1980). Learning to adapt concepts and skills to meet different practice contexts and settings itself is a distinct skill which reproduces new knowledge.

In safety practice, knowledge gained through different forms of guidance from expert others or through formal training may not necessarily lead to what is deemed as safe practice because individuals may perceive and make connections to both their personal and occupational experiences in different ways (Billett & Smith, 2007). Hence reinforcing collective interpretations by the community of workers in particular worksites are essential.

Inherently, reciprocal processes in knowledge generation and deployment also illuminate the contested and ambiguous role of tacit knowledge which Eraut (2000) argues can be activated unconsciously and can profoundly affect actions and behaviours. Polanyi (1983) described tacit knowledge as the knowing of how to do something without thinking about it, which is often automatically translated into action. Unlike declarative knowledge, this kind of knowledge is not found in manuals, books, databases, or files, but tends to be developed through episodes of and rehearsal of engagement in practice in particular contexts or in social interactions and networks. Different learning theorists attempt to explain how the tacit nature of the knowledge is correlated with the notion about insights, intuitions, and hunches (Becerra-Fernandez, 2004), or what is known as embodied knowledge (Somerville & Lloyd, 2006) associated with making judgment that is often learnt through experience and not easily articulated. This makes learning in the circumstances of work a key consideration. Likewise, Evans et al. (2004) explain the nature of tacit knowledge not being apparent or explicit. It emerges as attitudes or values that is idiosyncratic, or has not been shared and considered relevant by others. Eraut (2004), highlights tacit knowledge as necessary for making complex

decisions and solving problems. In his view, proficient workers apply their tacit knowledge in three different forms: seeking situational understanding; making intuitive decision-making that involves pattern recognition and rapid responses to developing situations; and enacting routine procedures to cope with demanding workloads without suffering from information overload. What these propositions suggest is that tacit knowledge may begin as explicit procedural knowledge and subsequently become automatized and increasingly tacit through repetition. This leads to concomitant increases in speed and productivity as one advances in professional competence and gains accumulated experience. This is important for learning to work safely where enactment in safe practices can be developed as a habitual and routinized act. Correspondingly, it is important to recognise tacit dimensions of safety knowledge and how it is acquired.

Figure 1 illustrates how tacit knowledge is acquired in the case of operating a machine.

Figure 1. Knowledge and practice of safety.

As illustrated in the diagram, a worker acquires declarative knowledge on how to operate a machine safely through attending safety training to explain codified knowledge outlined in the operating manuals. In this instance, declarative knowledge provides the bases for understanding what to do. Subsequently, procedural knowledge is developed as he learns to operate the machine through direct guidance from the trainer, experienced others, supported by own practice. The experiences gained from operating the machine helps to

reinforce declarative knowledge learnt from training or inscription. During routine work, the worker may refer to the manuals or training materials to validate or seek clarification from other experts. For instance, adapting to different model of machinery at work or receiving guidance from different expert others through his work circumstances. Collectively, those interpretations form tacit knowledge that may influence and shape individual thinking and action, whether in a safe manner or not.

Tacit knowledge has important implications for safety learning and practice. How individuals construe meanings from different sets of knowledge and relate these to their practice may not always be explicit. Yet, given the threshold for errors is marginal in perilous work environments, accuracy and preciseness in decision and judgment making is very important, ways of developing tacit knowledge becomes a necessity. However, as tacit knowledge is not easily assessed. It is the product of rehearsal and practice (Nonaka, 1994; Polanyi, 1983), hence, there is a greater need to consider learning in the circumstances of work. How tacit knowledge is verbalised, internalised and eventually translates into action or behaviour is key to individuals work safely. Therefore, workers' learning and acquisition of tacit knowledge must be supported through workplace provisions.

The centrality of the above discussion is that while some aspect of safety knowledge can be learnt through codification, it is also largely conceived as competence-to-act that is inextricably bound up with action. For instance, a maintenance worker who is deployed to different work sites may need to make the necessary adjustment between his routine practice and what is being practised (collectively) by other workers in new work settings. The conception of safety learning is thus concerned not solely with the acquisition or appropriation of bits of knowledge but the ability to act with competence based on participation in the system of situated practices (Gherardi & Nicolini, 2002). Hence, how a worker learns and responds to risk exigencies at work can be acquired not only from reading safety manuals or attending safety training, but through the act of doing and modifying practices to adapt to particular work contexts or situations. Learning outcomes that are closely associated with the acquisition of procedural knowledge thus arguably provide far more delineated criteria for determining empirically any potential relationships that are significant between the workplace environment and workplace learning (Clarke, 2010).

Understanding how individuals learn to work safely is a complex subject which entails not only how content and technical knowledge can be effectively circulated and acquired, but those processes and imperatives that may eventually shape and guide how individuals evaluate and respond efficaciously to circumstantial requirements for safety. Both explicit, that is, the action or behaviour, and tacit aspects that is, those bases that guide intuitive and decision making, are thus critical to understanding how safe work is learnt. One way to

advance workers' learning would be through giving greater consideration to the types of knowledge generation associated with different learning approaches. Much of the workplace learning literature advocates how learning through circumstances of work is effective at generating and developing contextualized, personalized, and procedural types of knowledge, important for individuals to carry out their jobs (Eraut, 2000; Raelin, 2000). As learning shifts from a classroom-based context to workplaces, there is, therefore, a greater need to understand how these different forms of safety knowledge are constructed and translated into practice within circumstances of work.

2.5 WORKPLACE LEARNING FOR SAFETY PRACTICE

Studies on organizational performance have argued how training is necessary, whether to fill skills gaps or as a means to sustain continual improvement and competitiveness (Berge, de Verneil, Berge, Davis, & Smith, 2002; Jaselskis, Strong, Aveiga, Canales, & Jahren, 2008; Storey, 2004). Likewise, safety training is credited with allowing enterprises to increase their return on investment by limiting bottom-line losses resulting from workplace injury costs (Filer & Golbe, 2003). Other positive benefits of safety training include improved workers' morale or well-being and safety performance measured in terms of lower accident rates and economic costs (Cooper & Phillips, 2004; Dewlaney & Hallowell, 2012; Edmonson, 2002).

In safety practice, workers are often regulated by rules and procedures on how to work safely. However, there is also a risk that over emphasis on imparting such codified knowledge can potentially overlook the embodied learning of the workers that occurs in the social and physical environments of the workplace (Somerville & Lloyd, 2006). In particular, strict conformance to prescribed operating standards as a practice requirement in most perilous workplaces could limit individuals from exploring other possibilities. However, learning in the circumstances of work offers opportunities to learn more than what is taught in the training classes. How learning to work safely, as theorised in a training classroom setting and distinct from developing knowledge through work circumstances, calls for an understanding of how safe work practice is learnt in circumstances of work.

2.5.1 Learning approaches to safe working

How individuals and organizations adapt and respond to changing work environments to stay competitive depends very much on their capacities to learn (Sambrook, 2005a, 2005b). Unlike training that is aimed to achieve measurable outcomes, workplace learning tends to encompass a broader aspect of learning activities and processes which can be non-formal, incidental, and contextual. Studies by Somerville and Lloyd (2006) highlight the significance of embodied learning where individuals engage their physical embodiment and personal

agency as safety learning occurs through everyday practice entrenched in an array of contextual influences in workplaces. However, because of the intangibility of informal learning, there is often parsimonious recognition of the quality of the learning processes and outcomes acquired through work practices. To develop and optimise the capacity to learn would imply a need for new understandings about the changing nature of work and how learning is being integrated into practice. In this respect, the need for active participation from learners is central. Yet, how learners engage in this process with respect to how they construe, construct, and interact is often not visible. What is afforded to individuals in the workplace, their existing domain of knowledge about safety, the situational setting, personal factors, and the impetus for learning form important considerations for understanding how workers learn to work safely.

Differentiation between learning in the workplace and learning in and through educational institutions has always been a popular subject among workplace learning theorists. Two main dimensions that are particularly influential to the discussion on context in workplace learning are examined here. The first relates to the paradigmatic distinctions that characterize how learning occurs in workplaces and evaluates the pedagogical contributions of workplaces. The second dimension pertains to the quality of pedagogical practices in workplaces which serves as a precursor in establishing the framework and conditions for learning and practice.

There are two differing paradigms about workplace learning which Sfard (1998) describes as “learning metaphors”. One focuses on the articulation between education and work for the purpose of recognition and credentialing all forms of learning (Vaughan, 2008). Hager (2004) calls it “learning as acquisition”, and is often related to the notion of formal learning or “standard paradigm of learning” (Lee et al., 2004). The other focuses on the workplace as a learning environment where learning is embedded in the production and organizational structures, and therefore seen as part of communities of practice (Lave & Wenger, 1991).

The theoretical bases advanced in the learning by acquisition paradigm are congruent with many workplace practices utilised to circulate and reinforce safety knowledge. For instance, Hancock (2011) provides the example of how a worker responds to an alarm in an oil refinery and associates the sound and flashing light with abnormal conditions. Likewise, textual or material artefacts and objects are commonly used to provide the mental imagery and draw on the visual, auditory, or kinaesthetic sensory memory of the learners. This can be exemplified through the use of symbols and different colour codes or acronyms in safety to communicate hazard information. Pecuniary penalties against unsafe work practices is also an approach to correct behaviour or condition particular acts or behaviours. Harris (2012)

cautioned that such a reinforcement approach to safe behaviours may undermine the influence of social, organizational, and cultural factors. The critique is that when individuals are able to carry out their job according to the prescribed methods, it does not necessarily lead them to thinking safely or to eventually creating a safer culture (Machles, 2004). Inherently, other environmental and social imperatives are therefore undermined and discretely regarded. Despite admittedly being seen as outmoded and criticized for these plausible limitations, the paradigm does provide a useful adjunct to the circulation of safety knowledge in contemporary workplace practices.

Conversely, within the paradigm of learning as participation, learning is conceptualized as a situated and social practices. Developed from constructivism and social theories of learning (Engestrom, 2004; Lave & Wenger, 1991; Wenger, 2000), this perspective sees learning as produced and reconstructed through the relationships and interactions among individuals and the environments within which they work. As posited by Lave and Wenger (1991), learning is mutually constituted by the agent, activity, and the world. In this theoretical frame, both the historical and social dimensions of learning are illuminated, rather than the isolated individual. As such, two leading perspectives in workplace learning theories which relate to Lave and Wenger's (1991) notions of legitimate peripheral participation and communities of practice are often synonymously represented and discussed in tandem with this learning metaphor. Correspondingly, research on safety practice also suggests how learning to work safely is seen as a socially constructed set of practices constituted by competences which workers learn through their engagement and participation in everyday work life (Baarts, 2009; Lukic et al., 2010). Researchers like Gherardi and Nicolini (2002) also accord the practice of safety as a social process in which workers, technology, values, and other symbolic forms are embedded in the process of knowledge and competency development.

While most of the workplace learning literature tends to endorse learning by participation in socially rich contexts, such approach to learning also has its foundational dilemmas (Wenger, 2000). One criticism is that the learning process is vertically and hierarchically developed as newcomers learn from old-timers and/or apprentices learn from their mentors. Other forms of social learning, such as from peers, does not seem to be considered. In discussing its limitations, Harris (2012) also highlights other criticisms and commentaries such as limited attention being paid to the structural constraints and agency issues and the downplaying of formal learning in this theoretical frame of learning (Fuller et al., 2003; Hager, 2004; Rainbird et al., 2004). These critical claims have relevance for considering how learning is conceptualized socially in the field of safety practice. For instance, hierarchical occupational structures determine professional roles and practices in safety.

In safety practice, job roles and hierarchy are commonly used as cues for problem-solving to provide a systematic way of managing and controlling safety issues. For instance, line managers, safety engineers, and supervisors are usually principal agents who provide guidance when imposing controls to manage health and safety risks (Hennart, 1991; Lee et.al, 2000). For the same reason, learning relationships tend to move unilaterally and from the periphery where full participation can only be achieved when the individual has received recognition for his or her efficacy in a particular set of vocational knowledge and trade skills, or has validated ability to manage complex problem-solving issues (Lave & Wenger, 1991). Indeed, these practices very much characterize the safety profession, as is the case in Singapore where accreditation qualifies one to engage in a specific safety trade. The recognition of formal learning plays an important role. This is contrary to the critique that formal learning has been downplayed under this metaphorical perspective (Harris, 2012). Accordingly, structural imperatives that underpin the safety profession also suggest that there is a need to examine discursive relationships in workplaces and effects on learning.

The social aspect of learning has also gained increasing attention in recent years within the study of workplace learning research. Often, these are manifested as studies relating mostly to workplace discourses, practices, and social-cultural dialogues and interactions in professional work or negotiations of work identities of individuals (Billett, 2006; Billett, Harteis, & Eteläpelto, 2008; Billett & Pavlova, 2005). To understand workplace learning, there is thus a need to first define context, which can be distinct for a particular trade or practice community and can have a profound influence on how knowledge is circulated among its members.

2.5.2 Workplace context and pedagogical qualities for safe working

The notion that context has an integral role in mediating institutional learning has recently become more evident (Billett, 2009; Eraut, 2004; Fuller & Unwin, 2003). Bound and Rushbrook (2015) argue that context has become an amorphous term, noting that context is related to an array of socio-political, economic, and cultural norms and discourses that are specific to particular national objectives and industry practice settings. Other authors relate context to more specific nuances of learning and work. Billett (2011), for instance, describes them as sets of institutional facts comprising social norms that arise from the kinds of activities and interactions with which individuals are presented to participate at work. Eteläpelto (2000), on the other hand, took a more specific view from the employees' stance and ascribes contextual knowledge to social support received from co-workers.

The term pedagogy is often discussed in relation to how and why teaching takes place but this has expanded to include the teacher's role, the relationship between the teacher and student, the learning process, and the context in which the learning takes place (Waters,

2005). In the context of this thesis, it is used to describe the principles and methods of instruction including the action, process, or art of imparting knowledge to adult learners. Pedagogy is the term that is most common in literature about learning in the workplace, hence its use in this thesis aims to preserve consistency. Much of the literature on workplace pedagogies attempts to examine the role and contributions of workplaces to learning. While Resnick (1987) ascribed pedagogical contributions to learning in the workplace through effective utilisation of objects and events, Billett (2004, 2008) highlights the need to examine the invitational qualities of affordances in workplaces that contribute to the professional development of individuals' vocational skills and efficacy.

These descriptions suggest that pedagogical qualities of a workplace can be shaped by three considerations:

- i. how materials and artefacts are utilised;
- ii. deliberate instructions by knowledgeable workers and experts; and
- iii. practice arrangements which establish structure and systems for engagement.

How each of these relate to safe working are further discussed.

Mediating materials and artefacts for safe working

There is now a growing interest in the concept of mediating artefacts as a means for knowledge construction and circulation. Grounded in the social-cultural perspective it draws on the work of Vygotsky and activity theory (Engestrom (1999). Mediating artefacts (such as physical devices, text and inscriptions, signs, and symbols) are viewed as cultural and representational objects with rich pedagogical qualities that facilitate the interpretation of meaning; develop acceptable work norms; and the ordering of practical activities (Marshak & Heracleous, 2005). This concept of mediating artefacts can be applied to contemporary workplaces, influenced by information technologies and technical tools to support everyday practices. Carlile (2002, 2004) describes these artefacts as boundary objects that offer different capacities to represent common knowledge and provide an infrastructure where differences and perspectives among organizational members can be explored and addressed. These objects and tools act as connections to past learning, and concurrently regenerate new meaning as members seek intersubjective understandings and engage in modes of action (Engeström, 2008; Engeström & Blackler, 2005; Miettinen & Virkkunen, 2005). The complexities and qualities of knowledge relations can therefore be influenced by how these mediating artefacts are utilized and interpreted by their users to augment safe working

practices and coordination. Moreover, learning to utilise the mediating materials and artefacts more effectively can be enhanced through guidance by expert others.

Guidance by expert others for safe working

While mediating artefacts are a focal point to promote shared understandings for knowing and coordinated work practices, a well-tested pedagogic practice affirmed by Billett (2011) is direct engagement with and guidance by those who are more experienced or who assume expert roles. Here, individual scope of learning is potentially expanded through dyadic processes which provide interactions between novice and expert, collaborative work among peers and individuals, or joint problem-solving (Billett, 2011). Guided learning, which is commonly associated with mentoring and coaching arrangements, is seen as a conventional mode of learning support in workplaces. Commonly practised learning strategies that provide deliberate instructional guidance, whether directly or indirectly, include instruction where an experienced worker provides extensive off-task exposure to work-related knowledge to a newcomer before engaging in the work; instruction where newcomers are first given peripheral roles before being given more explicit instruction; a laissez-faire approach where newcomers receive no instruction and have to depend on their own capability to learn and problem-solve; and lastly, observation and mentoring. These strategies may vary in a number of ways such as timing; the extent to which the transmission of knowledge is controlled by the supervisors, learners themselves, or others; the extent to which they are intentional rather than incidental; and the types of resources required to support the learning strategies. Billett (2000) identifies an array of learning strategies for guidance as a workplace learning intervention. He argued that guided learning, perceived as a form of mentoring, can provide a particular contribution both directly or indirectly which may not be realized through individual solitary work or mere participation at work. He suggested sustained efforts and frequency of interventions can reinforce the quality of guided learning useful for conceptual development and complex problem-solving. Limitations associated with readiness of both mentors and mentees and physical segregation and locality dispersion could have a profound impact on the quality of mentoring process and learning outcomes. Though guided learning may be viewed as one of the most effective yet natural approaches to learning in workplaces, Billett cautioned about the potential risk of learning inappropriate knowledge and difficulty in gaining access to expert individuals for assistance in workplaces (Billett, 2000). With respect to safety practice, these barriers to learning could lead individuals to enact unsafe practices and potentially make mistakes that may endanger personal safety and that of others at work.

Billett's (2000) notion of guided learning is premised upon a distinct hierarchical relationship involving a more experienced and a less experienced worker. As most workplaces rely on a hierarchy of authority as a way of coordinating responsibilities and the ordering of organizational activities and resources, collegial work relations (Parker, Axtell, & Turner, 2001) to engender a friendly workplace may not always be appropriate or congruent with the practice setting, such as a legislature-bounded work environment. Despite its virtues and benefits to develop inter-professional development, collegial work relations may be incongruent with a particular work and practice culture. Power relations likely present an inherent tension that may impact on the quality of learning and needs to be adequately addressed. On the same note, Illeris (2010) suggests that guidance may be mutually provided among workers of equal level or through enactment of interconnected work practices. Collin and colleagues (2010), note that experience sharing is not limited to sharing experiences verbally. Rather, the opportunities to work alongside colleagues provide equally rich learning experiences. Through these collegial networks, opportunities to receive assistance from experts and peers during problem-solving, or sharing personal experiences and stories, are effective pedagogical qualities of the workplace. It is important to account for the way structural and interpersonal issues are embedded in particular professional or workplace settings (Flores, 2004; Truijen & van Woerkom, 2008). Positive interpersonal and work relationships contribute to building trust among co-workers and promote safe working collectively (Naderpour, Lu, & Zhang, 2014; Neal, Griffin, & Hart, 2000; Tharaldsen, Mearns, & Knudsen, 2010). However, perilous workplaces in particular, often require individuals and groups to act strictly within the prescribed rules which are not easily compromised for safety reasons. Hence, collective agreement must be clearly understood by all.

Practice arrangements for safe working

The types of practice arrangements set up for organizing and ordering work tasks are therefore also pertinent when considering the pedagogical quality of a workplace (Billett, 2011). Individuals participate in everyday practice for particular institutional purposes such as realizing organizational efficacy or financial outcomes. On the same note, not all practice arrangements are intentionally institutionalized or established with learning as the primary goal. In some circumstances, they arise out of circumstantial requirements such as critical incidents or normative standards of particular communities of practice like interagency training. Billett (2011) describes them as goal-directed activities which he argues are analogous to, and form important bases of, a pedagogical structure or learning curriculum in workplaces. Unlike the notion of curriculum or pedagogy premised upon prescribed educational syllabi, what is distinct about these deliberations is that the sequencing and structuring of workplace

activities can constitute a curriculum that provides particular pathways and progression for the development of occupational skills as individuals enact those collective task-related activities.

Billett (2001b) identifies a range of pedagogical properties that are commonly manifest in organizational activities such as daily work practices, providing or receiving coaching, questioning, observing and listening, modelling, and access to workplace document procedures. Not only do they offer different learning opportunities, but each of these strategies also provides different means of supporting particular type of learning outcomes. Choy (2009), explains that practising daily work activities presents opportunities to reflect and learn from past errors. Intergroup discussions provide spaces for negotiating differing views and reaffirming procedures or approaches. Different learning strategies of questioning, modelling, and observation are helpful for clarifying ambiguities and strengthening understanding on both conceptual and procedural knowledge. Lastly, documentation not only establishes the prescribed systemic requirements, but also provides linkages between organizational processes and practices across different work communities and past events. Barriers to developing deeper knowledge for workers include social isolation, a lack of expert guidance, and limited peer contact (Cullen et al., 2002). Essentially, participation and engagement through these social interactions lead to individual framing and reframing of experiences, seeking and integrating perspectives, and experimenting with different ways of doing things, all of which inform safety practice.

Some researchers draw particular attention to the need for considering those pedagogical practices and activities that will develop learners' capacities to reflect on experiences in the workplace. For instance, the opportunities to learn from trial and error (Bauer & Mulder, 2007), developing critical thinking and reflection (van Woerkom, 2004), and fostering the development of "meta-abilities" such as ingenuity, open mindedness, and self-awareness are also seen as critical to meet situation specific circumstances at work (Raelin, 2008). Workplaces as sites for learning thus entail deliberation of socio-material attributes as well as effective ordering and structuring of work activities that will provide pedagogical contributions, which makes learning intensely embedded in social relations. The notion of affordances as advanced by Billet (2002a, 2002b) is therefore relevant here. Essentially, the notion of affordances attributes to the readiness of the workplace to provide opportunities for individuals to participate in work activities and access to direct and indirect guidance and support which determines the quality of learning in the workplace. Most common examples include: access to other workers, time to practice and learn, inclusion in knowledge sharing, discussion groups, access to knowledge, implementation of training programs, encouragement, attitude and skills of coworkers, opportunity to practice. An important aspect embedded in this notion is the access provided to learners to engage in particular kinds of

learning activities. Billett (2002b) further elaborates that affordances need to be invitational and that learner agency is required to seek access and engage with the opportunities offered by the workplace.

Eraut (2007) focuses on the individual and their learning, noting that learning can be a by-product of work processes such as participation in group processes, working alongside others, consultation, undertaking challenging tasks or roles, exploring new ideas, problem-solving, and consolidating and expanding or refining skills. Billett (2001a), on the other hand, notes that workplace pedagogies include routine affordances for learning such as team meetings, internal communication systems, time allocation for group learning, opportunities to solve problems, acquiring systemic knowledge of the workplace, shared responsibility for learning and achieving organizational goals, timely access to assistance from others, and making appropriate use of assessment. In particular, these different social platforms create learning opportunities for receiving guidance from expert others through working collaboratively. This has important implications for safety practice as individuals engage in the process of negotiation and clarification and seek consensus to achieve a safer outcome.

As workplaces are contested environments, this means that affordances could also be unevenly distributed (Billett, 2002a). Barriers to accessing these learning affordances could result from a diverse range of individual and social bases such as individual position and employment status or workers' perceived competence in the organization. Seminal studies by researchers such as Lave and Wenger (1991) highlight the existence of newcomers and old timers. Bernhardt (1999) raises the disparity between those working full-time and part-time. Others like Darrah (1996) and Hull (1997) allude to tensions between workers assuming different roles and responsibilities in the organization. Billett (2002a) asserts that both affiliations and demarcations of workplace tasks can influence individual participation at work. Such unequal distribution of opportunities and support for participation can be influenced by workplace hierarchies, group affiliations, personal relations, workplace cliques, and cultural practices. Social and individual factors have influential control to determine how workers are granted access to prized tasks (Billett, 1995). He concludes that affiliation has significant influence on not only shaping the way information is to be shared, but also the distribution of workload, and recognition and assessment of individuals' contribution to work.

2.5.3 Workplace as a learning site for safety practice

What has been discussed in this review so far, highlights salient conceptual assumptions that are critical for appraising the qualities of workplaces learning to support safety practice. The three cited attributes of a) artefacts and materials, b) guidance, and c) practice arrangements

provide bases to understand how safe working is reinforced in those circumstances of work. Safety as a form of situated practice is learnt when people interact, collaborate, negotiate, or share ideas during work, and affords spaces for individuals to build certain schemas about the notion of safety, values, and culture (Gherardi & Nicolini, 2002; Machles, 2003, 2004). Material, artefact, and other symbolic systems are synthesized to circulate safety knowledge (Gherardi & Nicolini, 2002). These integrative influences can determine the practice, culture and workplace discourses to shape practices (Cox & Cox, 1991; Huang, Ho, & Chen, 2006).

However, there is a need to examine the invitational qualities of workplace norms and practices, as well as artefacts. Of course, these can be challenging with workplace contestations which may create disparities among group members who assume different job roles and status. For instance, experienced workers will likely be given the opportunity to engage in more complex safety tasks to minimize potential risks of incorrect judgment or behaviour due to inadequate knowledge about safety. For these reasons, certain types of learning strategies such as trial and error may be curtailed. In contrast, close guidance or assigning only peripheral roles to new workers may be a more appropriate learning intervention as part of the regulatory process until they are ready to take on more complex tasks. Issues relating to political and power relations would also require careful consideration.

Importantly, learning to work safe entails not only acquiring the conceptual knowledge, but also how cultural objects and knowledge from other social agents contribute to the construct of contextualized and situated knowledge. How individuals interpret and make sense of the new knowledge will influence their decision-making that eventually translates into action or practice. That is, learners need to play an agentic role.

2.6 ROLE OF LEARNER AGENCY FOR SAFETY PRACTICE

Agency refers to agency as the basis from which individuals engage in the process of construing and constructing knowledge by relating to what they have experienced through their work (Billett 2009, 2010). These bases can be developed from the individuals' personal values or beliefs, and the ways in which they acquire that knowledge determined by complex social-cultural influences. Agentic efforts are thus seen as helpful accounts of personal epistemologies that need to be accounted for in understanding workplace learning (Billett, 2009; Hodkinson & Hodkinson, 2004).

Research on adult learning suggests that active engagement in learning activities could increase learners' persistence and involvement that is constructive to their learning (Czarnowsky, 2008). A key proposition is that while workplaces can provide a range of opportunities for learning, whether guided or indirect, the need for learners to be actively engaged in the process of learning is necessary (Fuller & Unwin, 2003; Hodkinson &

Hodkinson, 2004). Billett (2001b, 2004) refers to such learning processes as “co-participation” to describe the relational and dynamic relationship between structure and agency. In his view, understanding workplaces as a learning environment is determined largely by the interrelationships between the opportunities that are afforded by the workplace and the extent to which individuals elect and utilize them.

This can be best explained through Schon’s (1987) work on reflective practice illustrating how individuals think and act when activating their knowing of technical rules and learning by doing. Schon uses the term knowing-in-action to the technical rationality or rule-following to describe how an individual will respond to a situation spontaneously without conscious deliberation if that situation falls within what is learnt or already known. However, when the technical rule produces unexpected outcomes or results, a reflect-in-action situation will occur as the individual begins to question the technical rationality. Consequently, individuals will make adaptations through reshaping these strategies and actions, and monitoring the success or otherwise of that adaptation. What this means is that learners’ dispositions toward that knowledge together with the tasks that they associated with it, will determine the response and behaviour. Furthermore, individuals’ personal histories which form the bases of their knowing can lead to particular ways in which they respond to the social experiences and shape their learning (Smith, 2006; Billett & Smith, 2007). These bases will guide and direct individuals in how to act in the workplace when engaging in work activities and how to negotiate with others when working together and sourcing knowledge from them. Beyond those invitational qualities that workplaces may afford, learning can also be mediated by personal agency that entails individual subjectivity and intentionality and is a central element of individuals’ personal epistemologies: how they think and act (Billett, 2010b). Gardner (2000), Ericsson (2006), and Marchand (2008) content that the onus is on learners to actively engage in the learning process with little direct guidance or interaction from experts. To achieve effective performance, individuals will need to proactively find ways to access and learn what is required (Smith, 2006).

The role of agency is not new in safety practice though it is often discussed in relation to how psychological attributes such as attitudes and personal values affect behaviour; or with respect to institutional practices that aim to improve member participation and engagement for effective intervention (Clarke, 2010). The notion of employee engagement is receiving increasing attention in the field of safety as a means to promote safety culture and performance. According to recent findings from the European Survey of Enterprises on New and Emerging Risks (ESNER, 2012), workplaces which allow workers to actively contribute to safety and health activities are found to have lower occupational risk level and accident rates. Learning is fostered by exchange of knowledge and views.

Agency, thus, has important implications for the understanding of learning to work safely as they draw attention to how learners construe, construct, and interact with what they experience. In all, how individuals value or perceive the purpose of learning to work safely will determine their effort and engagement. Safety learning and practice is beyond just understanding individual intentionality and efforts to shape learning. Individuals participate in work activities that are socially shaped, and how they develop their occupational practices and techniques and adapt to the norms and discourses of the physical and social settings are often relationally negotiated. Nonetheless, for safety practices, social surveillance and control settings necessary to guide practices may limit personal contributions.

One other important point is the complex relationship and interdependency between structure and agency. On a practical as well as conceptual level, this interdependency implies workplace learning is an ongoing social process where these two elements cannot be considered independently. While the issue of agency is deemed imperative for constructive learning through participatory practices at work, there has been criticism that it is being over played (Lee et al., 2004). The notion of agency in Billett's (2009, 2010a) discussion is seen to suggest voluntarism, distinct from contextual constraints in workplaces. Though he has identified a broad set of factors on how workplace affordances are distributed and impact on learning, how agency is grounded within these social relations and tensions was not explicitly discussed in his argument. For instance, contextual constraints such as how occupational positioning within a workplace hierarchy or one's social class location limits participation to learning were not directly discussed. It seems to imply that the decision to participate or not is independent and dictated by the individual, which often is not the case. The existence of power relations within organizations and how they control the access to opportunities and participation in learning cannot be undermined. Fuller & Unwin (2004) also did not explicitly discuss the operation between the dynamics of structure and agency. They do invoke the idea of how learning can be shaped through complex interplay between organizational structures, workplace contexts, and participation through communities of practice. It is therefore important to have a nuanced understanding of how personal factors shape individual occupational trajectories to align with the institutional goals and practice requirements for working safely.

2.7 CONCEPTUAL FRAMEWORK

The review above enhances understandings about ways in which workplace learning is understood and its contribution to circulate safety knowledge. The conceptual framework presented in Figure 2 captures the essence of how safe working is learnt. Essentially, the

framework draws connections between three dimensions of workplace, agency and knowledge intertwined to guide safe work practice.

Figure 2. Conceptual framework.

The framework maps the three domains to highlight their relational contributions to learning and practice of safe work. The interplay between workplace and agency contribute to learning different forms of safety knowledge in workplaces. On one hand, the pedagogical contributions of the workplace are attributed to how artefacts; guidance and practice arrangements (which entail co-participatory practices in workplaces) provide support to learning. On the other hand, the role of learner agency entails individual effort and engagement in response to what the workplace affords, and how learning is mediated as they engage their cognitive, social, and affective influencers. For instance, the way workers respond to the workplace culture for safe working and their experiences in receiving different forms of guidance may be influenced by relationships with co-workers or peers.

The interplay between workplace and agency contribute to the construction of different forms of safety knowledge, that is, learning the “what to do” (the declarative), and “how to do” (the procedural) safe and appropriate ways. As safety knowledge also embeds the tacit knowledge, the need to look beyond just the act of doing and understand how individuals negotiate their practice to meet the context-dependent work nature effectively thus, need to

be considered. Understanding how safe working is learnt and translate into practice is primarily about knowing how knowledge is verbalised and internalised that eventually for safety practice.

In all, the issues raised in this review set the basis for the proposed framework for inquiry into current learning processes and practices of individuals and institutional bodies with the intent to provide informed recommendations to enhance participatory practices for effective learning in perilous work environments.

CHAPTER 3: INVESTIGATING LEARNING TO WORK SAFELY: A CASE-STUDY

3.1 INTRODUCTION

This study is designed to investigate how workplace context and individual agency shape the learning and practice of work safety. This implies a need to select a method and utilize research procedures to capture the dynamic and complex social, individual, and institutional processes that influence individuals learning to work safely. Such an understanding is important to determine how learning can be organized more effectively to meet both personal and organizational needs and development. Drawing on findings, possible interventions can be developed to further enhance workers' learning. Rather than searching for an objective reality, a qualitative research approach is adopted that allows the researcher to explore multiple realities brought forth by a variety of interpretations, perceptions, and values about how safety is learnt.

Patton (1990) argues that the strength of a qualitative study lies in its ability to portray holistic settings by giving greater attention to the nuances, interdependencies, and complexities of idiosyncrasies and context. Central to this, a qualitative inquiry focuses on the idiosyncratic as well as pervasive characteristics of the possible ways that petrochemical workers acquire and construct their knowledge about safety in their work contexts. A quantitative approach is often preferred in safety research to examine the effectiveness of exploratory variables in designed interventions, because understanding the complexities of the phenomenon of workers' learning could not possibly be reduced to several variables or linear causal relationships. Such information is not readily apparent or easily collected from a quantitative study. As qualitative research tends to focus on describing and understanding a phenomenon. This intent is congruent with the objective of the study to obtain rich descriptive insights of individual interpretations and situational processes of learning for safety in circumstances of work.

3.2 STUDY CONTEXT AND SETTING

The case site is an established petrochemical plant situated in Singapore. The plant has received numerous national awards for its outstanding safety performance and is renowned for commitment and exemplary standards in workplace safety and health. Incorporated with the latest technologies, the fundamental principles and processes of the plant are also considered typical of the petrochemical industry both in Singapore and elsewhere. The plant subscribes to highly regarded industry standards and programmes for safety and health, such as "Responsible Care", which features international companies including Shell and ExxonMobil. As the key production processes encompass typical practices common across the

petrochemical sector, the work context and setting of the case present a gamut of workplace safety and health issues that can be generally found and are representative of similar work settings. The plant employs about 350 staff of which more than 80% are in technical and operational roles. Site operators are involved in different job roles and functions, hence, an array of perspectives and experiences enhances the richness of the data and offers a more holistic representation of the study population. Through the assistance of a reference group member, consent from the plant was obtained to conduct the on-site study.

The plant, known as SPCC (pseudonym), is situated at Jurong Island in Singapore that accommodates clusters of petrochemical companies and oil refineries for the region. Figure 3 shows a visual representation of the island which was an amalgamation of seven surrounding islands joined by land reclamation. It is now a cornerstone of Singapore's energy and chemical industry.

Figure 3. Site view of Jurong Island showing the different clusters of petrochemical companies and oil refineries.

Gazetted as a protected place, the island is restricted to only employees and approved visitors. Tight security and safety precautions were observed at the work site. The interviews were scheduled at the convenience of the participants. Data collection took about eight weeks to complete.

At the first visit, the researcher had to watch a media clip. The intent was to inform and remind visitors about compliance with the safety rules and procedures. This arrangement was also to meet the statutory requirement. Security is taken seriously here, though it is much driven by the pressure to meet statutory obligations. Moreover, the regulatory approach that is adopted here extends to how work is organized to minimise errors and accidents.

There are currently two major complexes (Complex I and Complex II respectively) located within the site. Presently, there are more than 10 other downstream companies. Many

of them are well established in the chemical industry. Their physical proximity characterizes the close-knit work relationships between the upstream-downstream companies.

As the lead producer and upstream company, SPCC provides a range of petrochemical products (including supplies of olefins and aromatics) to downstream companies. The supplies to the downstream companies are subsequently used for the remaking of a wide range of both industrial and consumer products for households, transportation, electronics, medicine and agriculture. The site also oversees safety operations of the entire complex. Figure 4 (adapted from a flowchart provided by the company) provides an overview of the Complex Scheme to illustrate highly complex and interconnected flow of process work. As depicted in Figure 4, being the upstream company, the plant produces and supplies a range of different petrochemical products such as ethylene and propylene to its partner companies.

Figure 4. Process workflow of the Complex Scheme.

A high degree of interdependence for workflow means that the partners are reliant on each other not only economically, but also ecologically, and are morally responsible in terms of maintaining safe work at the complex. Manufacturing of these petroleum-derived chemicals produces highly toxic emissions and contaminated wastes that are hazardous to both individual lives and the environment, therefore maintaining high standards of safe practice is critical to the plant. To achieve this, it is imperative for all the site operators to work safely for both their personal safety and that of others.

Situated in a technically demanding global industry, the plant's entire manufacturing operation is controlled by state-of-the-art process control systems. An extensive maze of pipelines and clusters of gigantic cylindrical storage tanks used to facilitate the transportation of chemical products are prominent features at the work site, as illustrated in Figure 5.

Figure 5. Physical site of the petrochemical plant, showing extensive and complicated control systems.

To ensure that the plant is well maintained and operates smoothly and safely, the company engages external contractors to provide maintenance services. Contractors' quarters, provided at the site, serve as resting places in between shifts and as a temporary meeting point for the workers. Some of these contract workers are not direct employees of the plant. It is therefore critical that they are accustomed to the safety rules and standards of the plant and able to work safely. Safety as a prime concern means the plant relies intensively on sophisticated safety systems to monitor all its work processes and activities, including its waste management to ensure the production and disposal of highly toxic substances are safely carried out. Workers who perform these job functions are mostly stationed at the two control rooms located within Complex I and II. The rooms serve as offices and meeting points for other co-workers (such as the engineers and safety officers) who are not directly performing work at the field. Access to these two complexes is restricted to employees of the company and visitors are escorted by a staff member. Rules and standards are to be strictly observed during the visit which includes maintaining high standards of personal hygiene. For instance, clean footwear is provided for visitors when entering the control rooms to protect against possible contamination.

Overall, it is the distinct work setting where human movements and work processes are constantly under close surveillance for safety and security purposes. Observations of how tight security was enforced at the plant in different ways such as pervasive use of video surveillance and stringent access control depict the importance of safe work in a perilous work environment. In particular, the ubiquitous use of safety signs was another prominent characteristic of the perilous work context. Inherently, these regulatory practices contributed to reinforce safe learning as workers were constantly reminded and guided through close supervision in their everyday work.

For the purpose of discussion for this thesis, SPCC is identified as the host plant.

3.3 RESEARCH DESIGN

A qualitative methodology in a case site was adopted to understand how safety knowledge is constructed and learnt from day-to-day practices and experiences from those work tasks. This is the focal point of the study of a petrochemical workplace. Central to this, the interest of the study is on exploring and understanding individual perspectives and experiences about learning and practice for safety.

Since the topicality of this research is around workplace learning, the primary interest thus resides in the individual workers' learning. Semi-structured interviews were conducted with workers at the particular plant site to understand how they learn through involvement in handling and managing safety issues and practices. As workplaces are often contested environments, complicated by the miscellany of learner idiosyncrasies, the case study aims to understand the social processes for learning. This provided in-depth insights about how workplace learning contributed to realizing safety performance. The research approach also identified critical learning points that provided the basis for a conceptual framework to enhance workplace learning in perilous work settings.

Being qualitative in nature, the inquiry is grounded as a case study which is considered suitable for addressing descriptive or explanatory questions to produce first-hand understanding of the studied phenomenon (Yin, 2009). This study is exploratory and descriptive in nature for two primary reasons. The aim here is to identify "what is going on" which describes well the intent of qualitative inquiry. First, it attempts to develop an understanding of how individuals learn to work safely in high-risk work situations as in the case of the petrochemical work setting. The study also describes the workplace's processes and practices through the workers' interpretations and experiences. Secondly, as the nature of the work performed by these workers is largely situationally based and constrained, the context is highly pertinent to the study which supports the use of a case-study design (Yin, 2003). A better understanding of the personal factors, situational processes, and practices that occur in the workplace context, informs practical strategies which can be applied to other similar work circumstances or contexts.

3.4 THE PARTICIPANTS

Like in any other industrial setting, workers at the site are employed in ways typical of a petrochemical facility. They are organized either by departments or work groups. Most workers are engaged as engineers, maintenance technicians, or general plant workers. While plant workers are primarily engaged in the production processes such as packaging or preparing product for shipping, maintenance workers are generally involved in carrying out

both routine and non-routine maintenance of the plant. This includes routine tasks such as conducting regular inspections and replacement of mechanical parts, and non-routine tasks such as conducting inadvertent investigations and repairing leakages or equipment failure. As these workers' jobs are directly involved in handling or working with dangerous chemicals, equipping themselves with adequate safety knowledge and the ability to work safely are necessary in their field of work.

Twenty site operators were selected, including both direct and indirect employees who are involved in different technical roles. Given the nature of process work is bounded by interconnected practices, it was important that contract workers were invited to participate in the study. Their participation provided insights on how learning might traverse within the boundaries of different work communities at the site. The intent was to select a purposeful sample that would have the best knowledge to provide rich and thick data (Merriam & Simpson, 2000). The sample size was deliberately maintained at 20. First, the study was intended as qualitative research focused on depth rather than statistical significance. Second, the sample should not be too small making it difficult to achieve both data and theoretical saturation, as well as redundancy of data.

The participants were mostly shift workers or on contract arrangement, a convenience sampling strategy was considered most appropriate to accommodate their work schedules. Principally, the selection of participants was subject to their willingness and availability to participate (Creswell, 2013). However, to add richness to the data, an arrangement was subsequently made through the plant manager to include workers from different age groups, cultural backgrounds, work experiences, job roles, and employment status. The intention was to gain a comprehensive insight into how different individuals learnt and practised safe work within their respective occupational roles and how they participated and engaged with others in a perilous work context of complex interconnected practices.

Table 4 provides a summary on background details about the 20 participants.

Table 4
Participants' Background

Category	Descriptor
Gender	Male
Age	25 to 54 years
Nationality	Non-Resident = 7 Resident = 13
Employment status	Contract = 7 (<i>also referred as work permit holders who are non-resident workers employed on a contract basis governed under the national foreign worker policy</i>) Permanent = 13
Length of service	> 10 years = 8 6 – 10 years = 6 2 – 5 years = 5 < 1 year = 1
Occupation	Manager = 2 Supervisor/Foreman = 4 Safety Officer = 3 Technician = 8 General Worker = 3
Educational qualification	Degree = 4 Polytechnics/Technical = 9 Secondary/High School = 6 Other = 1

3.5 INSTRUMENTATION AND PROCEDURES

The actual investigation was advanced through two major phases. The first phase of the study primarily focused on document review, analysing the organizational mission statement and values, safety policies and programs, and operating procedures and guides to draw insights on how safety is practised at the work site. Samples of documents such as log sheets and organizational charts were collected during the interviews. Overall, the documentation not only provided important background information on the organization's safety practice but was subsequently used to verify claimed beliefs and perspectives. The researcher also observed different points of work sites at the plant such as the control rooms, staff library, and workers' quarters. She also had participated in workers' toolbox meetings to observe how the meetings were convened. This experience was helpful in understanding and interpreting the workplace context.

The second phase of the inquiry entailed a series of face-to-face interviews. The purpose of the study was to elicit in-depth understanding of individual learning and experiences, face-to-face semi-structured interviews presented opportunities for deep discussion and clarification. A predetermined set of questions that were relevant to the research objectives and served to guide the flow of each interview discussion. The questions were intentionally open ended and conversational (Yin, 2009) to allow the researcher to validate the meaning of the respondents' responses. More importantly, the use of pre-planned

questions not only allowed the researcher to have the flexibility to make necessary adaptations to the line of questioning and generate a diversity of responses, but also effectively kept each interview from being overrun. This approach was helpful particularly for participants who were from a non-English speaking background and needed prompting to express their thoughts. The language difficulty tends to be a common problem among any diverse work community (Trajkovski & Loosemore, 2006). The interviews were conducted during work hours. Each session had to be completed within the timeframe to minimize unnecessary disruption to participants' work schedule.

Each interview lasted between one to two hours. They were mainly conducted in a meeting room. The natural and enclosed setting provided the necessary privacy.

Prior to the commencement of each interview, each participant was reminded about the research purpose and the process carefully explained. They were also asked to complete an information sheet that captured personal information pertaining to their demographic and work backgrounds. Such personal information was useful for profiling and making necessary variations to guide the conversation during each interview. Participants were also asked to indicate any past training information. This provided some indication of their learning pattern and validated pedagogical practices as claimed by the management. The information sheet can be found in Appendix C.

Overall, a conversational style was used in the interviews because a narrative approach is useful for gaining insights into human agency and life events that contribute to understanding how individuals make meaning and enact their lives through their personal stories (Sandelowski, 1991). The interviews were staged according to the sequence and relevance of the research questions. Principally, the questions aimed to draw information pertaining to an array of personal, situational, institutional, structural, and cultural issues that may influence workers' learning and practice of safety in a regulated work setting. These key categories also framed the format to guide the conduct of the interviews which made it easier for data analysis, coding, and comparison of the findings through a common format in a logical order. Essentially, the sequence of questioning was developed to first gather broader background information before progressing to explore more specific perspectives and experiences by probing for details and examples. This way of sequencing the interview presents a more logical flow to address the investigation themes and effectively guide the participants systematically through the use of conversation, discussion, and questioning (Marshall & Rossman, 2014; Newton, 2010).

Table 5 presents the list of the interview questions and the corresponding objectives used to generate these activities and guide the flow of conversation. The interviewing questions were used only as a guide.

Table 5
Interview Questions Guide

Issues to be investigated	Questions	Purposes
Workplace practice and job role How does workplace contribute to learning? What are the learning affordances in the workplace? How do individuals relate their learning to their occupational roles and guide own practice? How does individual receive the learning and guide their practice?	Can you tell me about a typical day at work and how it relates to workplace safety and health? How do you learn about safety in your workplace, and what can you say about your experiences? How does your company support your learning? What other ways do you learn to help you work safely?	These questions provided possible insights to: Contextual influences that shape learning and practice Key workplace affordances that contribute to workers' learning and practice Dispositional and agency issues that guide learning and practice
Specific circumstance How does formal and structured training contribute to learning safety? How does peer learning provide guidance and contribute to learning safety? How does guided learning occur and contribute to learning safety? How does situational and incidental learning occur and contribute to learning safety? What is learning experience and how does each of the circumstances influence individual's thinking and action?	Can you share a classroom training session you have attended? What is your experience? Can you tell me something you learnt from a peer? What is your experience? If you were responsible for a new worker, how would you help them learn about safety? Can you describe a situation where you are not sure how to do a job safely and need to get help? What is your experience? Was there a situation where you think there was a better way to do a job safer but not according to the prescribed standards? What did you do?	These questions provided possible insights to: Social and cultural influences on learning and practice Distinct qualities of learning through intentional and those that occur incidentally or situationally Dispositional and agency influences in responding to situationally demanding circumstances
Enhancement Are there any potential challenges or limitations that impact learning and practice? Are there ways to optimize workplace learning?	In your opinion, how can your company help you best to learn to work safely? Are there any changes you think will help to improve workplace safety?	These questions provided possible insights to: Possible tensions faced by workers in their course of work that impact workplace learning and practice Identify critical attributes and qualities to enhance workplace learning and practice

The questions focus on how individuals relate their experiences to their job roles and workplace practices, particular learning or work situations, and personal views about possible ways to improve learning. These three dimensions inform the role of the workplace as a learning site, the significance of agency and dispositional influences, and the interplay between the two key attributes in contributing to safety learning and practice. It also includes experiences in adapting to the circumstantial demands in a perilous work context.

The interviews commenced with participants telling about their work in relation to safety practice. The intent was for the participants to think about their learning and practices on a broader scale. Such questioning allows participants to develop their personal reflection and experiences of the subject matter. More importantly, a story-telling approach also allows the researcher to build rapport with the participants and discuss topics that may maintain their interests throughout the interview. The rapport-building process is necessary to ensure that participants will be comfortable to share their personal stories and views particularly when the study was conducted in a masculine and command-controlled work setting. For instance, one participant who initially provided very brief and pithy comments. He was apprehensive about the research purpose and sharing his personal stories with a female researcher. However, after realizing that the researcher shared his perspectives about the importance of safety practice, he candidly professed that his austere character had a significant influence in contributing to his proactive attitude towards working safely. Such information thus added richness in terms of dispositional influences.

Subsequent questions focused on identifying key learning affordances in workplaces which participants have utilized to support their learning and practices. One particular challenge during the interview was getting participants to understand and relate how learning occurred beyond attending traditional classroom training, and to describe their experiences. Though many participants were not readily able to relate how their participation and engagement in workplace activities was perceived as a way of learning (which reaffirmed the interweaving relationship between work and learning), they did acknowledge the contributions of learning opportunities. These experiences suggest an array of different institutional, social, and personal contributions such as working with experienced peers, participation in social circumstances, and being involved in problem-solving activities.

More specific questions with respect to particular learning or work situations were discussed during the interviews. The intent was to elicit deeper insights into situational and dispositional factors through the participants' stories. Hence, situational questions such as how they may handle a workplace problem in the absence of guidance from their supervisors or in ambiguous situations were asked. Role-play questions were also raised to have the participants reflect and share their perspectives on learning experiences such as their

experience in providing guidance to a new worker. As the participants verbalized their stories and experiences, they shared their understanding of what they perceived as working safely and provided examples of critical life events to exemplify safe working. During the interviews, the researcher was mindful not to impart personal judgment of what was considered safe or appropriate. Billett (2009, 2010a) reminds how individual past histories and epistemologies can determine learners' agency. The intent was to allow the participants to explain what they believed in order to understand the underlying motives or influences that guide their practices.

Last of all, participants were asked to discuss some of the challenges or tensions that they faced in circumstances of work in relation to their learning and practice. This data informed the research objective of improving workplace learning by uncovering those workplace discourses that may have received parsimonious attention, particularly in a controlled and regulated setting. These insights could have a serious impact on both learning and practice if they are not appropriately addressed.

3.6 DATA ANALYSIS

As suggested by Flick & Gibbs (2007), it is critical that information is accurately captured through the transcription process to ensure procedural reliability. The audio recorded data from the interviews was transcribed verbatim by professional transcribers. The verbatim transcripts were found to contain grammatical errors as many of the participants are from non-English speaking backgrounds and what was reported, therefore, needs to be understood within a specific context or subject knowledge. Each set of the transcribed interviews was reviewed and validated by the researcher while referring to the original taped interviews to ensure content clarity and accuracy. Concurrently, clarification with the participants and verification against the organizational documents were made to validate some of the statements and terms of reference. Many related to specific practices and technical requirements for safety practice. The edited transcriptions were imported into a word processor and a work spreadsheet was used to capture the participants' demographic information.

Data analysis was conducted based on inductive analytical approach, primarily oriented towards a descriptive and exploratory research design was applied (Guest et al., 2011). As an exploratory study, the analytic approach was designed to be content driven, aiming to search through the data to identify key themes and recurrent patterns of the phenomenon. This was achieved by identifying emerging clusters of related categories of issues conveying similar meanings that informed the research questions. Interpretations of the interviews with the workers were also supported by observation notes recorded during the site visits. To maintain confidentiality, each participant was assigned with a pseudonym.

Principally, the analytical procedure adhered to steps for thematic analysis suggested by Guest, MacQueen, & Namey (2011)). The intent was to identify relevant themes in the data to address the research questions. Hence Yin's (2009) suggested strategy of applying the study's theoretical framework to analyse and interpret thematic data, the coded data was examined to identify patterns. The analysis of the interviews commenced with an iterative process of reading and coding the interview transcripts. The first round of coding focused on examining the raw data and labelling them to identify key learning provisions such as 1) toolbox meetings, 2) safety training, 3) videos, 4) working with supervisors and seniors.

An initial list of codes was compiled and the process was repeated numerous times to revise and refine the codes. The codes were then classified into categories and subcategories related to the issues under investigation according to the broad themes such as 1) guidance, 2) practice-based learning, and 3) peer and social learning which were identified to be relevant to safe work learning. During the process, if a theme arose which did not fit directly into the initial list of codes, a new code was added. For example, participants' account of their personal experiences which were non-work related but found to have impact in shaping their thinking towards working safe. For instance, a new code for individual agency was developed to capture how these personal experiences which may not be work-related contributed to safe work learning. When no new concepts or themes were found, coding had reached a natural saturation point and no further coding was found necessary. The final level of coding entailed further refinement by reviewing and drawing interpretations from the coded data to understand how each of these provisions were experienced, their qualities and purposes that contributed to safe learning. The intent was to identify key emerging themes to address the research purpose.

Consequently, the findings were used to build narratives and explanations on each unit of analysis (Yin, 2009) in terms of how workers were supported with learning and factors that may have influenced their experiences. Figure 6 provides an example of the use of software to conduct the coding and analysis process.

Quotes	Respondent	Practice or Experienced Based	Direct Guidance	Peer or Social Participation	Problem or Situated Based	Self Directed
Definitely, because you are doing it more. Maybe last week you have done once. Then today I am going to do one more time. That means I know more about what to do. I do it more faster. More practice you become more perfect.	T1	X				
Like I was saying about the safety specs thing, once I experienced the pressure hose. So when I dismantling the hose, spilled to me. Actually I was wearing safety specs. That experience teaches you this for life. So this kind is what you call near-misses. Near misses teach you for life. Like driving, once you have the experience. When it doesn't happen, can't relate or understand the importance.	T3	X				
Experience factor.	T3	X				
Learn more on site.	T1				X	
Job is very normal and routine.	T1	X				
Peers who have done it more. Upon doing it, becomes a routine.	T4	X				
Working with external parties like vendor and contractors.	T4, T5			X		
Job rotation. Rotate from one section to another section.	T1, T5	X	X			
Yeah I think we have because for example our field work, in the field work sometimes we do things cannot everything follow said procedure, sometime procedure is not very safe to follow when you look at the environment, when you look you know the situation.	T5	X			X	
It is not SOP, for example, live purging no procedure, live purging, okay normal live purging, you shut off the valve and then you one line purge, the other line go to drain or something like that, and then before they go for this hot work or cold work, then they need to do gas check and then the procedure, the whole procedure sometimes can be amended not really need to purge from here and then need to be flexible, sometimes need to be flexible.	T5				X	
This one for example we want to drill hole, the explosion caused, explosion fire is triangle, for example, we have got oxygen, we have got heat, we got fuel, then that will cause the explosion. So once we drill hole, make sure if inside, if inside is fuel, that means it is dangerous. And then we have got to remove one of the elements. The heat is definitely there when you drill hole, the heat is there so we want to remove oxygen, make sure no oxygen inside or nitrogen and continuous nitrogen. Then if there is nitrogen, nitrogen will be purged out. It is not oxygen going in. Oxygen going in is dangerous and then how to prevent it up to the sense that you feel okay, all the knowledge for example the knowledge that we have can be applied to this or not. And then if still not safe, discuss with contractor. The contractor may have some better good idea. And then sometime maybe if for example cannot remove the oxygen, cannot remove the fuel, maybe the fuel is present. Maybe we can remove the heat, we can do a cold cut.	T5	X			X	
To sense, can say sense, common sense, instinct, sometime instinct also, but what I feel is safe, what I feel is safe.	T5	X			X	

Figure 6. An example of the coding and analysis process.

The dataset was consolidated and sorted into different categories of learning provisions which may entail more than one particular form of learning or provisions. For instance, participants cited how learning to problem-solve occurred by attending to unexpected situations during field work. As these occurrences also contributed to building on their experiences, such situationally based learning was thus considered and grouped under the key theme of everyday practice and experience. Such a reiterative process refined and consolidated the data into salient themes that helped to address the research purposes. Concurrently, the findings were also analysed and compared with field notes recorded during observations, for instance, how workers participated in toolbox meetings and visiting the different sites of the plant such as the staff library, control rooms, and workers' quarters.

For the analysis, the role of observational data is also instrumental to provide both the contextual information needed to frame the investigation and make sense of the data collected from other methods such as interviews and document review. This is critical and helpful to address the logistical constraints in accessing information particularly in a secured workplace such as the petrochemical plant. For instance, the researcher was able to observe how toolbox meetings were conducted at the work site and among different groups of workers which gave insights into its contribution as a critical learning provision in day to day and routine work. Subsequently, the observational data was also used to clarify and reaffirm the researcher's understanding and interpretations of the findings and validate the data collected from the interviews. For example, participants shared about what their supervisors would advise them on safety during the daily toolbox meeting. This information was validated with the researcher's observation and subsequently used to report the findings.

Through a reiterative process, the data were re-examined, validated, and interpreted according to the key themes. Throughout the process, additional information was added and organized to support the respective themes. The major themes were consequently reviewed and refined by re-examining the supporting data and literature to accurately relate the key learning affordances utilized by worker. These also included institutional, social, and personal imperatives that influenced the learning and practice of safety considered to be pertinent in addressing the research questions.

As the investigation was conducted exclusively by the researcher, individual bias was also acknowledged. Creswell and Miller (2000) ascribe the assessment of validity to how the various stakeholders such as the researcher, the participants, or the readers determine the accuracy of the findings. As such, feedback was sought from the researcher's supervisors to verify if interpretations were congruent with the context and practice requirement.

An overview of the data collection and analytical steps is presented in Figure 7.

Figure 7. Methodological framework.

3.7 ETHICAL CONSIDERATIONS AND INFORMED CONSENT

Prior to commencing the data collection, ethical clearance was sought from the University Human Research Ethics Committee in accordance with Griffith University's policies and procedures.¹ Issues concerning the basic rights and safety of the participants, relevance of questions asked to inform the research, and plausible measures to protect privacy and confidentiality were carefully considered and explicated in the application. The investigation only commenced upon securing approval from the case site. This research was also supported and funded by the Institute for Adult Learning Singapore (a government research organisation), ethics clearance and approval were also sought and granted by the institute².

In this study, ethical issues are largely concerned with the procedural or relational aspects in conducting the investigation. By definition, procedural ethics relate to the substantive content of moral decision, independent values, and moral significance of decision-making (Gang, 2008). The emphasis is on the nature and negotiation of the process and procedures for the investigation. Though relational ethics are commonly associated with medical and healthcare research associated with ethics of care (Bergum & Dossetor, 2005; MacDonald, 2007), it is also pertinent in social research. This study places the importance on respect for personal privacy and acknowledges that the relationship between the participants and the researcher can potentially influence the research process and outcome.

One of the important aspects of ethical issues pertains to privacy and anonymity. The collected data contain information on the organization and individuals, therefore both institutional and individual privacy were addressed and maintained (Litchman, 2012). Data were collected primarily through semi-structured interviews and text from official documents. The issue of privacy invasion, therefore, represents a considerable risk when relying on these sources of information (Baez, 2002; Biber et al., 2010). While the use of semi-structured interview aims to elicit each individual's perspectives and experiences, the approach requires participants to share and disclose their thoughts, feelings, and practices that may be personal or private. Procedures for eliciting data also relied on the interviewer's interpersonal skill to establish rapport and trust with the participants. This considered ethically sensitive (Newton, 2010). Likewise, information extracted from official documents may contain commercially sensitive information that is restricted from public access. Permission to use the materials was therefore sought from the organization.

As a way to safeguard participants' privacy, information collected was treated in strict confidence. The interviews were conducted individually, allowing the researcher to better control any personal information from being shared with other participants which could

¹ GU Ref No.: EDN/50/13/HREC

² Ref No.: IAL- 029-116-0912

potentially cause distress to the interviewee. Throughout the interview, a conscious effort was also made to assure participants that their participation was voluntary and they would not be subject to any penalty if they withdrew at any stage of the inquiry. The names of the participants were kept confidential between the plant manager and the researcher. Prior to each interview, the researcher made an attempt to explain to the participants about the research purpose and address any concerns or queries.

A consent form (see Appendix D) was developed to obtain participants' agreement to participate in the study. The conditions and procedures were succinctly outlined so that the participants adequately understand what was entailed throughout the inquiry process. These included the use of a recording device, how the data would be stored and used, as well as providing relevant contact information by which the participant could seek clarification or redress if they had any concerns. Many of the participants are operative staff and considered as vulnerable subjects. A primary concern was to ensure that they were not feeling obligated or coerced to participate for fear of being seen as not complying with management directives that potentially threatened their employment. The consent form thus highlighted that their participation was not mandatory and they could withdraw from the study any time without any penalty or their employment being implicated. These conditions and procedures were explained personally by the researcher to each participant to seek their assurance during the interviews.

3.8 PILOT STUDY

Prior to the main study, a preliminary pilot of interview questions was conducted in 2013 with three site operators from an established construction company. The purpose was to review and evaluate the study design, particularly the data-collection procedures and instrumentation. Aside from availability and accessibility, the three participants were selected because they had good working knowledge about workplace safety issues and years of experience at different construction sites, including carrying out similar trade tasks at other process plants. Principally, the intent of the pilot interviews was to ensure that the interview questions were appropriate to the context of the study and were clear and unambiguous (Creswell, 2013). The piloting provided useful practical insights on how site operators learnt about safety in their daily circumstances of work in a high-risk work setting. More importantly, the information helped the researcher to gain practical insights into the subject on safety practice and experience of real work situations.

In addition to the pilot interviews, comments from both the researcher's supervisors and peers (who work at the same research centre with the researcher) were sought with

regarding appropriateness of the interview questions. Some of the questions were revised for clarity.

3.9 LIMITATIONS

One of the major criticisms about the approach adopted here is the issue of generalizability from a single case which could potentially threaten its credibility (Denscombe, 2007; Stake, 2005; Yin, 2003). It was important to enhance the value of the study through a consideration of validity. Although the study was conducted at a single site, with the aim to learn about exemplary practices, the organizational profile and the context represent an epitome of typical petrochemical work setting. More importantly, the face-to-face interview approach allowed the researcher to elicit more information and gain clarification through a natural exploratory conversation. This process is critical since the primary interest of the study is centred on individual experiences which could be articulated in different ways and could embed details of critical events that may not be uncovered in quantitative studies. Collectively, these data provided deep insights gathered from various key informants (Marshall & Rossman, 2014).

Another potential limitation pertaining to the credibility related to a male workforce. The researcher was cautious about the gender dominance and power relations when conversing with the participants who may have reservations about sharing their personal experiences and views with a female researcher. Building on the researcher's past knowledge and experience working with migrant workers, she was able to appreciate the cultural diversities and relate well with the participants. To mitigate the potential risk of power relations, the researcher was conscious about her disposition and the importance of maintaining a modest attitude. The exploratory approach also served as non-confrontational and allowed the researcher to gain participants' trust and acceptance. Many of them were willing to share their seemingly candid views and keen to impart their knowledge because they perceived the researcher as a learner rather than an expert or someone evaluating their practices. This helped the researcher to elicit information that may not be apparent yet is important to understanding how learning occurred.

3.10 SUMMARY

This chapter described and explained the rationale for adopting a case-study perspective as an appropriate approach for the study. The detailed research design and methodological procedures outlined the sample population, adoption of instrumentation, and ethical issues. Details on the data-analysis process through the use of a thematic approach and cross checking with peers. Lastly, potential limitations were discussed, including explanations on how these were mitigated and addressed. The findings are discussed in the next chapter.

CHAPTER 4: LEARNING SAFETY PRACTICE IN THE WORKPLACE

4.1 INTRODUCTION

The purpose of this study was to develop an understanding of how workers in a perilous work setting acquire their safety knowledge and learn to work safely through their everyday practice and work circumstances. From the data, it is concluded that safety is not merely an independent object of knowledge to be learnt. Instead, it arises through the enactment of practices that are shaped and influenced by an array of social, physical, cultural, and interpersonal forces in the work setting. The research examined how learning occurs beyond conventional classroom-based safety training classes as a primary means for the development of occupational knowledge and skills, and how individuals learn as they actually engage in their work (Wenger, 1998). Attention was also directed to consider shared routines and procedures, sensibilities, artefacts, media, and a repertoire of professional practices distinct to the workplace community.

While some of these practices and experiences may not be new and are commonly found in empirical studies on workplace learning, the contributions of this study lies in how safe working is learnt in a command and control (i.e., highly regulated) work setting. The study also highlights significant imperatives in the workplace that shape and guide safe working is pertinent to a local context. Essentially, the findings presented in this chapter are discussed to address the following research questions:

1. What are the current provisions of learning for safety and health in a process plant?
2. How do the workers participate and engage in workplace learning for safety?
3. How can their workplace learning be optimized?

4.2 KEY FINDINGS

Six salient learning provisions³ which have contributed to workers' learning and enactment in safe work practices were identified. These include:

1. Safety training for skills currency and effective communication
2. Quality and appropriateness of expert guidance
3. Practice curriculum for knowledge distribution

³ For the purpose of this study, the term "provisions" covers a broad range of activities, intermediaries, and artefacts that are either intentionally or unintentionally provided for or are utilized by workers to learn and work safely.

4. Everyday practice and problem-solving for skills and knowledge refinement
5. Artefacts and materials for developing awareness and compliance
6. Disposition, values, and goals as agentic impetus

These six learning provisions capture the different ways in which workers in a process plant may access, participate, and engage in their work circumstances to help them learn and practise safe work. These learning provisions are provided largely through intermediaries (e.g., other workers), workplace activities, and artefacts that help participants to acquire, develop, and transform information into necessary knowledge and skills to work safely. While some of the provisions are intentionally developed to help the workers learn and work safely, they could also occur incidentally. Each theme is examined and discussed in detail in the following sections.

The workers engage in rhetoric and discursive practices when enacting, applying, exercising, realizing and practising safety procedures. Interpretations of the interviews with the workers are supported and augmented by the researcher's observations. Verbatim accounts of the conversations reported here have numerous grammatical errors. This is because many of the participants are foreign workers from non-English speaking backgrounds and showed low levels of proficiency in English. To ensure that the participants' views were interpreted correctly, clarifications were sought during the interviews.

4.3 SAFETY TRAINING FOR SKILLS CURRENCY AND EFFECTIVE COMMUNICATION

In process work, safety training is important primarily as a way of regulating access for entry into employment and continuity to maintain currency and capacity to work safely in a perilous work environment. Risks associated with workplace safety and health are inherent in the petrochemical industry. To the organization, good safety performance can only be realized with a well-trained and competent workforce that will learn to be cognizant of immediate work hazards and occupational risks and be able to work safely and responsibly for both their personal safety and that of the community. Several important themes pertaining to how safety training contribute to workers' learning were discussed in the interviews.

Most of the workers reported that mandatory attendance for entering the trade and improving their occupational practice were the primary reasons for attending safety training. To understand how workers access safety training, participants were asked to indicate how frequently they attended training during the past 12 months. Table 6 provides a summary of the frequency of training as indicated by the participants:

Table 6
Frequency of Training by Number of Participants (Last 12 Months)

Frequency	No. of Participants
None	3
1	2
2	5
3	1
4 or more	9

The findings showed many of the participants attended safety-related training more than once during the past year. While time constraint was a common reason for not being able to attend training regularly, most participants claimed that their employers would support their requests to attend training. Mohammed, who works as a Technician with the host plant, spoke of how workers could just inform their employer if they want to attend training:

If we want certain training, you can ask for it, you can opt for, there is no restriction. They won't say no.

What Mohammed's remark suggests is that, there is generally a supportive learning culture to foster active learning among the site operators. Though most participants were ardent about attending training to improve their vocational knowledge and practice, they were also apprehensive about being absent too frequently from work, as attending training requires reordering of any planned work arrangement and crew duties.

It is evident that safety training remains an important source of learning for safe working, when working in such a precarious work setting. Providing workers with consistent and adequate training is seen as critical to help them cope with the complex work demands safely. According to the plant manager, periodic reviews are conducted to identify critical skill sets that are needed to help workers advance specific areas of their occupational knowledge. Two particular sets of information are used to analyse and identify gaps in training. First, incident rates are captured as part of the safety performance management system to identify any high-risk activities that may present possible learning gaps. Second, feedback from the contractors and co-workers provides another useful set of information for developing training plans and learning arrangements.

During the interviews, three distinct areas of safety training were cited which participants claimed to be necessary for their practice in process work:

1. plant safety (pertaining to the overall safety practice within the plant);
2. process safety (referring to work processes); and
3. personal protection safety (associated with the use of protective equipment and preventive measures against exposure to workplace hazards).

From the organisational perspective, it is important that site operators possess good knowledge in these three aspects of safety practice given the perilous work setting. The plant manager redefined these sets of knowledge to three major skill sets which are critical to the context of the plant operation: a) conceptual knowledge, b) procedural and applied knowledge, and c) communicative knowledge. These different types of knowledge are seen necessary to deepen workers' understanding and practice of safe work beyond the statutory knowledge. The capacity to understand and the ability to enact appropriate work procedures to operate and maintain equipment safely, as well as possessing adequate literacy skills to improve comprehension and communicate effectively, are also seen as imperative to working safely.

Some common themes are observed as the participants discussed about the different learning experiences they had from attending safety training. These themes are presented in section 4.3.1 to 4.3.5 which provide insights into the nuances of learning to work safe through structured training.

4.3.1 Mandatory training for practice

One common issue cited by participants was related to the importance of how safety training was made mandatory to prepare them for the trade. Workers who are new to the trade are required to attend mandatory safety training to help them work safely in a process plant. The Oil and Petrochemical Safety Orientation course (OPSOC) and the Construction Safety Certificate course (SOC), which aim to provide foundational knowledge on the nature of process and construction work. Many participants conceded that such training is critical and necessary to help them learn how to work safely in a high-risk workplace such as a petrochemical plant.

As a practice requirement, new workers will need to attend a 1-day induction program that is conducted at the training centre located within the plant. The training primarily aims to educate and prepare new workers with the safety knowledge pertinent to the specific operations of the plant. Though these induction programs are mainly provided by external training providers, the host plant also provides similar training for site operators to readily access these learning opportunities. Ravi, a foreign worker who has worked in Singapore for more than six years and currently holds a supervisory role, explained the nature of induction programs as a way to help newcomers learn about the safety rules and practice-requirements:

First day we join the work, people must training in-house. The people training one day, they have to talk all the complex rules and regulations. [sic]

Workers who have attended the induction training are taught different facets of workplace safety practice. These include identification of workplace hazards, proper use of protective equipment and material handling, appropriate and safe behaviours, and acceptable norms and work practices when working in a process plant. In other words, these comprise declarative knowledge which provide factual insights to prepare workers for undertaking their occupational roles. Given the perilous work environment, these types of knowledge and skills are necessary to help workers learn how to prevent workplace accidents and injuries by adopting safe work practices. Explicit rules and practices more so with prevalent contracting work arrangements in the industry. Contract workers may be required to perform work at different petrochemical plants and may have to attend additional training to learn about specific rules and practices established by the respective petrochemical plants. Ganesh, who works as a foreman for a resident contractor, mentioned that he had to attend similar training when he first joined the trade. The first training was provided by his contracting employer and the subsequent training was provided by the host plant when he was assigned to work at the site:

We have the in-house, our company own training for even my hydro-jetting work, they have give a training before we come to work.

His experience exemplifies the need not only to reinforce those declarative knowledge and provide workers with understanding that serves to promote institutional learning.

Learning about contextual and practice requirements is an important way of learning to work safely. Many of the participants explained how contextualized content provides meaningful learning and improves their understanding of the plant's operating policies, procedures, and practice requirements. Likewise, attending multiple training is helpful in deepening understandings and reinforcing knowledge about working safely. John who is a recent school leaver, highlighted how attending the induction training provided practical insights into the work context and practice requirements of the trade which he did not learn in school:

To me it's useful because most of us do our time in school or maybe you don't learn the same industry as what we want to expect. So, I think safety course is essential.

Attending training in this instance, thus provides linkages to organisational processes and practices (Choy, 2009).

The emphasis on learning and knowing about the work context is observed as a critical attribute for safe working. The plant manager reiterated the need to adapt the training

curriculum specifically around the plant's setting and practices so that what workers learn from the training will be relevant to their practice at the site. This is critical particularly in process work where the nature of the interconnected work demands that all site operators have adequate knowledge of how their practice may implicate the safety of others and the overall operation of the plant. Peng, who works as a safety supervisor with the host plant, emphasized the importance of induction training as a way for contractors and their workers to learn about the explicit rules and practices when working at the site:

Our contractors have to follow our practices. They have to attend orientation before they come in to work with us. Spell out to them what they should do or not. If they are not doing safely, we have the power to stop them.

Such practice requirement reiterates the importance for all levels of site operators to possess adequate knowledge to work safely in a precarious workplace. Correspondingly, the significance of workplace context is also evident here. Learning to work safely is seen as a collective goal where watching over co-workers' action or behaviours, and correcting them which is necessary practice for safe working.

4.3.2 Maintaining skills currency

Many participants held in high regard about how attending safety training to cope with demanding work conditions. This is more so in a process plant which is inextricably bounded with complex technical and regulatory requirements. Workers therefore need to continually advance their knowledge and skills in order to respond effectively. This includes learning to operate contemporary technology, even for workers who have been in the trade for a long time to maintain their skill currency. Apart from learning new knowledge, a few participants explained that training also helps to recollect knowledge which they may not apply in everyday work. One example is the Fire Prevention Safety course which is mandatory. Working in a process plant means individuals are often exposed to corrosive and carcinogenic chemicals and toxins. Training in fire prevention and safety measures is therefore critical to renew and refresh workers' knowledge and skills. All workers are required to attend the same training once every 3 years. Experienced operator Loh, who has worked for almost 20 years with the host plant, supports the need for continuous training; because workers may become complacent over time if the knowledge and skills are not reinforced:

Refresher course, e.g., Firefighting. Because after sometime, you become complacent with your work.

For John, attending safety training addresses a similar learning need in helping to revisit past knowledge he learnt in school. He further emphasized the importance of training, particularly for local male workers who have to complete 2 years of conscription (otherwise known as “national service”) prior to joining the workforce:

It will be good because we serve National Service for 2 years. You just need something to refresh your mind. Like firefighting, something new so it's kind of fun and you generally want to know what you are going to do.

These experiences suggest that safety training is well regarded for the purpose of providing ongoing occupational development as a way to maintain skills currency and cope with job exigencies. The examples cited above also indicate the need to reinforce different forms of safety knowledge. Attending training in this instance, thus provides linkages to organisational processes and practices. This is far more critical in high risk organizations where workers need to be able to effectively apply their skills and knowledge in a safe manner in all circumstances. The reciprocal contribution of both declarative and procedural knowledge is evident here. While declarative knowledge learnt through training or text helps to provide foundational understanding to work safe, procedural knowledge gained through enactment of work is helpful to reinforce those declarative knowledge.

4.3.3 Learning to communicate effectively

While mandatory training and maintaining skill currency are regarded as critical ways of learning to work safely, the findings show that safety training does not focus on merely developing workers' technical skills. The ability to communicate effectively about safety is perceived as equally important in order for one to work safely. This is particularly so as a significant pool of the contract workers at the plant are from diverse cultural backgrounds and do not share a common language. Though most of the safety training classes are mandatory to meet statutory requirements, one particular exception is the on-site English language class specifically provided for site operators to help them learn and understand how to work safely more effectively through improved communication skill.

Ravi described how his employer supports workers' learning by providing financial support to subsidize their training costs, and encourages them to actively participate in different training opportunities:

Last year we send 10 workers, other company they also language course. English language course. They take each worker \$50. Company pay. My boss say never mind. It will be good for workers to go communication. Our

company management say never mind this who's going they easy to communication. This language understand then easy to communication, so send. So we send 10 persons to go this course. [sic]

Ravi explained that employer's support is helpful by lessening workers' financial burden, particularly for foreign workers who are not earning high wages.

Essentially, workers' literacy skill is seen pertinent to improve communication and raise awareness about being safe at work. Workers' ability to communicate effectively about safety errors, sharing error knowledge, and fostering greater compliance and participation in safety activities are equally important. Despite language training being seen as important for learning to work safely, participants did discuss some inadequacies of the language training. For instance, Ganesh had qualms about the effectiveness of the language classes because of workers' low literacy (as many of them were from developing countries, with little education):

All the safety course they also give our language but the people still don't understand. Language problem. They got different languages. Even same language also they still difficult [sic]

Many participants in the class were not able to understand even if some of the classes were taught in the workers' own native languages. More experienced workers helped to translate and explain to their peers in "their native language". One particular example highlighted by participants was the use of multiple choice questions used to test workers' knowledge about safety. This did not assure that workers understood what they were taught. Another participant Loh explained that videos were a better source of learning as the visuals helped their understanding.

The experiences cited above illustrated how potential constraints such as language and literacy limit workers' learning from the training, and the reliability of the assessment approaches. While adequate literacy and language skills may not be the primary focus in most safety training, they serve as the prerequisites to support the circulation and transfer of knowledge effectively. Despite so, the findings also suggest possible pedagogical interventions to address these learning constraints by considering mediating artefacts such as audio-visual tools, and possibly a 'plant language' to help workers learn more effectively and meaningfully.

4.3.4 From theory and practice

The importance of relevance between knowledge learnt in class and its practice is another salient point discussed by participants. James commented:

Not every course you attend definitely come back is useful. Then certain things not applicable to us and certain things we can use.

While he considered safety training to be important for learning to work safely, he also explained that classroom-based learning may not be able to provide authentic learning experiences in the workplace, which he described as the “real thing”. Likewise, Ganesh shared a similar experience and concurred that classroom and workplace learning provide different experiences:

Our classroom only say this is the rule, you have to follow but at the site, we have different experience. So we also learn from the experience, the working experience. Workplace and study is different.

Ganesh further cited an incident where his team had to set up equipment at the site. Although they were taught and learnt the procedures of how to erect the equipment, the physical space constraint presented a challenge in complying with the prescribed procedures learnt in the training class. When performing the job, he explained how the site operators would need to consider the physical and situational constraints to avoid damaging the piping system was used to transport dangerous chemical materials.

The capacity to adapt and respond to the actual environmental conditions or changing situational circumstances are examples cited by participants. Their accounts suggest possible gaps between classroom learning and actual practice at work. The importance of congruency between theory and practice is evident here as participants’ experiences reiterate the need to consider the work context to maintain safety.

4.3.5 Engagement and interaction

As participants shared their learning from safety training classes, the topic of learner engagement was also discussed with respect to the contribution to learning. Some participants commented how “dry” some of the classes were as the sessions were either too lengthy or there was a lack of learner engagement. John, for instance, prefers hands-on to classroom learning:

I think most classroom lessons are generally dry. To be honest, it’s very dry. You have to force yourself to be awake most of the time. Obviously a bit bored, very dry. Honestly, it’s dry.

The notion of engagement was discussed largely with respect to the opportunities to interact with others and the instructor, whom participants perceived as someone “qualified” to seek guidance from. There was a general impression that the opportunity to share and

clarify during classroom learning was appreciated as a way of contributing to one's learning. When speaking about these experiences, participants expressed a preference for a more interactive approach such as in the case for Salim, who felt that this would be more interesting:

Create the content into more fun kind. Kind of mock up, play acting instead of lecture after lecture and PowerPoint.

Others also suggested the use of case simulation and role-play during training as ways to encourage more inclusive and active class participation.

Seemingly, these comments suggest that the opportunities to interact socially are necessary to create a supportive learning environment. Participants' experiences also suggest that through those interactions, new knowledge is constructed as they question and seek clarification with others. However, what is more important is that the intermediary role of the instructor, whom participants perceived as a trusted figure to guide their learning, is pertinent. What this means is that while social learning is well regarded, there is also a need to validate and seek reaffirmation of what is learnt from those interactions.

4.3.6 Summary

The experiences discussed here suggest that safety training remains as an important way of learning to work safely. However, the findings also highlight the importance of work context. Participants' experiences suggest that situational and contextual experiences in everyday practices need to be considered that is necessary for working safely in a precarious trade.

Correspondingly, the opportunities to interact and the contribution of social learning are found to be important. Learning through attending training classes provides the opportunities to develop community and collaborations through which workers could learn from one another's experiences, and deepen their knowledge about safety practice. However, the findings also indicate possible gaps which may limit workers' participation and engagement. The cited examples about language barrier and uninteresting instructional design suggest the need to re-examine these dimensions of learning so that knowledge can be more effectively distributed. Further to this, an important finding from these shared experiences is that there is generally a collective view about seeking validation of the quality and accuracy when seeking guidance. For instance, learning from the instructor during safety classes is perceived as a trusted and credible source of learning. This implies that though informal learning contributes to knowledge circulation such as through social interaction with other learners in class, validation of what is learnt is important as a way of learning to work safely.

How receiving guidance from expert others provides as another important way of learning to work safe is thus examined and discussed in the next section.

4.4 APPROPRIATENESS AND QUALITY OF EXPERT GUIDANCE

While safety training provides workers with both pre-employment and continuous learning to refine their knowledge and skills, receiving guidance from knowledgeable co-workers (including superiors) in their day-to-day work was routine but important way of learning reported by participants. Guidance was explained in terms of transmission and circulation of safety knowledge from an authority figure or expert. These learning opportunities were either deliberately organized or manifested in everyday work activities. In this context, guidance received and provided for learning was also discussed interchangeably as mentoring and coaching. Participants' perceptions, of the quality of mentorship were largely influenced by how they viewed their job roles and the dynamics of that partner relationship.

The following sections 4.4.1 to 4.4.3 report how guidance was provided as an important source of learning for practising safe work.

4.4.1 Receiving guidance from supervisors and seniors

Participants reported learning from supervisors or experienced peers (otherwise known as the seniors) as the most common form of learning on the job, particularly for those who are new to the plant. Unlike classroom-based experiences, these arrangements prepare the workers for physical enactment of the work, including learning a spectrum of workplace practices relating to the trade. The participants described this arrangement as on-the-job training (OJT) where they learnt, participated, and engaged in actual work activities. This learning process was also cited as the "hand-holding" period where the new member was under close supervision for between three to six months.

Guidance from supervisors appears to be a significant form of learning for most participants. The safety supervisor is tasked with the responsibility to ensure all safety policies, programs, and procedures are well managed and executed to comply with the organizational and institutional requirements. To the workers, the perceived role of a supervisor not only entailed effectively organizing, planning, and allocating work tasks to meet production and performance requirements, but also included general sense of reliance to educate and provide proper guidance to his crew to work safely.

Many participants spoke positively of receiving guidance from their supervisors. Participants reported such guidance as the most direct and accessible way to advance safety knowledge and improve practices in their daily work. For both Advik and Jayesh, their

supervisors play an important role in not only organizing their work duties but also guiding the team members in their day-to-day work:

Supervisor collect the permit, explain everything to group, brief them what to do, what hurdles. Explain all the danger, then people understand. [sic] - Advik

So basically, before starting supervisor must inform all the workers what is the dangerous, how to do what. - Jayesh

In the case of Jayesh, his learning situation was also discussed largely with respect to how his supervisor acted as an important intermediary to circulate safety information, and as someone who clarified any work issues in their everyday work. He refers to him as the “responsible” man:

Everyday. Everyday supervisor also inform company also before going inside the plant for meeting, arrange meeting every day, toolbox meeting. Then supervisor share some workers’ problems, every day share. One worker also share every day. Ask question. Here supervisors, all workers very friendly. Ask supervisor because he's the responsible man.

The participants explained that they learnt as their supervisors apprised them of particular work conditions or situations, and reminded them what safety procedures to follow. Consequently, such information was helpful in advancing their safety knowledge through understanding the circumstantial requirements for performance.

When relating about guided learning, participants also spoke about seeking guidance from their supervisors in ambiguous work situations and were not confident that it was appropriate or safe to perform a particular task. As Peng commented:

If we have a doubt, we’ll go further with our supervisor to determine whether the job is safe or not. Then we ask something like what if this happen.

These experiences suggested that learning from supervisors occurs during problem-solving situations. Seemingly, these described situations suggest the onus is placed on supervisors to be exceptionally familiar with the work processes and safety practices.

While guidance from supervisors usually occurs during problem-solving work situations, in some circumstances, a supervisor may also act as a mentor to provide guidance beyond work-related issues. Rohan described how his relationship with his supervisor is not confined to discussing work:

Now I many thing learn from my friend also supervisor foreman, like a friend, many things rules and regulations. I understand all this.

He expressed his appreciation of how he also learnt non-work and personal issues from his supervisor whom he regards as a friend and mentor. What this suggests is that as individuals learn through seeking guidance, they also build relationships with others.

On the whole, the above examples reported by participants suggest that the supervisor is perceived as someone with expert knowledge. The judgment and decisions made by the supervisor are considered reliable and accurate. This appears more so amongst the foreign workers who described a supervisor as authority who guides and affirms doing the right thing. This also highlights how a hierarchical relationship which represents one's expertise, status, and responsibilities provide clues to which guidance is to be provided or received. Peng cited the example of the different types of safety knowledge he learnt from his supervisor and seniors. While his supervisor provided guidance largely on what he described as "theoretical" knowledge, his learning from the seniors involved more practical and hands-on insights as he observed how the experienced workers physically perform a job. Peng viewed learning from experienced peers as the quickest and most reliable way for new workers to master the trade:

Learning from the seniors. I think is one of the fastest ways because they already gone through the path so they know what's the danger rather than you go, maybe you will hit the rock.

Peng's experiences again suggest that workers do appraise the quality and reliability of their learning when they receive guidance from expert others. Concurrently, the emphasis on the practical dimension of learning over theoretical knowledge, as well as learning to respond to physical and situational requirements, also suggests that the opportunity to rehearse and practise the act is an important way to learn how to work safe.

Guidance received from experienced co-workers was found to occur mostly during the initial employment stage when the participants first joined the work community. Kee shared about his experience when he joined the host plant as a junior technician:

Normally they start for OJT. OJT so we will follow the senior, so-called senior. The first time they will do, we will see. Normally we see. Until maybe the next few times, we will try to hands-on already. And slowly we learn.

Similarly, Ravi indicated observing and modelling co-workers' performance of the work:

New workers don't do the job. They just follow and do general housekeeping first or normal job only. Not one time this and give you all the job. Just follow follow only. [sic]

Essentially, Lave and Wenger's (1991) concept of legitimate peripheral participation characterizes most participants' learning in process work. In both situations described above, they illustrate how novices learn through a process of highly controlled and progressive pathways occurred by observing how others perform the work and by taking on simple and low-risk tasks during the initial stage. Such a controlled practice is appropriate to help workers learn in a safe manner when working in a perilous work setting.

4.4.2 Giving guidance through interaction, enculturation, and enforcement

Most participants experienced learning through receiving guidance from expert others. Some spoke about how they provided guidance to others. Many of them corroborated that group assimilation as a useful approach to help workers learn. Ganesh, a foreman, explained how he assigned his crew to work in groups so that the more experienced workers could help to guide those newcomers:

One group. Around five. They not work alone. I, some I mix them because I follow my workers every daily maintenance, they have experienced workers. I put half to my experienced workers, so they teach them then they also learn from them. [sic]

Likewise, enculturation of less-experienced workers into work group was considered as a valuable approach to help the workers learn:

So, what are we going to do now is when the new worker join in, we have old workers there, and then the old worker will try to guide them and then the enforcement is very, very critical at that moment. – Leong

These approaches to learning suggest enculturation provides spaces to promote mutual learning for both experienced and new workers. Working in a culturally diverse work community, such reciprocal ways of learning help to develop group affiliation and promote solidarity, is critical for communicating and circulating safety knowledge (Kemmis, 2005; Svensson, Ellstrom & Aberg, 2004).

Other participants who engaged in a mentoring role reported that they contributed to workers' learning by assisting those who are constrained by language barrier to be able to communicate more effectively about safety issues. Efforts to develop the workers' social skills were described as equally important to providing technical guidance as part of the mentoring

process. This is so because some workers may not be able to understand the operating manuals as they are from non-English speaking backgrounds or low literacy skills.

Some participants explained safety messages to their co-workers by communicating in their native language or through the use of pictorial illustrations to improve their understanding and practice of safe work. In doing so, workers learn through self-reasoning and appreciate the importance of safe work rather than merely receiving and following instructions. This way of learning resonates with Vygotsky's (1978) contention that language and thought are pertinent in a learning process to promote individual understanding of the subject matter.

Another distinct aspect of mentoring described by the participants relates to monitoring the physical and psychological well-being of the crew. Supervisors explained how they need to be watchful of workers' physical and psychological readiness as a way to help them work safely. Some of the examples cited by participants included helping workers to manage their personal problems and monitoring their physical health daily as part of supervisory work. Participants providing guidance also relate their supervisory role as synonymous with that of an enforcer or regulator. The guiding process was described as a hand-holding approach similar to performing a "patrolling" or "policing" job. Mohan, who worked as a Senior Technician, described himself metaphorically as a "policeman with a gun" when supervising his crew:

We always call this hand-held training, together with your new colleagues. So, your new colleague will normally work and follow wherever you go. So, it's like a policeman carrying a gun everywhere. So, you are very uncomfortable. But actually it's a good thing because doing hand-held training, you monitor him closely, what is he doing, and he must ensure that he is doing the right things that's being set out in the Standard Operating Procedure.

In this view, providing guidance as a supervisor empowered Mohan with a sense of responsibility to ensure rules and order were followed, which he believed was critical for working in a perilous work setting. Learning through a dogmatic process of close and direct monitoring, modelling, and complying with prescribed rule systems is therefore marked as a way to learn how to work safely.

Participants mentioned working alone as a forbidden practice in their trade. Pair work was reported as another salient way of providing and receiving guidance. Such arrangement allows a more experienced worker to guide the practice of his co-worker and at the same time, for the pair to watch over one another's safety during work. As Jayesh described:

All pair by pair. One man cannot do the job. [sic]

Working as a contract worker for more than six years, Logan ascribed watching the safety of others was also a way of learning to work safely by being mindful of the situation, and understanding how the actions of others may implicate everyone's safety. He termed such pair work practice as the "mission and message" with which every site operator has to comply:

You never work alone here actually. That's the mission, and that's the message, I want to tell you.

Guided learning as described from these experiences occurs primarily through pair and group work to provide opportunities for site operators to work alongside and learn from one another. While social interaction presents a distinct way of learning and observing safe practices, it is also important that learning is accompanied by close supervision and direct guidance. Such an approach is practised to provide validation that appropriate knowledge and skills are learnt.

4.4.3 Identifying and asking the right person

On the whole, most participants' experiences suggest that guided learning is provided mostly through formal work arrangements. Whom they provided guidance to or sought guidance from, is dependent largely on the hierarchical and reporting relationships within their work context. Some participants were hesitant about seeking guidance from peers or other experts who were not their direct supervisors or elected mentors. The concern about appropriateness and legitimacy are important considerations to the participants when learning from others. This suggests that learning arrangements need to be predetermined or institutionally sanctioned. However, a few participants highlighted that there were also circumstances where they had to seek guidance from others, such as during times of work exigencies when their supervisors were not able to provide immediate guidance. Participants identified that the job role, length of employment, seniority, past working experience with the individual, and recommendations from peers provide cues and bases to help them select a role model or mentor for guidance. These attributes help one to appraise the quality and establish some form of credibility with respect to seeking guided learning.

The findings suggest that participants who are direct employees are more likely to approach other expert co-workers for guidance. Conversely, most contract workers who are foreign workers tend to seek guidance more frequently from their direct supervisors, who they believed are authorised to provide guidance. The contract workers explained that they needed to perform their work accordingly to what was taught by their supervisors because failure to

do so could potentially jeopardise their employment. Such concerns are not limited to those who seek guidance. Participants who experienced providing guidance to their peers also expressed apprehension about being held responsible for giving wrongful advice that may lead to adverse consequences. Mohammed explicitly remarked:

No one will dare. No, of course you will be answerable. It's individual.

Human being anything, I'll be, to be blamed, have to answer. [sic]

Jayesh also reiterated the importance of seeking guidance only from his supervisor whom he perceived as the responsible man:

Responsible people is supervisor. Supervisor still have the final say. Cannot listen to peer even experienced men. [sic]

These two examples suggest that providing guidance is not merely sharing knowledge with others but relates closely to legitimacy and responsibility, particularly in a perilous work environment where inappropriate guidance may lead to adverse consequences.

Though most participants were concerned about the legitimacy of selecting others as role models to guide their learning, they also cited some positive contributions of learning from experienced peers. One important contribution was learning about the workplace norms and values which participants described as "the acceptable practices" in the workplace. This is perceived to be particularly important as such workplace discourses often cannot be readily learnt from attending safety training or text. The importance of context was highlighted as participants ascribed these norms and standards as unique to their work setting and practice. To work safely means they need to understand these norms and standards.

During the interviews, participants also discussed how the quality of their relationships with their supervisors or mentors influenced the way they learnt. Ming shared about one of his unpleasant experiences learning from a supervisor whom he described as "arrogant" and "authoritative". He gave an account of how his supervisor would constantly engaged in nit-picking which discouraged him from actively learning. He felt a mentor needs to be patient and empathetic, as he constantly reminds himself to be when guiding his crew.

It is not like more on teaching, there is always teaching is always people will resist, more on like sharing type is better for them to absorb. [sic]

In his view, an authoritative approach would discourage open discussion for active learning. Salim spoke about a similar experience of how the quality of the relationship with his supervisor impact his learning. He provided examples of conflicts between him and his supervisor during times of ambiguous work situations where both parties had differing

approaches to resolve the problem. Though he may not agree with his supervisor, he would still follow the instructions given by his supervisor so long as his personal safety was not implicated.

Sometimes the shift order say we are supposed to release certain things.
And no clear guideline, just a guideline. No clear way of doing things. So, I will, after looking at it, I will suggest my way of doing things. But in the end the supervisor will always supersede us, override. I want you to do this way. Then I would follow as long as doesn't compromise my safety.

Both experiences discussed here suggest that learning is a reciprocal process of which the quality and outcome can be dependent on the working relationship between the mentor and mentee. While regulatory and systemic compliance are important to promote safe work practices, opportunities for open discussion and interaction in a mentoring relationship are critical to promote learning. Essentially, these illustrations suggest that a dogmatic approach and overemphasis on rules and standards could potentially undermine the validity of the ontological and epistemological contributions of the learner.

4.4.4 Summary

Overall, the experiences discussed here provide insights into the different facets of receiving guidance from expert others to learn safe working. Guidance provided in most of the instances suggest that close supervision (such as pair work) and direct guidance are necessary to ensure safe work practices are observed. Learning through guidance is therefore a deliberate and controlled form of intervention to caution and mitigate unsafe work practices. This is more so because inappropriate guidance can lead to unsafe work behaviours and dire consequences.

Primarily, a formal learning arrangement is important to establish the quality and legitimacy of the learning. The approach to seeking guidance relies largely on the reporting relationships and individual professional roles which workers use as cues to affirm and validate what they learn. This marks an important feature of guided learning in precarious trade where validation and legitimacy of guidance is highly critical.

Though guided learning needs to be supported formally and legitimately, the findings also indicate guidance may also be sought during unplanned work circumstances and is socially situated. In some circumstances, learning through these circumstances of work provides opportunities to learn beyond just the technical know-how. The learning entails acquiring knowledge about workplace norms, practices, and discourses which may not be easily learnt yet are pertinent to enactment of safe work.

The findings also suggest the quality of relationship among co-workers can have significant influence on shaping the learning process which occurs in those socially situated circumstances of work. This implies that learning to work safely is relational as individuals learn by negotiating inter-professional perspectives and seeking alignment for safe working.

Understanding the nuances of guided learning as discussed here may thus be most useful and relevant to enhance the qualities and processes for knowledge sharing. For instance, the findings emphasize the contributions of intermediaries and social agents as important resources not only for knowledge distribution but also appropriation. Indeed, this has important implication to learning safe work in precarious work. The next section reports how learning occurs socially through the structuring and ordering of different work activities which can provide pedagogically rich learning in workplaces (Billett, 2002b).

4.5 PRACTICE PEDGAGOGIES FOR KNOWLEDGE DISTRIBUTION

The following section specifically examines different types of workplace activities that support workers' learning in their everyday work practice. Collectively, these reported activities and interactions form a distinct pathway of experiences that help to augment workers' learning for safety practice in the workplace. These deliberate learning provisions resonate with Billett's (2011) notions of practice pedagogies that assist workers in developing procedural skills and conceptual understandings. Moreover, as workplace activities are authentic in terms of the practices required for particular settings, they are relevant to meet workers' occupational needs and therefore make learning more meaningful. Participants spoke of how their engagement in workplace activities helped to reinforce, refine, and transform individuals' existing ways of understanding and responding to work safely.

4.5.1 Mandatory safety programs

Three key intervention programs were mentioned as important initiatives to promote safe work practices at the plant. These include the Speak out for Safety (SOS), Stop and Report (STAR), and No Name No Blame. In explaining how these initiatives contributed to workers' learning, Tang described using the SOS program which aims to promote learning through active interaction where every individual could "talk freely, fearlessly and in a friendly manner" about safety.

This SOS program is where we encourage people to speak out. It can be anything – their experiences, what they think should be done or even to just to regurgitate what they have learnt and it can be said, basically anything, it's free for you to stop as long as it's related to safety. They can

share about their experiences they heard from workers at the dormitory or they share what they have learnt and what they feel that their co-workers could also do. So, every morning we encourage workers to speak out, every morning in their own small group meetings. So, some examples are that they may say that when I work at height, I must always remember to hook on my lanyard. So, that is a way for himself and also to let his co-workers know that this is the practice. So, through this also we also have gauges that whatever we have imparted to them through various avenues are actually, is sort of set in some of the practice. So, in a sense these are fillers.

Essentially, the primacy of learning from these participatory practices is largely ascribed to sharing experiences and providing feedback on unsafe behaviours or practices. Learning that occurs through such interactions serves to raise awareness about safe work behaviours and helps to reinforce specific norms and values that are practised at the plant. These initiatives contribute to workers' learning as they observe and attempt to correct unsafe work behaviours of other co-workers. As in most social activities in workplaces, participants valued learning through these interactions which provided them the opportunities to exchange professional experiences and clarify ambiguities about their practices explained by James and Ganesh:

We have this so-called star program, stop and report and then SOS, the speak out for safety. These are ways they can bring up issues. - James

Because SPCC have the speak-out-for-safety. We practice them to speak out for safety. They help each other and discuss with their co-workers.

Learning is thus perceived as changes in states of knowledge as individuals engage in those rich interaction, discussion, and negotiation processes to generate new knowledge. Participants also found that they could apply reflect on their own learning, while they are observing others and being observed by others. As such, they learn to be more mindful of their behaviours.

Some participants commented that every worker is expected to contribute at least one observation each month. The observation is documented using a standard template outlining key descriptors to be provided when reporting a case incident where the observer could also provide snapshots of unsafe practice as visual illustration. Central to these is that learning activities are captured and codified in incident reports and pictures to reinforce workers' comprehension and encourage safe work practices.

Though the utility of artefacts is perceived to be helpful to support and mediate learning in this instance, concerns about how they may threaten workers' psychological safety

were also raised. The term psychological safety here describes how workers perceived their work environment to be conducive to taking learning risks without being penalized for making mistakes (Edmondson, 2002). Participants said they were not aware of any incidents of disciplinary action taken against individuals who were caught working unsafely. As the name suggests, No Name, No Blame, participants were positive about the pedagogical intentionality of these safety activities and were less concerned about being seen doing things unsafely. Some workers were already “immune” to the practice:

BBSO - everyone has to do it. I think is 3 - 4 per month. BBSO has been very long already. So, everyone is like immune so they are okay. – Mohammed

Others suggested ways to mitigate the threat by disguising the identity of the violator. Some examples cited by participants include not photographing the frontal view of the violator, or seeking consent from the individual before reporting the incident. These examples illustrate how learning is mediated as individuals engage in the process of reflection and meaning making.

4.5.2 Toolbox and work group meetings

One other common yet important form of social learning in workers’ everyday practice was through different work group meetings. In safety practice, toolbox meeting is a mandatory practice requirement to inform site operators on safety matters in their daily work. Though the meeting is intended for work purpose rather than learning, it was repetitively spoken of by participants as an important activity to learn safe working, particularly for contract workers performing field work at the plant.

Two forms of toolbox meetings were provided at the plant - daily and a monthly. The daily toolbox meeting is specifically organized for individual groups of contract workers performing different job tasks at the work site. The meeting is mandatory and held before site operators commence their work each day. The monthly meeting, on the other hand, is specifically organised for all site operators, including direct employees of the plant. These two forms of toolbox meetings are critical to workers’ learning as they provide opportunities for site operators to share their experiences about safety practice. In their daily meetings, workers receive guidance from their supervisors on how to order and organize their daily work activities, including drawing attention to risk-prone activities and appropriate controlling measures to address work problems when they perform their shift.

The researcher was permitted to attend and observe how both forms of toolbox meetings were conducted. A snapshot of a daily toolbox meeting with a particular group of contract workers was taken during observation (see Figure 8).

Figure 8. Daily toolbox meeting.

Both Rohan and Kim emphasized the importance of toolbox meetings to work safe in their daily practice:

Every toolbox meeting, they tell you what hazards, identify, job, what happened, how to do safely everybody briefing. Including site manager, safety supervisor, everybody like 30 people. Teach the men like work safety, how to do safely, what is the correct work procedure. [sic]

Toolbox meeting everyday work. Whatever today we are doing before we go to work, our supervisor informs us how to do, what to do. Everyday every company. Toolbox meeting advise what to do. [sic]

Primarily, such work group meetings provide opportunities to receive direct guidance on the ordering and learning of important clues or cues about performing work safely.

Similar to the daily toolbox meeting, the monthly toolbox meeting provides spaces for communicating about safety practice across all levels of site operators working at the plant. During the meeting, different work group activities are planned as part of the learning purpose. Some of these activities include quiz sessions to test workers' knowledge about how they can work safely. Individuals also present a safety topic to the audience. The purpose of these activities is intended for learning. Hence, participation is therefore voluntary. To encourage active participation, participants who can provide the correct answers or deliver the presentation receive some forms of pecuniary rewards.

Participants described the opportunities to interact and discuss with other co-workers during such meetings as helpful in that they could receive direct guidance from their superiors

or learn from the experiences of others. The meetings provide spaces where site operators could communicate, exchange and clarify safety matters with other co-workers:

Anybody can talk. All people all share working problems. Everyone will talk.

Who have the experience talk. – Jayesh

Mass toolbox meeting. During this meeting itself, the ending part we have open concept, meaning you can talk anything related to safety here. –

Aamil

Likewise, Logan agreed that engagement in work group meetings provided the opportunity for workers to seek validation and reaffirm what they have learnt from others:

Sometimes the job very long time already doing. So that one Maybe I never remember. So, I discuss with them. Foreman already discuss everything. The toolbox meeting time, we discuss how to do also. [sic]

Such intergroup-level discussions by different groups of site operators provides learning opportunities to access and share different inter-professional expertise for problem-solving or corroboration on safe work practices. This is essential to help workers learn to work safely as the context of their learning is centred on a common ground, that is working at the plant which participants felt it was authentic and relevant to their practice. It helps to foster collective learning and coordinated behaviours.

Guided learning also includes those who provide guidance by acting as intermediaries to assist and interpret what was being shared by the supervisors with peers who were non-English speakers:

In the toolbox meeting we teach one title one day. So we teach them. Let's say today is the personal protective equipment, so I read all these then they understand. If they don't understand English ... Translate to them. One topic for one day. [sic] – Rohan

Toolbox meeting must explain in English. But don't understand some peoples. Some manual worker, some worker, Indian worker also don't understand English. Some people understand, I understand Tamil. So, I explain. [sic] – Jayesh

These descriptions of learning experiences suggest knowledge can be developed and reconstructed through different bases of participation either passively as a recipient or by contributing actively as an intermediary. For instance, as the participants help to explain work

procedures to their co-workers, the explication process allows them to also reinforce their own knowledge and comprehension. The opportunity to discuss, question, and clarify are pertinent to support learning and knowledge circulation. This is reported in a significant body of research showing how sharing and communication can positively shape and impact practices (Griffin & Neal, 2000; Probst, 2004). Further observation and findings gathered from other participants indicated that often, specific sets of norms and exemplars unique to the practice and communities were shared, discussed, and established which would not only reinforce or refine existing knowledge but also generate the construct of new knowledge. Essentially, these were the intentionalities underpinning the primary activities of the meetings to promote collective learning and understanding by clarifying social conceptions about danger and risk, and what behaviours and attitudes were deemed appropriate to constitute as safe practices. However, the examples cited by Rohan and Jayesh also highlighted the need to provide workers with adequate literacy and language skills in order for them to communicate effectively about safety practice.

When relaying his views about learning through work group meetings, Aamil highlighted a changing phenomenon about how others participated and contributed during the event:

In those days, two people like to go up but now the mentality of workers are different, everybody rushing to go up to share their experience. This is where we are seeing a culture, a good culture being practised down to the workers. So that is where we share all these incidents or procedures, so it is very good so called from the workers so one thing over here, we working like a family. [sic]

His remarks suggest that safe working is socially constructed for which institutional support and an array of social-cultural practices in the workplace are instrumental to inculcate what is described as “the good safety culture”. These social-cultural imperatives also serve to promote solidarity and build positive workplace relationships

Correspondingly, participants who are direct employees and not performing field work at the site also found their regular work group meetings as valuable learning platforms to learn safe work practices. Ming, who works at the control room, gave examples of different forms of work group meetings that are organized within his centre:

Different platforms of meetings to share critical incidents or safety issues. Sometimes the SI (Superintendent) will share some experience on what happened on this equipment, why this equipment keep failing. And then

maybe they got access more experience on other plants on equipment failure and caused what problem. Besides shift meeting, we have manager meeting, we have safety meeting, all these meetings once a month, sometimes manager brief about other plants what happening and then maybe the history. Recently they got share one about the platform at the sea and the explosion caused hundred over people die, safety working and then what is carried on to our this one and what our safety working committee will be highlighted, the members highlight.

Through sharing and discussing of perspectives, the process provides learning spaces for listening, observing, and reflecting.

When describing how they participated during work meetings, many participants mentioned the importance of note taking where they would either translate information in their own language or use drawings to help them understand complex issues. Documentation was also reported as a mandatory practice where the process and information discussed during each meeting was recorded by an elected member. Documentation is used as a reference tool for decision-making and records of past events. Work group meetings appeared to be more frequently organized for direct employees than for contract workers, possibly because of their physical proximity. Studies on group norms have shown that physical proximity can significantly shape and impact ways in which group members interact and function effectively (Aamodt, 2012; Kiesler & Cummings, 2002). For example, as the site operators work alongside each other within the enclosed work premises of the control centre, they are able to interact more readily. In contrast, cross level group activities were less frequently organised for contract workers, which could possibly be attributed to a lack of permanent locality and the distinct temporality of the nature of their work. Essentially, the physical proximity and close social spatiality, as well as the readily available infrastructure and physical resources appear to be important features in supporting learning (Fleming & Spicer, 2004).

When speaking about group meetings, participants also mentioned there were other forms of work group meetings that relate to safety practice. These include safety meeting organised for the contractors and safety supervisors respectively. Primarily, these meetings are planned to raise awareness of risk-prone activities at the site, and to promote safe work practices through sharing of inter-professional and expertise knowledge across different levels of site operators. Tang provided an example of a contractor meeting which served as a training session with the different groups of contractors, on safe work practices as part of ongoing learning and development for the site operators:

The contractors I think is easier because every month we have a training, a short training for them, more like a, how to put it? It's like a refresher on work permits, on procedures. So, every month there will be one topic.

Participation in discussions during these work meetings about the workplace norms, practices, or institutional facts (Searle, 2010) provides opportunities for the site operators to be kept informed of changes that will impact on their work practice. Such intergroup meetings provided continuing learning for the site operators and for promoting collective acceptance and understanding about safety matters within the practice community (Fu et.al, 2006). The need for safe working is therefore consistently reinforced. This is critical in process work where individuals and groups work closely within interconnected processes.

4.5.3 Task and shift handovers

Safety studies have indicated that poor handovers between shifts contribute to numerous accidents (Brazier & Pacitti, 2008). Participation in discussions during shift handover was cited as another learning space in workers' everyday practice that help them work safely.

The handover activity typically occurs during shift intervals. Workers at the plant typically work on three rotating shifts to ensure that the plant's operational processes are being attended at all times. This is safety requirement. After conducting their field inspection, workers need to record their daily activities using "shift logs". These shift logs serve as important documentation to keep track of every task and activity conducted by the site operators. More importantly, the purpose is to highlight any critical or risk-prone situations that may require attention of co-workers so that they can work safely in a subsequent shift. A simple illustration of the process is presented in Figure 9:

Figure 9. Shift handover process (Control Centre).

Before the handover, team members documented the list of tasks carried out during their respective shift. It outlines a list of items to be checked during each shift. The site operator needs to record all activities and critical situations. The information is verified by the team supervisor before circulating to the other team members. The document is displayed on a pin board located at the control board room. This allows the next team to be informed about the activities and processes which have been performed in the previous shift and to caution co-workers of any risk-prone events or situations.

In describing the shift handover process, Mohammed's experience suggested some salient practices that are important to support their learning:

Yes, from the start we work, we will have a shift meeting. So, from there the chief superintendent will say okay, this area, zone, this radiation work, have scaffolding, some roadblock. Then after that the supervisor will tell us okay don't go to this place, radiation work, as long as you see the light, they will one, so-called barricade, one blinking light so you can't go there, that area. They will announce. Certain major things we will document it. Then normally, we will write in a book, a log book. That's why the Chief Superintendent, they will take down the notes. So, they will hand over to next shift. Okay, this team happened just now, so don't open too much. Beware when you're opening. How we start things when pass on to next shift. They'll probably pass down to next shift.

The process described by Mohammed highlights the utilisation of different artefacts and intermediaries providing important means to facilitate and organise the circulation of safety information. Firstly, guidance from superior and expert others is evident and remains critical in every work process. Next, the documentation process highlights the significance of socio-material practices where artefacts serve as important cues and connection to facilitate the circulation and transfer of knowledge. The site operators constantly need to adapt their practice to meet the changing situational needs in each shift. The shift handover process thus provides learning spaces for them to learn through engagement in the job, as well as observing other co-workers perform their job across shifts. These daily experiences help to reinforce the workers' knowledge as they share their daily work experiences and providing continuity and connection to past actions for knowledge circulation. This is critical to their learning for safe working in a perilous workplace. Workers can make informed decision and take appropriate action based on their knowledge about past actions or events.

4.5.4 Collaborative work with others

In process work, complex multi-layered working relationships imply that there are circumstances in which site operators need to work collaboratively and effectively across teams. An example of inter-professional work occurs when workers need to conduct joint inspection with other contract workers. Another is when the plant needs to engage contractors with specific expert skills for repair work. As James described:

When they patrol we also get this contractor to be together with us and then they themselves also will spot the unsafe and then tell us.

The opportunity to engage in a dialogical interactive process provides pedagogically rich learning as different groups of workers share their expert knowledge. Such interactions help to promote collective views about the practice requirements of the site, and is critical for maintaining the overall safety of the plant.

Several examples were discussed by participants, drawing on different work settings for collaborative efforts that contributed to their learning. One particular contribution of collaborative practice was the opportunity to access specific knowledge which may not be acquired in their routine vocational practice. Ravi cited an incident of how his team learnt about piling work from other contractors:

Sometimes we, other contractors meaning they same like very big job, or other pilings or some painting job, very big, we don't have license or we don't have experienced guide, maybe other things, so call other contractors to do painting job or piling job. Piling because we don't have piling license, piling material, equipment or machine. Don't have, so call other contractors come to do or same thing. So, we just supervising, they work.
[sic]

In this instance, the restriction is due to regulatory requirements such as a qualification, or the lack of expert knowledge and resources to undertake a specific work task. However, the work situation presents opportunity for learning.

In a process plant, free access to different parts of the work site is often restricted for safety reasons. Peng spoke about how his team had the chance to access restricted sites at the plant when working with the contractors during a plant shutdown:

Sometimes certain things inside we don't know what's, how it operates until the maintenance people open up then they show to us how is inside like during our turnaround, shutdown maintenance then we get to see what's inside the tower.

While collaborative practice offers participants the opportunity to access vocational knowledge or resources, learning also occurs when the engaged parties work together to resolve complex problems. Mohan talked about how his team worked with the contractors to overcome a physical barrier to set up a crane at the compound:

We actually learn something new from them as well. But we realize that it is not applicable because we have limited space. Just take one crane operation. Down here to move something, you need that crane to be upright, always. You cannot bring that crane down because the pipings all over. This is what I tell you, the limited space or limited resources, not resources, but limited environment. When they want to do something, they cannot do just like outside. Like building with all those moving cranes.

Another example provided by Ming relates to how his team and the contractors worked together to repair a pump:

So, because the contractors after for example we isolate one pump or we isolate the strainer and maybe the changer, the equipment, our equipment and then the isolation part maybe have some problem or what and then the contractors cannot carry on their work because once our part is not done good enough, their part will be not safe to proceed with their work and then we got to do our part. Once we hand over, sometimes we overlook some area, cannot see one, and then they will highlight to us. And then if still not safe, discuss with contractors. The contractors may have some better good idea. And then sometime maybe if for example cannot remove the oxygen, cannot remove the fuel, maybe the fuel is present. Maybe we can remove the heat, we can do a cold cut. [sic]

This incident illustrated that learning for safe working can occur during problem-solving situations as workers engaged in their goal-directed activities in circumstances of work. While the intention was not specifically for learning, exchanging professional perspectives and expertise to resolve work problems could provide rich pedagogical experience. More specifically, the incident also illustrated that safe working was premised on augmenting limitations in specific skills or knowledge to accomplish a work task.

Overall, the different experiences of engaging in collaborative or inter-professional work suggest that safe working entails gaining access to artefacts, clues, or cues that could augment learning which may not be achieved through self-discovery or when workers engage in routine work tasks. In such circumstances, individuals often engage in negotiations to justify

their actions to one another during problem-solving situations. When discussing those justifications, knowledge is also constructed in that process of negotiation and clarification. Consequently, implicit knowledge is translated into more strategic knowledge through verbalization and internalization. This leads individuals to adapt and regulate their action and practice accordingly. These experiences create opportunities to recollect what they have learnt and make appropriation as they reflect on their own practices. Learning also results from ways the members attempt to address work problems which often require taking into consideration those circumstantial and contextual issues evolving in the work setting. This process of interpretation, negotiation, and adaptation corroborates well with the notion of shared and distributed cognition (Ligorio, Cesareni, & Schwartz, 2008). It reiterates the significance of how a collection of individuals and artefacts and their relations to each other interact in a particular work practice (Rogers & Ellis, 1994) to develop a shared representation constructed by the group. Essentially, these experiences have critical implications for safety practice resulting in shared beliefs and coordinated behaviours.

4.5.5 Summary

The above account on various participatory practices suggests that learning to work safely is very much a socially constructed process that emerges from engagement and participation in everyday work (Baarts, 2009; Gherardi & Nicolini, 2002). In particular, how workplace activities are being organized and structured is thus important to support learning. A significant contribution is that workplace activities can provide opportunities for participation in groups, or in circumstances that enable learning to be constructed through interaction with others including expert others. The cited experiences suggest that learning often occurs as individuals engage in problem-solving situations where they have the opportunity to reflect and articulate their personal learning experiences, which sequentially shape their own learning process (Billett, 2001a, 2001b). For instance, learning through listening or observing other workers, and engaging in problem-solving activities with others allow workers to develop more specific forms of knowledge or knowledge which they may not have access to within their own vocational practice. As process workers do not have the autonomy to indulge in trial and error when situated in perilous work settings, learning through case studies on near miss situations therefore provides an alternative means to encourage critical thinking and problem-solving skills. Those everyday work group discussions about salient risky situations and observations of unsafe behaviours constitute crucial reflexive and interactive learning opportunities to promote greater awareness about safety. This is particularly helpful if workers need to apply the knowledge to other circumstances. This is more so in perilous workplaces where there is little or no threshold for errors.

Collective and collaborative learning are important to achieve coordinated and safe work practices. Clearly, there are practices that traverse the boundaries of different communities represented by workers from different levels or organizations in a process plant. The pre-existing hierarchy has implicitly prescribed a structure of how knowledge is distributed where different individuals and work groups presumably “know” different things about how work is to be done and maintain their field of knowledge in different reservoirs. To apply this knowledge for maintaining the plant’s safety, efforts to integrate and bridge practices across groups are paramount. Bridging practices enacted across the different work teams in the plant include cooperative action, shared representations, collaborative reflection, exchanges of personnel, networking across boundaries, and collaborative inquiry (Carroll et al., 2002; Gruenfeld et al., 2000; Suthers, 2006). Group interactions such as team meetings, intervention programs, and partnerships at work encourage and generate mindful learning that the work community can recognize, value, and share. Inherently, workers learn to construct a common grounding of beliefs, meanings, and understandings when they co-participate.

While the opportunities to engage in novel work activities and simultaneously secure guidance from other expert co-workers provide rich learning for workers, there needs to be acknowledgement of the agency of individuals, how they mediate their learning during those interactional processes, and the utilization of other social and cultural imperatives in supporting those learning processes and outcomes. These factors are central to understanding learning and practice of safe working. The following section on the contribution of everyday practice aims to present the significance of those agentic and social-cultural imperatives in shaping workers’ learning.

4.6 EVERYDAY PRACTICE FOR SKILLS AND KNOWLEDGE REFINEMENT

The earlier discussions suggest that much of workers’ learning is attributed to receiving guidance, whether directly or indirectly, from different sources such as training, expert intermediaries, or participatory practices. Similar to their experiences when participating in workplace activities, another way of learning to work safely that many participants spoke positively about was through learning by doing. Participants explained how physical enactment in recursive practices contributed greatly to deepening their learning about safety and allowed them to accumulate a repertoire of safety knowledge from everyday practice.

The following section provides an account of how workers’ learning and knowing are grounded in the habitus of practices (Bourdieu, 1994). In these circumstances, learning encapsulates the actual doing and acting in an authentic practice setting w. What is distinct in this form of learning is that unlike most planned participatory practices discussed in the earlier section, engagement in these work activities may be serendipitous, unintentional, or arising

from specific work circumstances. Consequently, these cumulative experiences have also unknowingly developed into a sense of value that shapes and influences how the individuals enact their vocational practice.

The discussions in this section draws insights from literature on practice-based theorizing of learning and knowing (Bourdieu, 1994; Giddens, 2009) with the aim to understand the nuances and how implicit dimensions of bodily practice and thinking processes transform individuals' ways of perceiving and acting. Learning is thus seen as corporeal which emphasizes the significance of embodied experience of the individuals. The findings also support theoretical bases of several key learning principles centering on the notion of experiential learning, reflective practice, and intuitive expertise that resonate with the principles of practice-based learning (Klein, 2008; Sommerville, 2005). Correspondingly, theoretical and practical implications are discussed with respect to how such an embodied approach contributes to safety practice.

4.6.1 Learning by doing

A critical skill demanded of workers in high-risk industries is the ability to accurately dictate and initiate appropriate and safe actions to respond to changing situational requirements. Typically, the plant operation is largely managed through a sophisticated computerized system, which automatically gathers information from different sensors and devices that control the operation of the plant. Human interface is also required to manage the different aspects of the process control flow. Workers who administer and manage these processes need to closely monitor key temperatures, pressures, fluid flow rates and levels, and operating conditions of key valves, pumps, and other equipment. The term "abnormalities" is commonly used if any deviations are found in the operating conditions relating to temperature or gas pressure. Inexorably, these constantly changing conditions at the wellhead, due to fluctuations in pressures and altering flow rates, operating instruments, or equipment of varying capacities and model may be different from those simulated models used in classroom training. This would require individuals to respond effectively to the changing conditions for the plant to operate efficiently and safely.

Different learning experiences were discussed by participants with respect to how non-routine events and encounters with unexpected work situations improved their vocational practices and knowledge to work safely. An aspect which participants mentioned was critical in learning to work safely was the ability to develop situation awareness with regard to anticipating and responding to workplace risks in their work. Speaking about his job role as a control room operator, Loh cited a typical work situation in his everyday work when administering the instrumentation process:

But sometimes you will need to work on your own discretion. Cannot be every time follow what other people say. Because the parameters change. Suddenly this equipment, suddenly, you thought it's actually nothing inside, it's quite safe. But then when you open up hot oil come out. Then you get panic and all this thing. So, you also must listen: what am I doing? I need to know a lot of things inside.

In his experience, learning very much related to how one learns responds effectively to changing situational circumstances. Interestingly, this form of learning is distinct from what was previously discussed about receiving guidance from knowledgeable co-workers in various social interfaces at work or through safety training. Learning from such situational practice settings is inherently reflective and highly dependent on the individual capacity to utilize their repertoire of knowledge to deal with variations in their circumstances of work. More importantly, it also suggests active agentic efforts engaged by individuals involving a process of self-reasoning rather than acquiescently following guidance from others.

Correspondingly, other participants also provided different examples of circumstances which required them to exercise judgment independently. One such situation arises when appropriate guidance is not available or adequately addressed through text or other expert representations. Peng cited the example of adapting to physical and environmental constraints, commenting that the prescribed standards may not address specific circumstantial requirements:

SOP is only a Standard Operating Procedure but those danger that you do on the way, it won't be inside the SOP. That's only the process, emergency, all the operating parameters but when you're in field, like maybe space limitation, the height, all these, you won't be so detailed that every small small thing is all inside but the larger one is all covered. [sic]

Participants cautioned the danger of unreservedly following the routine procedures learnt through text or guidance from others which may not adequately consider the situational requirements. Ming explained that learning to work safely requires one to have the capacity to assess and respond safely to situational needs:

Yeah, I think we have because for example our field work, in the field work sometimes we do things cannot everything follow said procedure, sometime procedure is not very safe to follow when you look at the environment, when you look you know the situation.

Respectively, John also shared a similar view about the importance of experience to make appropriate situational judgment:

I think you have to apply your knowledge differently to suit the approach on doing things because you just, you just can't follow the book because the book don't tell you on how the item is going direct to you you see? [sic]
– John

Learning to work safely through experience was also attested by Ganesh who reiterated the need for practical insights and knowledge which may not be provided in school or text:

It's different. Working place and study is different. If study only study ... but you come back to the job site, you have to ... Different. Some other sites, you need some practical experience. [sic]

These examples accentuate how learning and context are mutually constitutive and require individuals to engage all senses, intuitive self, and observation of the physical and contextual requirements to guide and make their own judgments and decisions. The importance of embodied learning was repetitively highlighted which suggests the significance of practice as a way to learn to work safely. Inherently, learning by doing is seen as an important way to practise safe work, as Koh explained:

Even though you are handling the same equipment, but the nature of the actually the work is totally different.

Likewise, James also accorded that being physically involved and having the opportunity to directly observe was critical in his learning:

Hands on actually patrol yeah because we see the actual one, actual situation. Sometimes we cannot imagine. This thing people do this way, I never imagine.

Mohan also corroborated the effectiveness of learning by doing which provides the foundation and understanding through personal and direct experience:

Which is your own peers, whom have done it, say like, more than you. Or maybe more well-versed with the Standard Operating Procedure (SOP). Because there are areas whereby some people never pick up from the SOP. Upon doing it, then it becomes a routine to them. So, these are the people actually you ask from.

Even Mohammed, who is a senior operator with years of experience, prized those experiences to address circumstantial uncertainties in daily work as a way for ongoing learning to advance his vocational knowledge.

No, cannot be expert. Every day we learn. Even those people who are working 30, 40 years they're still learning because every day like what I said just now, every day the plant is different. You will come across different, different things happening so that's where you learn. Not 10 years, 20 years you have the same thing, same problem. You won't, you won't have the same problem.

What the participants have shared above suggest some important insights into how practice contributes to the learning of safe work. Firstly, they suggest learning by doing, also described as tactile learning (Allison & Rehm, 2007) to be important and an effective way to learn and work safely. It provides workers the opportunities to apply their safety knowledge, and gain direct experience by engaging in those real work situations. The experience developed from adapting and responding to the changing circumstantial requirements represented in the forms of artefacts, normative practices, physical or visual objects is also prized for providing authentic experiences which may not be afforded in codified texts or classroom learning. Secondly, these experiences also suggest that while instructional materials serve as important resources to reinforce and guide safe behaviours and practice, they may not exhaustively anticipate all possible work situations to adequately provide procedures or directions. Individuals learn to act and work safely when they actively engage in a process of articulating, evaluating, and constructing viable and appropriate responses to meet varying situational requirements. The direct experience when enactment in the physical work.

4.6.2 Practice makes perfect

One other key contribution of learning through everyday practice was through repeated rehearsal and refinement of practices as workers engaged in daily vocational tasks. In the case of Loh, he described how doing the same task repeatedly in everyday work provided ongoing learning to improve his practice:

Definitely, because you are doing it more. Maybe last week you have done once. Then today I am going to do one more time. That means I know more about what to do. I do it more faster. More practice you become more perfect.

These experiences also suggest that the frequency of practice is an important feature for developing increasingly effective performance.

In another learning episode, the contribution of learning from everyday practices was articulated as a way of accumulating a repertoire of knowledge across developmental stages described by Mohammed described:

All these we have to learn day by day. It is not one shot.

And in sharing his experience of how his new workers learnt and developed their safety competences, he commented:

The fellow won't remember everything. Is day by day experience.

Learning is therefore perceived as a process of knowledge collection built over time Mohammed's comments also reiterates the significance of the interdependency between learning and doing as a means of reinforcing and maintaining the currency of knowledge through practice.

4.6.3 Becoming a habit

As workers engaged in recursive practices, these practices resulted in deeply embodied learning. Participants viewed such learning as a process of becoming proceduralized or habitual.

Upon doing it, becomes a routine. - Mohan

Some of the more experienced participants reported how the value of safety was so embedded in their work practices that it became an instinctive and self-directed act of doing. Many workers found themselves intuitively applying what they learnt at work in their personal lives.

And since because of this practice, even sometimes when I do work at home, like drilling, knocking, all that, I have one spare at home just to wear. Even to protect your eyes because sometimes it's been through practice that you find it's good for you. It's a good practice to wear safety specs whenever you do all this work. And learning, that is through, they call, callisthenics, whereby you use your hands, or learning through experience.

– Salim

Inherently, the illustration suggests individuals learn to work safely through a process of highly practised, automatic, and instantaneously applied procedures (Eraut, 1994; Reber et

al., 1993). Learning to work safely is thus synonymous with developing awareness and mindfully adopting appropriate acts such as wearing protective gear whenever one engages in any job task. Participants spoke of how this is particularly critical in their work where they need to readily respond to changing circumstances when working in a perilous work setting. This is more so when they work in a closely interconnected community which demands every individual to act and behave safely.

4.6.4 Learning to make judgment

Though much learning in safety is shaped by following sets of prescribed rules and procedures, those learning episodes described by workers suggest that learning through everyday practice is very rich during problem-solving situations. They also highlight that safe working is learnt through engaging in a process of more than just following any predetermined procedures or being readily guided by other experts. One prevalent contribution to learning from everyday experiences at work is the capacity for acts of judgment. Beckett and Hager (2002) described these judgments as practical decisions made during ambiguous work circumstances, to determine a course of action which is contextually appropriate and sensitive, that will bring about the most efficacious and effective outcomes.

The study shows that workers may explore different ways to resolve a problem at work when they do not have immediate access to direct and proper guidance. At times, they may have to engage their common-sense understanding to resolve the problem, particularly if their personal safety is directly implicated or the consequence was perceived to be threatening. The study also notes the rhetoric of judgment and nuances of everyday practice shared by the participants in order to understand those bases that affect their decisions and actions. The centrality of the discussion is on knowing how individuals learn to develop judgment that assists them to respond effectively and safely to circumstantial requirements.

Kee attributed safe working to engaging in common sense and intuition to make situationally sound and appropriate decisions:

To sense, can say sense, common sense, instinct, sometime instinct also,
but what I feel is safe, what I feel is safe.

In his case, common-sense understanding was built upon cumulative knowledge and experience gained through his everyday practice. Such repertoires of knowledge consequently transforms into awareness about possibilities and circumstances of dangers and hazards in work. For instance, Kee was able to specifically identify problem areas and address them appropriately if any abnormalities were detected because he has sound knowledge of how to operate the equipment and machineries at the plant.

One other key finding which participants acknowledged as influencing how they learnt to develop judgment involves sense-making process and intuitive system of information processing which helped them make informed decisions. Intuition is described as the capability to act or decide appropriately without deliberately and consciously balancing alternatives or following a certain rule or routine (Harteis et al., 2008; Hogarth, 2010; Kahneman & Klein, 2009). It is commonly applied to support rapid and effective performance of tasks in terms of reaction times, as in sports-related studies, but also in response to complex and time-sensitive problem-solving work situations in medical professions or emergency services like firefighting (Harteis et al., 2012; Klein, 2008). During these work circumstances, there is often little time for conscious introspection or examination. Rich cognitive resources are engaged to determine appropriateness and awareness of the situation.

Engagement of intuitive judgment is best illustrated from the experiences shared by Mohammed whose job role involved operating and managing the different types of plant equipment and machinery such as pumps and valves. The participant held high regard for his work as he explicated it was critical for one to be competent when operating and managing these devices which controlled the flow of highly combustible or corrosive fluids and gases across the plant. Workers who attend to these processes would need to know how to operate the equipment safely. Any inappropriate judgment or decision would lead to dire consequences.

At certain pumps, we have to handle differently. So, different pumps you have to handle it differently. Then walk around, any hazard, safety hazard, anything that you don't feel is right, you can stop the thing. – Mohammed

Inherently, learning involves engaging a variety of cognitive processes which direct individual thinking and acting in a safe manner.

One other example provided by Mohammed relates to how everyday practice allows individuals to go beyond simple information processing and construction of meaning. Workers constantly compare what they experience and observe in their daily work situation and context. Mohammed described how he learnt to make better judgments through collective experience with expert others and adapted tasks to meet changing circumstantial requirements:

By learning only, by experience. The first time I did also not so smooth. Then the second time nobody because the first time you know what happened if I do this, oh, this thing happen, the temperature dropped. Then the second time I will be more alert. Okay, better don't do this. So the

third time, okay, make your judgment because every time you do your judgment is not the same. Today I do 10, then next time maybe, 10 too much already, try eight. Then, maybe too little. So, from there you will learn the judgment everything.

Mohammed's experience also suggests the importance of active process of experimentation to construct new knowledge which is necessary to refine his judgment making skill:

I said next time you do this thing, you must do this way, try to encounter because sometimes the plant is today it's this way. Then tomorrow you do the same thing but the thing is different. Let's say now you open 50%, okay you meet the target. Then tomorrow you do 50%, hey, cannot met the target. So different day, it depends on the condition of the plant. So different days, that's where we learn. So you will learn and then you to make your own adjustments again or judgment. Cannot get the same thing. You won't get the same thing. So, all these we learn, oh they are doing something then at least we will know. [sic]

In this instance, how one learns to develop the ability to approximate and make appropriate decision to problem solve is thus built from a repertoire of knowledge accumulated from daily practice. Learning to work safely therefore is seen as the ability to respond effectively to changing situational conditions. The incident also suggests that reflective thinking takes place as individuals continually engage in a process of self-questioning and reasoning as they attempt to make connections with their physical world. Mohan shared a similar incident. His team attempted to secure the optimal energy balance for one of the fluid systems involving the control of pressurized liquids and gases. It was a risky job which required acute precision and caution as the consequences are dire:

One exciting things that I can share is the recent, before the shutting down of plant, we actually have an idea to actually improve. Because there wasn't enough steam to boil the so-called wanted C4. So, what we did was we realized that by doing external steaming actually it would drive the C4 further up. I mean to evaporation. So, we tried on, until it came up to be a very fool-proof idea. Then they realized that by adding another extra equipment to heat up the thing it would help to sustain. So, actually it worked from a silly way, but it becomes a very wonderful idea.

What is suggested here is that learning occurs through an active process of incremental experimentation, reflection, and judgment of events which could eventually lead

to reconstruction of new knowledge which the participant described as “working from a silly way”.

The examples of learning through problem-solving suggest that developing judgment entails a sense-making process and intuitive system of information processing to help make informed decisions (Harteis et al., 2008; Hogarth, 2010; Kahneman & Klein, 2009). Participants’ experiences showed that safe working entails an incremental process, through stages of discovery. The findings suggest judgment learning is often developed during times of instabilities and uncertainties in practices. How workers develop their judgment therefore is closely determined by their anticipation and expectation of the circumstantial imperatives. Thus, the role of contextual and physical imperatives cannot be marginalized as it provides authentic and meaningful learning experiences. It is also these insights that consequently assists individuals to make intuitive judgment, which over time can become second nature.

While these examples evidently reaffirm the significance of practice and experience as a way to learn and work safely, there is also a potential risk. In some circumstances, such intuitive decision making may also contest the statutory requirements or present judgment risks. For instance, workers are taught they need to wear protective gear for personal safety. Incongruously, there are situations where safety paraphernalia may become an encumbrance as workers physically enact this practice. Ramesh cited two specific situations of how wearing additional hearing devices (as a requirement for personal safety protection) could physically restrain workers from carrying out their duties effectively as sometimes, they need to engage their auditory senses to accomplish the tasks:

Yeah, of course you say you want ear muffler but you use it you cannot hear anything. Let’s say leakage or gas leakage hissing sound you will hear but we put it on we cannot hear anything.

He further described:

Then at this decibel below 100 or below 80, you just have to use earplugs. But sometimes when we use earplugs, let’s say you use the ear muffler also don’t really, it’s safety but come to process safety are two different things because we can’t hear, really hear the vibration or the sound because different pumps they got, this pump the sound is this way but if you use a muffler you won’t hear the sound. Then anything wrong with the pump you also won’t realize it.

Ramesh explained that he had to remove his ear muffs but he kept his ear plugs on as a safety protection. As the latter would provide adequate hearing protection and would not have any serious repercussions for his personal safety and health.

What these accounts show is that workers do learn to work safely from embodied experiences in response to the physical environment in which they are situated (Somerville, 2005). They will manipulate haptic qualities to assist them in their thinking and acting, especially when guidance is not necessarily made explicit or afforded to provide appropriate procedural competence for specific situational needs. The experiences also show participants were generally mindful about being safe when they were engaged in experimentation and judgment-making situations. One other example was illustrated by Ming when his team attempted to perform gas purging and testing in a way which he felt was safe:

For example, the line is not purged properly, try other means. Sometime up to the stage, sometime need to trial and error but when error comes, you make sure nothing serious happen ... No, it is not like testing is that we want to carry on to go on, to carry on, to finish all the thing but somewhere stuck, we try again, stuck here again, we try again, stuck again, we try again until it is safe to cross this line. When it crossed this line, it means expose everything out. Cannot expose everything so and then before cross our line, we make sure it is safe for them or something like that.

In this instance, learning occurs primarily through problem-solving which entails a process of experimentation. However, the narrative also suggests that the participant was mindful about the need for safe work even when he engaged in trial learning. The approach to resolve the work problem was carried out in a controlled and circumspect manner. The inter-psychological processes and ontogenetically derived values about safety were crucial as they influenced and guided individual beliefs and actions. This also highlights a need to understand the underpinning imperatives driving subsequent action.

Peng also described how his team members needed to exercise their discretion when carrying out process control work which required precise moderation to regulate temperatures, pressures, and fluid flow rates and levels for the plant operation. Often, unexpected operating conditions would require them to evaluate possible alternatives and the inherent risk involved. From his account, exploring alternatives and sharing perspectives together with other team members was seen as an appropriate way to problem solve and maintain safety:

So, dangerous in terms of maybe temperature, high pressure, that's our own judgment by experience. We think it's dangerous, so maybe we will bring out our doubts, say that's a high temperature one or high pressure one is it safe to do or not. What are the measures?

In his case, seeking clarification with expert others and acquiring collective consensus before engaging in any physical doing led to safety, and acting responsibly. This also suggests that collectively learning and seeking group consensus are more helpful rather than making solitary decisions.

4.6.5 Summary

The different accounts of participants' learning presented in this section suggest that the capacity to be an expert practitioner is seen as situational and arises through engagement in circumstances of everyday work. It is achieved through an active process of thinking and acting that contributes to the maturity of approximation and constitutes expertise for individuals to reasonably and successfully engage in transformational activity. Essentially, safe working requires workers to develop situation awareness. In safety practice, lacking or inadequate situation awareness has been identified as one of the primary factors contributing to accident occurrences. Studies on safety practices (Kaber & Endsley, 1998; Naderpour & Zhang, 2014) expressly advocate how situation awareness is particularly important in work domains with technological and situational complexity. Poor decisions can lead to serious consequences. Hence, an individual with an adept sense of situation awareness is deemed to have generally a high degree of knowledge with respect to inputs and outputs of a system or, the innate "feel" for situations, people and events.

These cited experiences also provide evidence that, despite being situated in a highly regulated work setting, there are circumstances which demand individuals to negotiate and exercise their judgment to address non-routine problems in the course of their work. It is through negotiated processes that individuals learn by embedding thinking and acting in specific contexts and simultaneously responding to diverse situational requirements when addressing these problem spaces. Learning to respond and adapt appropriately to meet contextual requirements is critical to working safely.

Participants' accounts described here are consistent with empirical research on workplace learning which suggests that everyday work activities can offer experiences that foster active and meaningful learning through engagement in work-related tasks (Billett, 2001; Billett & Choy, 2012), and situated activities within the physical spaces of the workplace (Fuller, Hodgkinson, Hodgkinson, & Unwin, 2005). These experiences suggest how physical and

social environmental imperatives can significantly influence and shape the learning and practice of safety (Van Dyck, Frese, Baer & Sonnentag, 2005; Varonen & Mattila, 2000). It demands workers to actively engage in cognitive processes of meaning making that is situationally appropriate. The importance of tacit knowledge and intuition through everyday learning experiences in circumstances of work is essential for experiencing, developing, refining, and honing past learning and generating new tacit knowledge, routines, and heuristics that will shape professional practice in particular workplace settings (Eraut, 2004; Harris, 2012). However, two potential challenges will need to be considered for learning to work safely. Firstly, there is a need to know how past experiences are interpreted, recollected, and reconstructed to form new knowledge. Secondly, social and cultural discourses and emergent characteristics in workplaces can have significant influences in shaping individual learning and practice. Previous accounts of group activities and learning from different mentors show how learning can be interpersonally shaped and developed that form bases for decisions and actions, and subsequently reconstructed into new knowledge. How they apply the reconstructed knowledge in different work contexts will therefore require constant validation to ensure relevance and appropriateness. Despite so, it is necessary that attention is given to examining how all these interpersonal and social elements will eventually be interpreted to develop individual schema, dispositions, and beliefs about safe working.

All these insights on everyday practice and experience have important implications for safety learning and practice. Accounts by participants have shown that individuals will negotiate safety and act according to their intuition and common-sense knowledge developed from experience. A particular concern, therefore, is the tension when conflict arises between what is taught in safety training and how that knowledge is applied in practice. How workers approach problem-solving would thus be of prime concern in safety practice. In relations to this study, learning to work safe is seen as not simply a matter of acquiring a set of skills but involves the embodied subjectivity of the worker in profound and fundamental ways. The next section draws attention to the role of social materials and artefacts in the workplace that has a profound influence in shaping and mediating workers' learning and practice.

4.7 ARTEFACTS AND MATERIALS FOR REINFORCING AWARENESS AND COMPLIANCE

Safety is a practice that is regulated and has explicit rules, regulations, instructions, standards, and procedures pertinent for specific practices. Clearly, findings from the study suggest that expert others like supervisors and training instructors are important intermediaries and agents for transmission of safety knowledge. However, the circulation of knowledge would not be achievable without the use of physical and intellectual tools and artefacts to facilitate the translation of information, codifying and capturing the knowledge and synthesizing into

material and symbolic systems (Gherardi & Nicolini, 2000) to mediate the learning and practice of safety at the case site.

From the social-cultural perspective, there has been a growing interest in studying the pedagogical contributions of material artefacts for an array of learning activities within classroom and workplace settings. A plethora of studies explore how different learning tools assist the way in which people act intellectually, practically, individually, and with others in different social settings, and how they help to support specific pedagogic approaches for dialogic learning, problem-based scenarios, or situated practices (Millis, 2012). More recently, interest in the use of innovative computer-mediated tools is also evident for organizing classroom learning environments in organizations and workplaces (Conole, 2008; Williams-Bell, Kapralos, Hogue, Murphy & Weckman, 2015).

One other important contribution to learning to work safely is the significant use of materials and artefacts to reinforce awareness and mindfulness about working safely. These material cues encompass an array of texts and inscriptions, symbol systems, graphical representations, and computer-mediated resources to help workers in their everyday learning and practice. Together, they form a set of representations within the practice setting to guide expected behaviours, minimize errors, and support effective and efficient performance.

The following section provides an account of the material conditions for learning and practice to understand how they contribute to knowledge circulation in the work community. Accounts of how workers utilize and interact with the cultural tools that influence and shape their thinking and actions towards safety provide insights into the mediating qualities of artefacts.

4.7.1 Text and inscriptions

Texts and inscriptions are commonly used to document and record safety policies, processes, and procedures as part of the safety management process. The standard operating procedures (SOPs) manual details the modus operandi of related processes and specific job functions pertaining to the plant operation. These documents stipulate the practice requirements that guide enactment of different job functions such as materials and equipment handling, process control measures, risk assessment procedures, and personal protective safety. While the repertoire of information contains mostly statutory standards to regulate practices, it also provides codes of behaviour and more importantly, past actions and events critical for making informed decisions. Zain explained how textual artefacts served as an important record of every action or activity:

Everything you do, you have to write down. Certain major things we will document it.

For John, these materials provided access to information to guide practice which individuals may not instinctively recall:

Read everything. You need to know everything but it's very difficult to know everything right so as time goes by, with your experience then you'll know the procedures. Even if there's any special operation, you just refer back to the SOP for more details.

In this instance, the text artefact was seen more as a supplementary resource during times of ambiguous work situations. Practical experience, on the other hand, is the precursor and is prioritized over theoretical knowledge in contributing to one's vocational knowledge.

Each worker is also given a notebook to document what they do daily during their course of work. The example illustrates not only how textual artefacts are utilised to provide guidance for safe work practices, but also a representation of the institutional effort to reinforce the practice for safe work through record keeping.

Another important text cited by participants is the contractor guide that is provided for contract workers who perform work at the plant. The distinct cultural diversity among the process work community means that translation of information and knowledge circulation may vary in interpretations by different representational groups. The plant recognizes the importance of such pedagogical resources to maintain consistent information to guide practices. Deliberately designing as a miniaturized document makes it convenient for site operators to carry it with them during their course of work. Unlike other instructional materials which tend to be text rich, the guide is intentionally written in simple English language with rich pictorial illustrations for easy understanding. Rauf, a contract worker commended how the guide has helped to improve workers' learning, particularly for those who do not understand English:

Then also sometimes if I not read understand or my workers or someone new workers don't understand to read, so explain the supervisor, he said what writing inside. This same like job one bolt and nut opening, process plan right, bolt and nut opening. Wrong position meaning the ... so hammer just throw there can hit the person. So inside also book writing have. So, after we follow the book, easy to work. [sic]

Though his supervisor acts as an important intermediary, pictorial illustrations make his learning easier particularly when the procedures are complex and difficult to understand. Such illustrative learning resource is seen helpful to workers who have language or literacy problems.

Participants who are contract workers also highlighted that the transitory nature of their workplaces implies that they receive different degrees of support in their learning from different host plants as they move from one work site to another. Participants spoke positively of how the guide serves as an important resource to improve their understanding of complex procedures so they can carry out their work safely. They also viewed it as a reflection of the plant's commitment to help workers learn which they claimed was not commonly practised in other work sites, including other established process plants where they had previously worked. In particular, Ganesh reported that his classmates from an off-site training class were envious of him when he shared with them the guide book.

Another important text document which participants mentioned that was critical to their learning is the incident report. Sharing knowledge on critical and near-miss incidents is a common but important way to reinforce safety awareness and practice. Learning from these incidents allows past knowledge to be accumulated and embedded in work environments in ways that can prevent future incidents from occurring (Cooke & Rohleder, 2006; Lukic et al., 2010). Often, information is translated into text or inscription which provides access to histories and past actions for learning. Consequently, collective knowledge is used for discussions during work group meetings or training classes.

We have this near miss report and PEPs, all available in G drive. They print out and circulate and you have to read and sign. Your manager or supervisor will ask you what happened or what you have read. –
Mohammed

Through reading these reports, workers learn about real-life work incidents which they can use as examples to reflect on their practice. Learning occurs through a self-discovery process of thinking and questioning about the possible causes and developing appropriate ways to act when faced with similar situations in the course of work. However, a facilitated reflective exercise or didactic approach to analysing the cases is more useful. Participants indicated that learning about these real-life incidents occurring in the plant helped them to develop awareness and be more mindful about working safely both in the workplace and in their personal life. As they learn and share the knowledge, it also helps to develop a sense of common identity and collective knowledge among their work community.

During the interviews, the point of accessibility was raised to understand how workers access these resources to guide their practice. Mohammed, a direct employee informed that workers could access most of the texts and documents at a staff library located at the control centre. He added that safety related information is stored in the computer system:

No issue, so whatever you ask it's all there in the library. What you want to know is all in the library and the computer. All the information is there.

However, access to these facilities is restricted to site operators from the particular control centre due to security reasons. Site operators from the control centres are mainly direct employees of the plant, so contract workers are generally not able to access the library resources. A catalogue outlining different types of documented texts was filed systematically according to subject matter for easy retrieval. Documentation on various work processes and activities such as operating procedures, safety assessment and inspection reports, meeting notes, critical incidents, and investigation reports are found in the library. The array of text resources indicates text and inscription are important artefacts to reinforce and guide safe working.

4.7.2 Audio and visual exhibits

An important way to learn and practise safety entails the capacity to interpret and identify hazard signs. This is taught in most safety training. Visual exhibits are important tools in safety practice to help raise awareness about workplace risks and hazards such as electric currents, toxic materials, and radioactivity, and to guide work practices. The study showed that the bulletin boards displayed across the work site are common visual exhibits. Primarily, these boards are used to circulate important notices and information specific to safety issues at the work site. Hence, workers can access the information readily and are kept informed of critical events that may implicate their work.

Though the provision of these visual exhibits in most industrial workplace settings is largely governed by statutory requirements, their contribution to safety learning is evident. Participants attributed the importance of these exhibits to reinforce how to perform a task, or educate about an unsafe work practice. Salim found the visual impact effective in creating awareness for being safe at work:

What they call it, I can't remember the term, callisthenics. I'm a more visual person. So, this is the direction I'm going. Whenever a visual person see colours, though I'm colour blind, but I see colours. The poster, it really gives you a message.

He added:

Whatever the company provide, you know, posters, all around, all over the workplace. Even sometimes during SPS they hang big posters at the plant itself. Everywhere in the office, offices, control room, everywhere you walk

you will see some safety messages there. Sometimes for you, you think it's nothing. But it keep on reminding, emphasising, enforcing, reinforcing this safety messages. It's just like become part of life. You don't feel it. You just see it, OK. But when you go out, oh yes, I must remember what I need to do.

Learning through utilizing these visual artefacts is largely premised upon influencing the cognitive domains and behavioural conditioning approach to gain attention for safe work behaviours and reinforce the need to work safe (Macpherson & Jones, 2008). As Salim described, these visual artefacts impact workers' learning in different ways. Firstly, the everyday exposure to these visual cues helps workers to become more cognizant of the potential workplace hazards and be mindful about working safely. Contrary to text-rich documents, the pictorial illustration also helps workers to improve their understanding, particularly for participants who have low level of literacy in the English language.

All the place have the signage, and they understand what is ... what is ... not. [sic] – Rayesh

Pictorial representations contribute to workers' learning by enhancing their comprehension, providing cues to complex work procedures and text processing. A similar study by Styhre and colleagues showed that both verbal and symbolic forms of communication were commonly used by construction workers to supplement other forms of decoded, written and computer-mediated learning (Styhre et al., 2006). In a highly regulated work setting, these visual exhibits are important practical mediums for knowledge circulation to recode and improve workers' recollection of complex text information that is often included in instructional manuals and policies.

Three distinct forms of pictorial illustrations suggested by Carney and Levin (2002) are found analogous to those used in the case study. These include (a) organizational pictures that provide a structural framework for explaining processes or particular text content (such as those illustrative images used in the contractor guide that outline procedures involved in performing a particular work task); (b) interpretational pictures used to explain and clarify complex texts or concepts (hazard communication pictograms); and (c), transformational pictures that are designed to enhance readers' memory and recall of text information to provide a more meaningful and interactive representation (graphical illustration reflecting accident rates). Understanding the purposive uses of these different forms of illustrative representation is therefore critical to utilizing them effectively for knowledge distribution.

One other form of artefacts that is important to reinforce learning for safe work is the integration of different interactive media used to circulate safety knowledge. These include television broadcasting on the corporate safety video which can be found at different communal sites. The videos are screened continuously to feature safe work practices where all site operators can view them. Additionally, there is also a digital sign board displaying the plant's safety performance. The functionalities of these media are similar to those of visual exhibits in drawing cognitive awareness and providing cues and reinforcement on safe practices. Sharing common knowledge through these artefacts helps to create a sense of identity for collective capacity building. Despite their pedagogical contributions in circulating safety knowledge, these media artefacts also have limitations. Salim made an interesting comment on how these communicative mediums had little impact on his learning:

More on, how you say, that's more on the message to remind me daily. For the audio order, or what you call it, every Monday morning, sometimes they announce safety messages. During the normal our local siren test, where ever Monday morning we will test the siren for every session. But that one doesn't affect me that much. I don't learn. But sometimes, unless it's music whereby you just listen to enjoy ... But it keep on reminding, emphasising, enforcing, reinforcing this safety messages. It's just like become part of life. You don't feel it. You just see it, OK.

Paradoxically, effectiveness of these interactive media seems to diminish as individuals grow acclimatized to the replicated content. John's experience also corroborated that the impact of routine exposure to the media may be twofold, as he remarked:

The TV reports on safety video. Keep running and running. I think after a while most of us will memorise. I think it's propaganda. It's effective actually.

The above narrative suggests that while repeated exposure to the media may serve to improve retention and lead individuals to become habituated with the appropriate practices, it could also result in a loss of effectiveness as individuals' attention reduces over time when they are cognitively conditioned.

Other reported learning experiences suggest that while the use of visual representations in these interactive media did generate awareness and provide guidance for safe working, the effect may be short term. Lim who has worked in safety profession for many years, described how watching gruesome images of others who are injured or lost their lives in

workplaces may heighten one's awareness to work safely. However, he perceived such effect was not as persuasive compared to witnessing a real-life incident:

I mean like certain accidents, there are pictures of limbs being torn off then that will make you wake up your idea basically. I mean even if you watch any videos, a video is a video to me because it basically kind of relate back to you this is wrong, this is bad actually. I mean unless you really see it then you will know it but not to the extreme cases where there's fatality or there's injury.

Essentially, the above experiences suggest a need to consider the learning outcomes and effects when utilising the different forms of media to support learning and practice. While social learning theorists like Cantor (2003) argued that media has an effect on modifying behaviours. Individuals learn through seeing direct experience and modelling after others. Huesmann (2007) argued that there are both short- and long-term effects of media on behaviours. He suggested that both short- and long-term effects of audio-visual media need to be considered for it to effectively mediate learning. While the short-term effect generally aims at priming and arousal to establish a connection to individual cognition (such as the awareness of practising safe behaviour), desensitization process in the long term through repeated exposure can lead to modification of behaviours or practices as individuals become habituated. While such consequences may be the desired goal for all safety practitioners to remodel behaviours, there is also a potential danger that desensitization may negatively impact safety practice. For instance, workers may lack the capacity to correctly interpretations and understand or truly appreciate the importance of working safe. Periodic reviews on content message and its impact outcome may thus be required to ensure these audio-visual elements can effectively mediate learning and appropriate behaviours as intended.

4.7.3 Computer-mediated tools

The concept of technology-enhanced learning is not novel. It draws attention to leverage work context by providing solutions to facilitate and integrate learning processes into work processes (Braun & Schmidt, 2006). In this case study, the role of computer and digital systems has provided the infrastructure to support functionality to find, assign, and grant access to learning resources for the workers.

Participants cited two primary software tools which they used frequently to support their learning and practice: an integrated information system and the use of electronic mail to communicate safety messages. To John, these computed-mediated tools provide great utility

to workers' learning through which they could readily access all related information expediently as he remarked:

You just log on to the intranet then you just surf. The only thing I access here is the intranet.

As an integrated resource of texts, graphics, and interactive media, the system provides easy access and retrieval for individuals to locate related information. The system also has a scaffolding effect to promote active learning as individuals navigate through those hypertext spaces to retrieve information. Leong, a supervisor, spoke about how such technological artefacts are particularly useful to support safety practice:

I also get the company to spend more money on IT meaning buy more computer and laptops. Also go for 4G website, facebook and email accounts. When plant gives info, the site manager will be the first to have the information. Drop me an email anytime. Communicate and share through email. So they can go and read and they have the copy there.

As mediating tools for sharing knowledge and information, these electronically based artefacts created a learning environment within the work community where the members could readily access past histories or receive timely information on important changes in the workplace.

4.7.4 Summary

Overall, the experiences reported here suggest that material artefacts can provide rich pedagogical contributions for safe work and learning. Each artefact provides different representations and interfaces for knowledge construction and meaning generation to mediate workers' learning and practice for safe working. The findings suggest that visualization is an important aspect to support safe practices represented by different forms of texts, symbol systems, graphical illustrations, and interactive media. Primarily, the role of artefacts is to make knowledge visible to mitigate tensions resulting from different practices between organizational communities. However, not all artefacts may bring about the same desired learning outcomes and effective performance. Alterman (2007) described the tool function as the quality to facilitate the accomplishment of a work task while the sign function acts on how individuals perceive and think about the task. Participants' accounts of learning effects and outcomes from utilising artefacts to mediate their learning highlight their role of agency. The findings also suggest the importance of appropriateness and currency of the content knowledge, rhetorical purposes, and the visual and affective effects (including both the short-

and long-term effects) to engage learners. These attributes can influence the learning outcomes and performance.

Indubitably, the mediating artefacts have a central role in organizing, structuring, and meaning generation for the practice of safety. Understanding the different forms of pictorial images and their purposes will be useful to ensure information is meaningfully represented and interpreted. This is particularly so in process work where site operators need to manage complex work procedures.

4.8 DISPOSITION, VALUES, AND GOALS AS AGENTIC IMPETUS

While safety is an interdependent social practice at the plant, there are also examples of individuals acting independently in ways which may or may not be consistent with the norms or prescribed standards. Potentially pervasive intrapersonal attributes such as self-motivation, the need to improve performance, job advancement, life experiences, and personal values with regard to how safety is valued may sequentially influence learning and practice (Griffins & Neal, 2000). Learning and practice of safety therefore need to be understood with respect to the individual's intrapersonal and agentic attributes. In other words, understanding personal influences which are developed from individuals' past histories or ontogeny can be helpful to understand what shapes their social experiences (Billett, 2010a). These impetuses could also potentially entail the physical, cognitive, and affective dimensions that are interlinked with an array of intrapersonal factors such as their emotions, beliefs, personalities, or motivation (Billett, 2010a).

The findings suggest these bases are important to understand the study phenomenon. Understanding workers' sense of values as derived from their self-perceived identity, their ways of thinking, and their ability to solve unforeseen problems are helpful to knowing how they respond safely to prevent incidents. Inherently, their relatedness to the values and practices of the workplace will also be central to understanding the qualities of their learning (Valsiner, 1994). The findings show that workers' intentionalities to work safe can be either intrinsically or extrinsically associated with their personal values and beliefs about safety.

4.8.1 Sociality for safe work practices

As a situated practice, safety is sustained as a priority within the context of relationships, making the creation of high-trust working environments among members and across functions of the organization highly important. Studies on safety practice (Cooper, 2001; Gherardi & Nicolini, 2000) suggest that individuals who perceived their organizations as valuing safety are more receptive and likely to comply with safety procedures, or even carry out voluntary activities to enhance the safety of their workplaces. Concurrently, the growing attention on

promoting safety culture among organizations also suggest its importance in shaping and guiding safe practices which can be influenced by the organizational or individual attitudes, beliefs, perceptions, and values towards working safely (Cox & Cox, 1991; Siu, Phillips & Leung, 2004).

Indeed, the strong safety climate and culture driven by the commitment of the leaders in this case study has significant influence in shaping workers' perceptions and practices towards safety (Leroy et.al, 2012). Many participants spoke positively of their employers' efforts in upholding the strong safety culture to maintain a safe work environment for all. Migrant workers in particular, felt privileged and valued the type of leadership and commitment of the plant which was not experienced by their peers working in other high-risk industries or work sites. Many of them regard the institutional emphasis on safe work practices as a distinct practice which they did not experience in their home countries either.

Reinforcing positive workplace relationships among co-workers is critical to encourage active participation and engagement for safe work practices at the job site. Participants associated themselves as families or friends with their peers which they held themselves responsible for each other's safety at work. Building upon these beliefs, the need to share, help one another, and be empathetic were ways in which participants helped each other maintained a pristine mental and physical state to meet challenging work conditions in a perilous environment. Inherently, this illustrates that safe working can be learnt through discursive and social relationships.

Language and culture is reported by Gilkey & Lopez del Puerto, 2011; Feng, 2014; Loosemore & Lee, 2002; Vazquez et al., 2004, to influence individual perceptions and attitudes towards risk. Robin, whose supervisory role requires him to manage workers from diverse backgrounds, emphasized the importance of developing team cohesiveness through indoctrinating the notion of family as an effective way to promote safe work behaviours. As he related:

They must have that mindset, everyone is in your family now although of different nationalities and backgrounds because they are working for you and for the company so I always emphasize this.

The need for cohesive and collective understanding is therefore seen as critical for achieving coordinated practices. Robin further described how this was practised in their everyday work life:

Yeah, they do, they have conversations, although they are of different nationalities, we try to group them together as a family. It doesn't mean

that you are from this country and you are from this country, you cannot get along, that is the wrong thing to do. And they are like, if you see my guys, they are like families here. The way they joke every morning, fantastic, so the feeling of satisfaction when I talk to them every day during the meeting, so it happens to pay off, the way they mingle, sometimes they joke around before they start work.

The above quote reflects the significance of how interpersonal relations between individuals at work can shape their participation and learning (Billett, 2009). The findings show that workers learn to appreciate and be mindful about safe working when their interpersonal relationships are strengthened as they develop affiliation with their co-workers. Intervention efforts from supervisors as the intermediaries or facilitators to influence behaviours by engaging their crew in active interaction to openly discuss problems and concerns without fear of reprisals are helpful to reinforce active engagement. Likewise, Rauf's experience with his peers suggests that group affiliation and cohesiveness is important in their practice of safe working as he commented:

Share, yes, they will feel like we, togetherness, grow together. [sic]

The two illustrative instances show how a positive relationship contributes to effective learning as individuals learn to build mutual trust and shoulder responsibility to reinforce the practice of safe working. This emphasizes the importance of safety culture and positive psychological attributes in contributing to effective performance and high-quality relationships at work (Carmeli & Gittell, 2009; Hirak et al., 2012; Khdaier & Shamsudin, 2011; Kosny & MacEachen, 2010; Tharaldsen, Mearns & Knudsen, 2010).

The importance of having positive work relationships for performance and occupational efficacy was further illustrated as other participants provide different examples of how they get along with their peers in their everyday work. Salim explicated the importance of showing more empathy to his peers who are migrant workers as they often have difficulty to relate and communicate about safety practice due to language barrier:

So, whenever they come to work, where they interact with us, I think we will expect more from them. I find sometimes they need, I need a person who understand me. We speak English better, and then it's better to communicate. But we really need to take care of these workers. As more on human being. Human empathy whereby you see them working, then we were. Receptive. [sic]

To him, showing care and empathy is a way of helping others to learn the importance of being safe at work. Likewise, Logan cited how co-workers act as interlocutors to constantly remind peers to wear their personal protective equipment and take responsibility for each other's safety at work:

So, sometimes working the grinding work, the worker wears safety goggles only, never wear the shield. So just remind the worker to wear the face shield. Because sometimes the person also never remember ... never. So, he just cutting or grinding, and just do. Never remind. So, the colleague remind to wear the face shield. After he remember. [sic]

The example provided by Logan was analogous to the study conducted by Roelofs and colleagues on Hispanic construction workers (Roelofs et.al, 2010) which suggests that how workers learnt to work safely is closely associated with their perceived role and responsibility to look out for one other's safety. In the same way, John reiterated the importance of this shared responsibility as he commented:

Generally it's just, it's not learning, I think more of a reminder for each and everybody here. So they will just inform you careful about this, go and do this, make sure there's this something you cover. It's more to a reminder.

Social support provided by co-workers to alleviate newcomers' anxiety was cited as another way which participants perceived as an important way to work safe in a perilous work setting. This is of particular concern with a considerable pool of migrant workers performing contract work at the job site who often face uncertainties and interpersonal risks both at work and in personal settings. Helping them to cope with psychological distress and maintaining good well-being are seen as ways that will help them to work safely. Jayesh related an incident in which he offered to help a migrant peer who was coping with his new job:

We're colleagues, friends, we discuss. So I ask why you crying? He say I remember I miss my mother. I also don't know, he don't understand English. That I ask my supervisor this man crying, I also don't know why crying. After supervisor coming, supervisor also ask man what's the problem. After this man said: I miss my mother. So, I said like that people share, problems share other friends. This man never share. So, he crying sometimes. This one also maybe cause of incidents. [sic]

The capacity to work safely can be influenced by individual emotional and psychological states of being. Sharing personal problems is perceived not only as a way to alleviate newcomer's anxiety but is also necessary for building a trusting relationship.

Other participants also mentioned the importance to build positive relationships that help workers to work safely. Mohan, John and Ganesh all shared similar experiences of how they learnt through appraising one another's work, and openly discussing viewpoints with peers or collaborative partners:

Actually to carry out such things, I need also my own peers to check on whether such things is actually working out safely. On top of correctly, that's the other thing. But safely. Then from there actually we will work out to a better idea. [sic]

Ganesh described the prevalence of an open culture in facilitating knowledge sharing and peer support across different representational work groups at the job site:

Yes, they help each other, discuss with their co-workers. We practise them to speak out for safety. If you anything wrong or something don't know, ask ... Everyday we share something is new or something new training program then they attend then they tell us, what's the new we learn, then we also learn from them. We work together, we all SPCC, all the in-house contractors, we all one place, we all know very well. So talk with each other is easy to communicate ... We can help them to explain our own language. Simple understanding. [sic]

Overall, the above accounts of participants' experiences suggest an expansive and supportive learning environment is necessary to encourage active participation and engagement (Fuller et al., 2004). The examples also reflect how workers support one another in their learning by sharing new knowledge that may not be accessible to their peers (such as the new training program), or acting as interlocutors and intermediaries to facilitate knowledge circulation. Yet it is also recognised that a supportive learning environment cannot be realized without effective institutional efforts and intervention. The consistency in institutional actions and views is critical for promoting positive psychological capacities to influence followers and form strong safety values that are aligned with organizational goals. Participants reported different instances of the organisation's effort ensuring the workers' safety even if production deadline is implicated. The culture of openness and transparency are necessary to provide a supportive learning environment where workers could unreservedly share their work problems. This is consistent with the plethora of literature that an open

culture can positively enhance an organizational safety climate through improved communication and appreciation for safety (Eklof, & Ahlborg Jr, 2016; Jukkala et al., 2013; Kachalia, 2013). The experiences also suggest workers' personal safety is being prized over production gains where one would not be coerced to perform a job with which he is not familiar. Such organizational value over safety is presumed to have a cascading effect on downstream behaviours to readily comply with safe practices (Ross-Hansen, 2002).

Participants discussed about how everyday practice and experience significantly contributed to their learning by accumulating a repertoire of knowledge and skill refinement. Correspondingly, participants also conceded that personal experiences deepened their awareness and value of safety which motivated them to learn and work safely. Two representations emerged from the study with respect to how safety is being valued and how it shaped workers' learning and practice. The first is established within the context of how safety relates to the interest of the work community collectively; the second relates to their personal safety.

When working in a perilous workplace, many participants were cognizant that they were in a situation where they could not indulge in trial and error where their first error might be their last trial. Hence, they learnt not only from near misses but from those situations which have the potential to evolve into near misses. Such learning is inherently reflexive, since the ability to identify a particular situation is in itself part of the constructed ambience of safe operation. This state of consciousness about their physical environment is found to have a subliminal effect on their sense of agency and willingness to work safely for fear of the impending repercussion that may cost their lives and of others. As Mohan remarked:

These are the things which are very important, which tells every single one of us we are already working in very dangerous environment. And we should be going back safely. So, it's a good thing that we always tell ourselves we go out safe, we come back also safe.

Though participants acknowledge that they have not personally experienced physical injuries, they did witness casualties that affected their peers or family members. These incidents consequently served as incidents for learning which both motivated and reminded them of the importance of working safely. Of all the experiences, two particular incidents cited by Jayesh and Leong are worth mentioning. Jayesh spoke about the loss of his sibling in a workplace accident due to the lack of safety awareness in his home country. The incident reminded him of the importance of safety. To him, working safely and protecting his personal safety means being responsible to his family. Similarly, Leong shared about a workplace incident in which he witnessed a crew member's finger being severed during the course of

work. When assisting the victim to receive medical attention, he had to personally keep the severed finger in an ice bag. Such experience reinforced his belief and value of the importance of safeguarding personal and others' safety. He sternly advocated the need for austere supervision of his crew members' performance:

Singapore is a no chance society. This chance you give to him, might lead him to do something more dangerous. In the future will cause accidents to other people. I don't allow. There is no chance at all. Zero.

His remarks indicated that affective influences can significantly shape how individuals perceive the importance of safe working and consequently the response to act safely. Salim said that personal experience did have significant impact on reinforcing safe working. He affirmed his belief about psychological and physical impact on learning after one experienced a personal injury, or others':

experience factor ... When it doesn't happen, can't relate or understand the importance.

This emotive remark suggests that intra-psychological effect and embodied learning are important influences that can impact the way in which one perceives risk and becomes more mindful about safe work behaviours.

In other instances, participants related the need to work safely and be responsible to their families. Salim cited an incident where he did not heed the supervisor's advice on knocking on the gas pipes to detect possible leaking. In doing so, he felt his personal safety was threatened as he explained:

I say I have a wife, I have family. No, I won't do it. You want me to put in to clear this sludge or whatever, I will do it. But knocking on the pipeline, for me is stupid.

To him, protecting his personal safety at work is important and so is being responsible to his family. However, this particular incident also highlights a situation where individuals may not conform to the practice standards when these institutional requirements are in conflict with their personal values or goals. Speaking from his perspective as a migrant worker, Loh also stressed the importance of working safely, being the sole breadwinner in his family. This suggests that Individuals' mindfulness of their personal roles and responsibilities can have a significant influence in shaping their learning and practice.

On the whole, the instances discussed in this section exemplify how personal histories, experiences, and past actions can significantly contribute to building individual schema and

perceptions about the need to work safely. Consequently, these cognitive, psychological and affective influences can profoundly impact and guide individual thinking and action.

4.8.2 Pecuniary rewards and self-efficacy

Another important approach to reinforce safe working as suggested from the findings, is providing different forms of rewards to encourage workers to work safe. Most participants candidly shared that they were enthused, particularly with pecuniary rewards and incentives to supplement their income.

One learning incentive aimed to encourage workers to contribute ideas on improving safety practice in their work. Participation is mandatory, and each worker needs to contribute at least one suggestion each month. The incentive approach was effective in encouraging active participation:

You just do, you can submit and get money. So, I think if you submit about seven or eight per month, I think it's about \$20 or \$30 around there. So, the more you write, the more you get. – Rauf

He also explained that the approach helped to generate greater awareness about safe working as workers need to actively observe safety issues at the work site and reflect on their own practice as they consistently search for ideas to contribute. Engaging in such activity not only reinforces workers' knowledge but creates an ongoing learning culture for safe working.

Ravi described another situation which his employer uses financial incentive to pay for the workers' training lessons:

My boss say okay today you get voucher right, SPCC, so okay tomorrow morning I give you \$10. Increase, means develop.

While he admitted that many workers attend training to receive the rewards, they also recognise the importance of training to improve their occupational knowledge and efficacy.

Though what participants have shared suggest that the provision of rewards and incentives can effectively invite greater participation. A potential limitation of such a conditioning approach is that it could lead to complacency if the practice is not periodically reviewed to meet individual expectation and maintain learners' interest for learning. Moreover, the effect on learning may not be apparent and may require an effective feedback process to review what is being learnt and how that knowledge is translated into practice.

Participants' accounts suggest that pecuniary rewards play a role in encouraging workers' participation for safe working. There are also other intrinsic reasons that motivate workers to work safe. Antecedents which foster proactivity in safety learning and practice

were also found to be premised upon a combination of personal values and dispositional factors which are closely associated with individual self-efficacy and self-esteem. Broadly, self-efficacy is defined as the belief that one has the skills and ability to apply the learning (Ford & Weissbein, 1997; Hirschfeld, 1990). Hence, those who believe that they have the ability to apply specific information and skills to the workplace are more likely to do so. For instance, Ravi relayed the need for him to continue learning so that he could advance in his profession as a process worker:

So, this after I just feeling this cannot do work, must go some and study. So, then my own money I use, so I go to mandatory training some courses same like BCSS, Building Construction Safety ... My own money then after I finish my course then my bosses ask me why go this course? Then I say I want to upgrade, I want to know something, to learning something. So, after my boss say okay never mind you learning first then after I give you job. So, after six months after my boss said do supervisor job. [sic]

Though he had to pay for his own course fees, he felt it was important to advance his knowledge and skills so that he could progress to a higher-level job as a safety professional. In his case, the need for personal growth and job advancement were important motivating factors to improve his vocational knowledge and skill. Aamil, on the other hand, who has more than 20 years of experience as a Safety Officer, also shared similar view so that he is more competent and can provide better guidance to his crew.

Day to day of course we learn a lot because not every day is the same. Some area maybe require a certain for example you go to this area, while working suddenly something happen, for example there is a leakage of gas or whatever, so as a person who doesn't know anything about this, of course they will panic. But if you are trained and you know what to do, of course we will react according to the requirement so that means if you don't know, then you have a problem but if you have knowledge and you train your staff what to do, they will not feel panic. [sic]

In this instance, learning was aligned to meet individual responsibility and provide leadership for appropriate guidance, particularly during times of unstable work circumstances. Aamil further related how he would usually approach a work situation during times of uncertainties:

For myself, my character is simple, I am not a shy person, if I don't know, I just say I don't know, I will find out. That is why, sometimes workers giving me examples on safety matters which is I am not so sure very well, so I tell

them give me a few days, let me check on the requirements and somewhere around the internet or my friend, once I get information, I will pass down to you. I am not super guy.

He went on to describe how he would actively seek guidance through his personal learning networks by discussing problems with other experts:

For example, for myself if I am always in doubt, I am talking about legal requirements, usually I will go back to my consultant. So my consultant will update to me how to go about but if I cannot get, I do not go to the consultant, of course I will see my friend, the senior guys. It is good, once you have this type of problem and you do your own research, that is where you learn.

On the whole, what Aamil has shared suggests that the intentionality to learn and work safely can be shaped by those agentic attributes such as personal goals and interests. In this instance, the need for learning is attributed to meeting one's responsibility to provide appropriate guidance by making conscientious efforts to seek validation and expert advice. This is pertinent to safety practice as it suggests that individuals are cognizant of the importance of working safely. Hence, they engage in self-regulatory actions as ways to seek reaffirmation of their learning.

The saliency of active learner agency was also evident, as exemplified in the case of Kee. He spoke about note taking and reading instructional guides in advance as useful to prepare oneself before physically enacting actual work:

Actually self-study, yes. Every night normally we will be doing our own self-study. Because before that they will give us some notes to self-study.

Normally I will read through ... Actually I got write down the notes.

While note taking as a learning strategy is not uncommon, Kee's experience suggested that it can be an effective tool for information transmission and processing to mediate learning (Hartley, 2002). More importantly, when individuals engage in note taking, they are also involved in a process of memorization and reflection for comprehension. In the same vein, learner autonomy is also evident as the participant independently and actively avails himself of possible learning opportunities, methods, and resources (pre-reading of learning materials) to direct and manage his learning.

The saliency of learner autonomy was also illustrated in the case of contract worker Sahil, who explained how he prepared himself by searching for information from the website prior to attending safety classes:

Before I going to supervisor course, at that time, I check internet.

Sahil helped many contract workers from non-English speaking backgrounds, who used web-based tools to translate the information into their native language to help in their understanding. These examples reiterate that workers will mediate their learning by exploring possible resources and tools to enhance their learning.

4.8.3 Summary

The experiences discussed here were congruent with a plethora of research on how affective and cognitive influences guide the way individuals think and act. There is also a general consensus that affective and cognitive influences can contribute to conceptualization of individuals' attitudes which determine how they perceive or evaluate situations (Agarwal & Malhotra, 2005; Farley & Stasson, 2003). For instance, participants who have experienced or witnessed dreadful consequences of unsafe work may have different perceptions about risks and approach a work problem differently. Any unpleasant experiences or negative consequences are thus likely to have the effect of minimizing or inhibiting undesirable actions or behaviours in safety practices (Burke et al., 2011). Inherently, individuals' cognitive capacities or processes, reinforced by their personal experiences, interests, intentions, and emotions that direct their efforts to attain the intentionality, are fundamental to understanding what mediates their learning in the circumstances of work across working life, as well as their rationality and engagement in safe work practices (Billett, 2009; Billett et al., 2005). Advances in understanding these influences are therefore particularly helpful to understand how they affect workers' learning and readiness to work or act safely.

4.9 OVERVIEW OF FINDINGS

Participants' accounts presented in this case study suggest safety practice entails more than an act of conformance to a doctrine of technical rules and standards as learning occurs through those circumstances of work. Unlike learning that occurs in conventional learning contexts, workplace learning for safety is thus far more complex and enriched when the learning becomes intrinsically part of the actual work. While rule following still prevails as a conventional approach to working safely there are also circumstances which require individuals to act beyond those prescribed rules or established requirements. Learning as experienced by different workers suggests it is determined by how individuals interact with and respond to those institutional and social imperatives in the workplaces, as well as their personal histories and epistemologies. Inherently, these form the bases to guide individual decisions and judgments that consequently translate into particular actions or behaviours.

Based on the six themes presented here, the case study concludes that learning to work safely is dependent on four important features which correspond to the discussed literature on workplace learning for safety practice. These include:

1. the practice arrangements which outline deliberate and organised work processes to support learning and practice, that eventually form the bases of the structure and context for practice (Eraut, 2004; Eteläpelto, 2000; Fuller & Unwin, 2003; Wilson & Myers, 2000);
2. utilisation of intermediaries and social agents to validate and facilitate knowledge circulation (Billett, 2011; Cook & McSween, 2000);
3. utilisation of artefacts for the ordering and organisation of information (Carlile, 2002, 2004; Macpherson & Jones, 2008; Marshak & Heracleous, 2005);
4. the role of individual agentic efforts to enhance learning and improve work performance (Billett, 2009; Hodkinson & Hodkinson, 2004)

These different dimensions of learning and work should not be viewed as distinct entities, but are intertwined to reinforce and refine workers' understanding and skills about safety practice.

On the whole, how workers participate in workplace learning thus, are grounded in three approaches which resonate with constructivist, social constructivist, and situated cognition paradigms. Firstly, learning to work safely is a collaborative process that is co-constructed through a process of social interaction to maintain a shared conception or understanding (Hager, 2004; Lipponen, 2002), that is, being safe at work in this instance. Secondly, learning is situated within a particular context which is dependent on how individuals cognize and make sense within the given context (Gruber, Harteis & Rehrl, 2008; Wilson & Myers, 2000). Lastly, individuals construe and construct their own meaning and knowledge based on personal experience and epistemologies (Billett & Smith, 2007); yet concurrently seek alignment with the site's expectations and values. More specifically, the findings show that workers' learning to work safely evolves from close supervision, controlled observation, routine practice, problem-solving and self-directing as workers engage in social interactions and goal-directed activities in their circumstances of work.

What these different dimensions of learning and work suggest is that for workplace learning to be effective to support the practice of safe working, there is a need to consider the complex relationships of work, learning, agency and space. As evident from the case study, these three dimensions are critical to provide learning spaces and appropriate guidance that help workers to make informed decisions and act safely at work. Overall, such a collaborative view is useful and legitimate to further develop learning and the field of safety practice. This is

achievable by informing aspects of complex behaviours, attitudes, and interactions within the myriad of dynamic, cultural, organizational, and technical interrelationships that are pertinent to learning and the practice of safety. Drawing from the findings, the next chapter outlines important qualities of workplace learning that are necessary to support safe working in precarious workplaces and trade. Possible tensions, constraints and interventions are addressed to further examine their implications on learning and practice.

CHAPTER 5: REVISITING SAFETY AS PRAXIS

5.1 INTRODUCTION

The genesis of this thesis is centred on understanding how workers in perilous workplaces learn and work safely within a highly bounded context governed by myriads of regulations and standards that shape and order labour processes. The inquiry was guided to address the following research questions.

1. What are the current provisions of learning for safety and health in a process plant?
2. How do workers engage and participate in workplace learning for safety?
3. How can their workplace learning be optimized?

The aim was to identify critical learning points that would contribute to advancing safety practices in similar kinds of work contexts. This exploratory study contends that consideration of workplace learning for safety requires thorough understanding of the different configurations that underpin complex relationships of work, learning, agency, and space. The workplace as a learning space can enhance employee agency if provided with opportunities and affordances for the development of personal skills, motivations, and outcomes (Brooks et al., 2012; Kersh, 2015). While much of what workers do is often examined empirically and framed in positivistic terms as is the case in most safety studies, to understand how they respond and choose to work in a safe manner requires further examination of the dynamics of interactions, rituals of the social structure and beliefs of the organization.

Essentially, participants' experiences attest that institutional effort is instrumental to provide the infrastructure for facilitating knowledge transfer and reinforcing the culture for safe working. As Singaporean companies assume greater ownership in workplace safety and health responsibilities, findings from the study form important bases for understanding and appraising how workplace learning can be organized to enhance occupational efficacies and organizational performance.

Two key sections are presented in this chapter. First, a review of the key qualities of workplace learning and its implications are examined and discussed in relation to how safety is learnt as praxis in a precarious work setting. The discussion considers the ordering of actions, activities, and discourses of practising that may affect the inter- and intra-psychological influences on individuals and groups that shape their practice and action for safe work. The second section presents a revised learning framework which summarises how the learning and practice of safe work is understood. Implications for practice are also considered for possible interventions to leverage workplace learning for safety practice. The chapter concludes by explaining how the case study has informed the overall research purpose - that is,

understanding salient and best practices which organisations can consider to advance their safety practice, and create a safer work environment for their stakeholders.

5.2 LEARNING SAFETY PRACTICE IN PROCESS WORK

The findings from the study suggest that there is a need for a more expansive view to look beyond didactic teaching (which is teacher and content centred) and classroom-based learning practices that are predominant. The themes and subthemes that emerged from the data of this exploratory investigation unlock important insights into an array of institutional, social, and personal practices that have a significant influence on how safe working is learnt and enacted in perilous workplaces and trades.

Essentially, the process plant is a distinct work setting where human movements and work processes are constantly under close surveillance for safety and security purposes. Observations of how tight security was enforced at the plant in different ways such as pervasive use of video surveillance and stringent access control depict the importance of safe work in a perilous work environment. In particular, the ubiquitous use of safety signs was another prominent characteristic of the perilous work context. Inherently, these regulatory practices contributed to reinforce safe learning as workers were constantly reminded and guided through close supervision in their everyday work. How workers learn to work safely in such work setting can be best summarised in the following vignettes constructed from individual learning experiences.

John - Experience and Ask When You Don't Know

As a recent school leaver, John valued the opportunity to learn through his routine work as a plant worker which he calls it the 'real work'. 'Let's say if you talk about what I learned in school, all equipment in school compared to the equipment in the actual industry varies in size because my school the equipment are all very small. To us it's like toys but you come to the industry, it's huge. So, there's a lot more impact that we see.'

He believes learning from others' experiences allows one to learn how to respond safely in different work circumstances in his line of work. Though he views practice and experience as critical - he describes his job analogous to devising a 'war plan' when operating the equipment to adapt to changing work conditions - he also cautions about the danger of overly relying on personal instinct and experience when operating in a high-risk work setting. 'There's no way you can trust your instinct in our line because you really have to follow safety.' To him, seeking appropriate guidance and clarifying by asking others was seen the safest way to learn when operating in a perilous workplace. 'There's no harm asking but if you don't ask, you won't know. If you don't know then you might do a mistake. It's better to clarify things

before you're doing anything because if anything happen, it doesn't just affect you, I think it affects us.' Learning to work safe means not just protecting his personal safety but also that of others' at work.

Mohan – Like a policeman

As a Senior Technician, Mohan has to frequently coach and guide new workers. He sees this as a 'parenting' role by providing close supervision to ensure everyone works safely at the plant. He envisions himself as a policeman holding a gun to maintain law and order. Though he feels uncomfortable at times to monitor others so closely, he believes it is necessary given the work environment that they work in does not allow anyone to make mistake. Even when one needs to make changes to meet situational needs, he reiterates that the process must be controlled, managed and contained. When asked how to ensure this, he cited the need to talk. "The less one talks, the more dangerous it is," according to him.

Koh – See and understand

Koh has been working at the plant for more than ten years since he left school. He remembered when he first started work at the site, he was always thinking how to by-pass the procedures in order to complete his job quickly. However, as he gradually learnt to understand the principles for working safely, he started to appreciate the importance when working in an 'industry that is different from other settings'. He stresses the fact that because process work is a highly dangerous trade, any negligence and near-miss encounters would 'teach one for life'. As such, he believes experience is important in their line of work. Learning through experience allows one to relate to the consequences. However, he highlights that it is still 'dangerous' if one never changes his attitude. He relates 'attitude' to the ability to understand, appreciate, evaluate and reflect. To him, such attributes are important for one to work safely in a dangerous work setting to respond according to the situations and not follow the book blindly. In circumstances that require workers to consider adaptations, one needs to make sure it is safe by asking for expert opinions during team meetings or through direct guidance from supervisor.

The above vignettes further suggest most workers are conscious that they are operating in a highly hazardous work environment which they acknowledge as a different kind of setting from other industries. There is a culture of commonality in how safety is and should be valued for fear of the impending repercussions. As commended by many, being safe is a doctrine that underpins the work culture which should be ingrained in every worker so that everyone goes home safely after work.

The *modus operandi* to learn and work safely when operating in a perilous work setting is premised on envisioning one as an enforcer and regulator, to constantly provide appropriate guidance and correct any unsafe behaviours. This, includes keeping watch on personal practice because everyone is also being watched by each other. The rule of thumb is to seek safest responses by seeking legitimate expert advice. When necessary, incremental and cautious evaluation of all possible options should be collectively agreed. Hence, one is to 'go to higher authority', or make sure the procedure is a 'tested' one in times of uncertainty or doubt. Engaging in active dialogue to seek information and guidance is therefore pertinent to ensure threshold for mistakes is minimised when operating in a perilous work setting.

The different illustrative experiences summarised in chapter 4 also show that safe working is enacted through close supervision, controlled observation, routine practice, problem-solving and self-directing as workers engage in social interactions and goal-directed activities in circumstances of work. Collectively, these findings suggest that there are distinct qualities associated with how safe work practices are learnt and enacted in precarious trades and work settings.

Overall, the study shows learning to work safely is grounded within the following conditions:

1. It is a collaborative process that is co-constructed through a process of social interaction to maintain a shared conception or understanding of being safe at work;
2. It is situated within particular contexts which are dependent on how individuals cognize and make sense within the given context;
3. Individuals do construe and construct their own meaning and knowledge based on personal experience and epistemologies; yet concurrently they seek alignment with the site's expectations and values.

The following section presents a discussion on how these distinct qualities to advance workplace learning for safety practice. Table 7 provides mapping of four salient qualities and bases for learning drawn from the findings which are deemed to be important for understanding how safe working is learnt and practised.

Table 7
Qualities of Learning Safety in Process Work

Bases of learning	Contextual	Appropriateness and legitimacy	Interactive and informative	Relational and purposeful
Safety training	√	√	√	√
Expert guidance		√	√	√
Practice pedagogies	√		√	√
Everyday practice	√		√	√
Artefacts and materials	√		√	√
Disposition, values and goals	√			√

Essentially, findings from this case study suggest that learning to work safely in a perilous work setting needs to consider the followings:

1. Considerations for circumstantial and practice requirements.
2. Appropriate and legitimate guidance.
3. Interactive and informative pedagogies.
4. Relational and purposeful alignment with personal and organizational goals.

Each of these considerations are elaborated below:

5.2.1 Considerations for circumstantial and practice requirements

This case study has shown that learning to work safely is situated profoundly within the context of practice, and grounded in the habitus of practices (Bourdieu, 1994). The notion of context has emerged distinctively as participants related how they learnt through the different learning provisions. The need for congruency between theory and practice in safety training; the disparity between the prescribed standards as represented in text or inscriptions and actual circumstantial requirements; the authentic learning experience gained from everyday practice and actual doing of work; and the different examples of problem-solving situations; all provide strong arguments that learning to work safe is context dependent. These different experiences suggest that learning to work safely is about developing the capacity to respond effectively to circumstantial and practice requirements. This implies that safe working requires individuals to look beyond just the 'doing' and gives recognition to adapt to the context-dependent nature of competence (Gherardi & Nicolini, 2002).

When learning for safe work practices is context-dependent, it implies that how individuals perceive, comprehend, and act is an entirely embodied experience where such cognitive and sensing processes are inextricably grounded on two key foundations. First, personal and life experiences resulting from major life-transforming events to minor injuries. Second, an important concept of which Strati (2003) described as the “sensible knowledge” concerns what is perceived through the senses, judged through the senses, and produced and reproduced through the senses. This is similar to the notion of “pit sense”, as described in the study of mining work by Sommerville (2005), of how workers learned by experiencing their body in interaction with their physical and social environment of the mining work or place. The cited example of how layers of hearing protection equipment interfered with the detection of leaking gas, and the salient features of safety artefacts such as signage and alarm systems suggest safety learning resides considerably in the visual, the auditory, the olfactory, the gustatory, and the tactile experience (Corradi et.al, 2010). Knowledge in the form of aesthetic judgment in individual practice to make logical and ratiocinated appropriacy that provides information about whether the body-in-place is safe, is thus generated through the dialectical relations of their perceptive-sensory faculties which is situated within the context of practices. Collectively, these intra-psychological and embodied experiences have significant effect in shaping the learning and practice of safety.

Though research has shown that learning should be situated within the context of practice (Lave & Wenger, 1991; Resnick, 1987), there are also other considerations which may impact learning. A particular concern is when tension arises between what is taught in safety training or prescribed standards, and how that knowledge is assessed and applied in practice. How workers approach problem-solving in real work situations in a safe work manner is thus of prime concern in safety practice. Hence, this highlights the issue of transferability and application of knowledge learnt. As knowledge is context sensitive, there is a risk that the repertoire of knowledge is domain driven and confined to a particular practice setting. This may be critical as knowledge developed is situationally and culturally appropriate to meet its contextual and practice requirements. However, there is also a risk if individuals are not able to relate and apply knowledge beyond specific context requirements. This is more so if past experience is inappropriately translated or interpreted when individuals are confronted with potentially anxiety-arousing situations. Practices to improve transfer should therefore be considered by assisting workers to develop connections across different work settings and generate appropriate problem-solving strategies whenever possible. Possible interventions can be considered, of which some have been cited during the interviews. One particular approach is the practice of the job-rotation arrangement in which workers can learn and apply their knowledge in varied work contexts when they undertake different job roles across the

organizational business units. Utilisation of interactive multimedia and simulation programs as illustrated in the case study and advocated by educators and safety practitioners (Bell, Kapralos, Hogue, Murphy, & Weckman, 2015; Darragh et al., 2016; Halpin, Halpin, & Curtis, 2015), as well as sharing critical incidents and stories, are critical interventions that can be incorporated in training curricula or pedagogical practices to foster interaction and engagement, thus, enhance the quality of the learning.

According to Eraut (1994), experts' structuring of declarative knowledge only accounts for one aspect of professional performance and is supplemented by individual intuition which may be tacit. Given that the learning and enactment of safe working is developed within those situated practices, workers also engage their intuitive judgment to guide their action. The learning episodes of different problem-solving situations illustrated that as workers learn through experimentation and trial-and-error, they also engaged their intuitive judgment to mollify precarious situations.

Accounts by participants have shown that in some circumstances, safe working may be negotiated when individuals act according to their intuition and common-sense knowledge developed from embodied experience. The outcome may or may not necessarily be the most efficacious or appropriate and could possibly lead to deviation in practice. Such deviation in practice is also what most safety practitioners are fervently concerned about. Likewise, intuitive judgment can be learnt through failure or error which can have serious repercussions as threshold for errors is often low in high-risk work contexts. Any experimental, or what is commonly known as trial-and-error approach to problem-solving, would therefore need to be cautiously monitored. To be effective, these processes require more expert co-workers who can furnish models for performance, guide that learning directly or indirectly, and otherwise support that learning, including by providing feedback to learners on their work performance (Billett, 2000). It is for this reason that the legitimacy and quality of appropriate guidance is found to be another salient feature of workplace learning. This is further discussed in the next section.

5.2.2 Appropriate and legitimate guidance

The capacity to work safely in precarious trade such as process work is critical. Thus, receiving appropriate guidance and seeking affirmation on the validity of the knowledge learnt is instrumental to reinforce the practice of safe working.

One other important quality about workplace learning in process work relates to the need for guidance to be legitimate and appropriate, as wrongful learning can translate into risky action that may bring about dire consequences. The examples provided in the case study on how participants assess the appropriacy and legitimacy of those who provide guidance such

as supervisors and trainer; how individuals are mindful about being accounted for providing inappropriate guidance; and others who pride themselves with the responsibility to ensure members comply strictly with the practice requirements to maintain the safety of the plant; exemplify the significance of validation and legitimacy of guidance being valued to reinforce safe working.

Research on guided learning and mentoring examines how an array of contextual, social, and interpersonal attributes could profoundly impact learning in workplaces (Billett, 2001b; Devos, 2004; Ellinger, 2005; Hansman, 2002). The case study highlights three key dimensions about guided learning which are central to understanding how workers learn through guidance in their circumstances of work. Firstly, learning to work safely is socially situated with knowledgeable co-workers acting as important intermediaries and moderators for appropriating information in the knowledge-transmission process. While this helps to facilitate knowledge sharing and promote collective learning for appropriate practices, it also requires efforts to validate the qualities of both the intermediaries and the processes in which knowledge is circulated or transmitted for greater consistency and uniformity. Strong institutional support to encourage safe work practices, and ensuring workers receive adequate and proper training, are therefore critical to enhance the capabilities of the contributors. Conscientious effort to improve the ordering and sequencing of workplace activities is also pertinent to ensure knowledge is appropriately circulated and interpreted to translate into safe work practices. For instance, providing learning spaces for negotiating differing views and reaffirming procedures are critical to clarify ambiguities and reinforcing understanding (Choy, 2009). Secondly, participants' accounts of different experiences with their superiors or peers when receiving guidance highlights that discursive relationships in workplaces such as supervisory and mentoring relations could inarguably influence their learning. The varied experiences shared by the participants suggest that learning is an idiosyncratic process. How individuals adapt and respond to external social events and agents could be determined largely by their personal histories or ontogeny within the physical and social work environment in which they are situated. This could explicate the differing perspectives between those direct employees and contract workers, where the latter perceive respecting authority as the appropriate way to seek guidance. The study shows that participants who are foreign workers are generally more accustomed to centralization of power and authority resulting in many of them strongly believing they should only follow guidance provided by their supervisors. This suggests much of their learning is developed from receiving direct guidance from their superiors.

Essentially, the pre-existing hierarchy in the organisational structure has implicitly prescribed a structure of how knowledge is being distributed, where different individuals and

work groups presumably possess expert knowledge of how work is to be done safely. For instance, the role of engineers is to provide technical advice and site operators to perform specific trade such as maintenance or repair work at the field. The existing hierarchical structure not only depicts the reporting relationships and job roles as in any organisational structure, but also provides a frame of reference for how guidance is to be provided.

While the distinct reporting framework may provide clearer direction for accessing guidance, there is also the constraint of learning to be confined to a specific individual such as the supervisor, which in itself may be a virtue or a problem. The learning outcome and how knowledge is constructed would therefore be dependent considerably on the expert knowledge and what is being taught by the contributor or mentor. More importantly, there is also a tendency to conform in a situation of unequal relationship in which demonstrated actions may be mistakenly perceived as learning, and inhibit deeper learning and understanding. For instance, a learner may merely follow the instructional procedures and be overly reliant on the supervisor or mentor for decision-making. A higher level of mental processing should be considered for a worker to develop the skill for interpretative appraisal rather than being a faithful follower. Experienced co-workers who are not legitimately appointed may also be reluctant to share his expert knowledge as he may be held responsible for providing inconsistent guidance.

As evident from participants' experiences in seeking legitimacy in guidance, power relations are a concern where job roles are used as distinct markers to establish sources for guidance as a way to mitigate unsafe work practices (Contu & Willmott, 2003; Foldy, Rivard, & Buckley, 2009; Lawrence et al., 2005; Nembhard & Edmondson, 2006; Smith et al., 2008). On one hand, the difference in power and status could pose a potential barrier to learning particularly where one group performs in an evaluative capacity such as supervising work over the other. The tendency for supporting experimentation and risk-taking learning activities may be limited in order to align with the prescribed practice requirements. Learning, thus, could be confined to validated knowledge or practices which may have implications for creating an explicit learning environment. It may also deter those in the lower social hierarchy from proactively sharing their perspectives. On the other hand, power and status could also reversely advance collective learning if it is used indiscriminately to direct team efforts and knowledge sharing to achieve shared goals and interests. For instance, those of higher power hierarchy such as supervisors may act as important intermediaries in facilitating and supporting the exchange and circulation of knowledge, as well as legitimize the contributions from all members. Essentially, effective management of power relations is seen as important to facilitate knowledge sharing and circulation among its members.

Workplace learning literature advocates positive mentoring as imperative, particularly for new workers who are struggling to come to grips with the expectations of the workplace, the language and literacy demands (Darwin, 2000; Harris et al., 2001; Hipes & Marinoni, 2005). Essentially, two distinct models of mentoring were identified in this study. The first type of mentoring resonates with what Holland (2009) describes as a restricted and functionalist model which is more paternalistic in nature for those with knowledge to pass on to workers lower in the hierarchical ladder. In this model, there is a formal distance between the learner and the mentor with the focus on learning outcomes rather than on the learner as a whole person. The second is a relational model which is built on a generalized supportive friendship basis, where the learner is regarded as a valued individual who requires specific support, and where interpersonal issues such as respect and trust are pertinent to the learning. Both forms of mentoring are relevant to the case study site. Mentorship studies have also exemplified similar values shared by mentors and mentees could positively influence learning (Lee et.al, 2000). While the latter is regarded as the highest quality mentoring state (Ragins, 2007), a paternalistic approach is more evident in this case study where guidance is commonly provided through close supervision as a way to control or mitigate unsafe work behaviours. This approach is perceived as necessary in view of the perilous work setting. However, it needs to be exercised with caution as it may pose as a constraint to foster active and deeper learning when workers merely follow orders and instructions to work.

Several empirical studies relating to leadership provide evidence that supervisors can have an influential impact on workers' attitudes and performance to enhance safe behaviours (Cook & McSween, 2000; Sanaei Nasab et al., 2008). The findings have exemplified that much of the guided learning discussed is developed formally to provide clarity for roles and responsibilities. However, such relationships need to be managed well to avoid power-laden outcomes that may impede learning. Examples provided by participants reiterated the importance of spaces to negotiate for differing views, questioning and open culture for learning. Hence, there is a need to recognize the distinction between supervisory and mentoring roles. The latter involves not only providing guidance on vocational practice but also entails the ability to recognize and develop the mentee holistically. Daresh (2001) cautioned on the conflicting interest when supervisors took on a mentoring role where they function both in an evaluative capacity and empathetically provide emotional and social support. With the strong emphasis on monitoring performance to meet specific practice requirements, it may potentially pre-empt an interactional relationship that is communicative and trusting to promote active learning. It is also critical that learners do not become replicas of their mentors and acquiescently accept the cultural practices or norms at play in the organization without truly understanding the intentions and relevance (Hansman, 2002).

Freire et.al (1997) also advocate the need to participate in a dialogic exploration and the capacity for learners to critically examine advice they receive. This is more so in a culturally diverse workplace where spaces for clarification need to be provided to align any variations in interpretations and intentionalities so that knowledge is appropriately translated into safe work practices. Indeed, the effectiveness of these learning spaces and interventions to support learning will depend considerably on the capacity of the contributors providing the guidance to ensure the currency, accuracy and relevancy of those knowledge to guide workers' practice safely. Likewise, institutional effort to enhance the learning spaces in those circumstances of work is also instrumental. Further to the consideration of the quality of guidance in contributing to workers' learning, another distinct quality of how safe working is learnt is grounded on the need for dialogic interaction and exploration to reaffirm knowing and doing. This is further discussed in the next section.

5.2.3 Interactive and informative pedagogies

This case study has shown that for workers to learn and work safely, spaces for dialogic exploration and interaction are critical to reaffirm what they have learnt, and being kept informed of critical events that will impact their practices. Examples provided by participants illustrated how workplace participatory practices provided rich pedagogical contributions to support their learning. As practices traverse the boundaries of different communities represented by workers from different job levels, roles or organizations, institutional efforts to effectively integrate and bridge practices across pairs and groups are also contributory to reinforce learning and practice.

Contributions of bridging practices such as cooperative action, shared representations, collaborative reflection, exchanges of personnel, networking across boundaries, and collaborative inquiry (Carroll et al., 2002; Faraj & Yan, 2009; Gruenfeld et al., 2000) are evident in this study. These learning practices provide important bases for knowledge to traverse from local learning by individuals and small work groups and integrate into collaborative and collective learning across the organization represented by the different groups of workers. Group interactions such as team meetings, safety intervention programs, and partnerships at work encouraged and generated mindful learning that the work community could recognize, value, and share. Inherently, workers learnt to construct a common grounding of beliefs, meanings, and understandings as they shared in those activities which provided a common frame of reference to observe and act in a safe and uniform manner. Workplace learning literature has also shown that a range of pedagogical properties are often manifested in organisational activities (Billett, 2002b; Choy, 2009; Cullen et.al, 2002) as evident in this case study.

Essentially, deliberate structuring of workplace activities is deemed pertinent to support the circulation and transfer of safety knowledge which will help individuals and groups make informed decisions to guide their practices. Billett (1996) asserts that such participation and engagement offer evidence that when pressed to engage in goal-directed activities, it is conducive for workers to access higher order procedural and conceptual knowledge, helpful for appropriation. For instance, learning through listening or observing other workers and involving them in problem-solving activities help workers to develop more specific forms of knowledge or knowledge which they may not have access to within their own field of work. As workers do not have the autonomy to indulge in trial and error when situated in a high-risk work setting, they could only learn from past critical incidents or situations which may evolve into near misses. Those everyday work group discussions about salient risky situations and observations of unsafe behaviours or work practices, thus provide learning spaces for knowledge exchange and generate mindfulness to work safe. The case study has shown that workers' engagement in the process of rich interaction and negotiation is found helpful to reinforce their learning and practice for safe working.

Despite contributions to providing rich learning spaces, workplace participatory practices may not always lead to development of the kinds of learning or knowledge transfer required for performance requirements. Furthermore, competing discourses in workplaces may negatively influence discursive work relationships. Working together to achieve a common work goal has certain challenges when different groups of practitioners with distinct expertise are required to work together. Collaborative practices often involve contributions from individuals with different functional perspectives and expertise which may present valuable knowledge sharing. The quality and outcome of learning will therefore depend on how knowledge is articulated, represented, and maintained as individuals and groups negotiate and seek alignment during the collaboration process. In some instances, there is also a tendency for inappropriate knowledge to be disseminated and learnt in the absence of proper validation or guidance. While this reiterates the need for proper guidance by competent intermediaries and social agents (such as supervisors or experienced co-workers) to guide the learning, another important resource for effective collaborative learning is to provide ways which individuals and groups could readily access those critical and relevant information that help to guide their practice. Accounts on the array of artefacts and materials identified in the study reaffirm how material engagements are important to mediate workers' learning. In particular, the documentation of observational findings; the practice of taking notes in meetings; keeping records of past incidents; provision of internal communication systems and pictographic materials such as the contractor guide, all provide clues to support and bridge knowledge transfer in co-participatory activities.

Participants' experiences from the study highlight that artefacts alone may not effectively influence or bring about systemic changes to effect knowledge transfer. The case study has illustrated that the quality and appropriateness of how information and knowledge is being captured, interpreted, communicated, and received will have effect on the outcome and subsequently the enactment of safe work. The significant role of intermediaries and social agents, such as supervisors or competent personnel, is therefore pertinent to facilitate knowledge transfer and provide appropriate validation when necessary. Differences in the perceived richness and usefulness of respective forms of artefacts shared by participants suggest the different effects on learning of which individuals may make meaning or interpret differently on those knowledge to guide their practice. Besides, potential language and literacy barriers may inhibit workers from engaging in more active learning. Proper guidance by expert others would provide clarity to ambiguities which may not be uncovered through self or solitary discovery. Assistance and guidance will also be particularly important to stimulate active and reflective thinking such as creating spaces for questioning and discussion during team meetings or peers acting as interlocutors. Such intervention is seen to be helpful to reaffirm procedures, particularly within a diverse workforce. The different intergroup discussions (e.g. toolbox meetings) and participation in safety related activities also provide learning spaces for workers to negotiate differing perspectives, reflect and learn from past or others' errors, all of which are helpful to strengthen their understanding (Choy, 2009). For instance, knowledge shared through electronic mail or internal communication systems would require a knowledge facilitator or information manager to circulate the flow of information and drive active discussions. These mediating artefacts not only provide the opportunity to develop new shared knowledge but also create new communal activities and practices (Macpherson & Jones, 2008) for ongoing learning. As trial and experimentation is often a learning constraint for workers in precarious workplaces and trades, the need for learning to be interactive and informative is critical to provide ways for reaffirming procedures. Conjointly, the array of artefacts and materials employed across those co-participatory practices affirms that safety practice is inextricably bound up with the material and social context in which it is acquired (Carlile, 2004; Orlikowski, 2008).

Opportunities to engage in co-participatory activities and simultaneously secure guidance from other expert co-workers provide rich learning. There is also a need to also consider contributions of agentic impetus in directing individual thinking and action, how they mediate their learning during those dialogical processes, and respond to the array of social-cultural materials. These factors are central to further our understanding of learning for safe working. The need for learning to be relational and purposeful thus was found to be another marked feature in this case study. This is further discussed in the following section.

5.2.4 Relational and purposeful alignment with personal and organizational goals

Another important quality that is critical for workers to learn and work safe purports that learning needs to be relational and purposeful. This resonates with Knowles' (1989) assumptions about the significance of motivation in adult learning. As evident from the study, enact safe work is a shared responsibility not just at the intergroup, but also individual level. This means that for workers to act safely, there is a need to consider those personal and interpersonal factors which form bases of their subjective evaluations and intentionalities that will guide their act of doing. Two distinct dimensions of how safety learning is relational are illustrated from the study. First, learning is interpersonally related which is influenced by how individuals relate to other social agents such as supervisors or co-workers and peers. Second, learning is intrapersonally related which is influenced by individual personal factors such as values, beliefs, experience and goals.

Essentially, an important notion that is helpful to explain how learning is relational is associated with the concept of identity developed from social, institutional, and normative discourses. Participants' narratives about the notion of working as a family, the need to be empathetic, their perceived responsibility to protect co-workers' safety and well-being at work, indicate that working safely is an important intersubjective and shared value. This shared value provides a frame of reference which develops into a group identity and collective behaviour. Such group identification becomes more secure if personal values are in alignment with inter-subjectively important values (Wan et al., 2007; Wan et.al, 2010).

Research on trust has shown that it can contribute to different positive safety outcomes in relation to communication, knowledge transfer, and individual perception and motivation towards learning to work safely (Andrews & Delahaye, 2000; Gubbins & MacCurtain, 2008; Kessel et al., 2012) thereby enhancing organizational safety culture and performance (Burns et.al, 2006; Conchie & Donald, 2006, 2008; Cox et al., 2006). In this case study, much of workers' learning and intentionality to work safely is reinforced by an array of trust-building factors relating to compassion, openness in communication, knowledge sharing, and valuing individual personal safety over organisational economic gain. Such safety values are strongly embedded within the organizational culture which serves as a set of ethics that positively guide workers' learning and practices (Cooper, 2001; Eiser & White, 2006; Tharaldsen et al., 2010). In the same way, the desire for connectedness also fosters workers' sense of identity and the need for inclusion in groups (Hogg & Abrams, 1990; Levine & Kerr, 2007). In effect, the sense of connectedness between individuals would determine one's affiliative tendency to act synchronously with the valued member or group. This is particularly helpful in a diverse workforce where engagement of all levels of employees is critical to achieve collective consensus and understanding about the need for safe working. At a personal

level, participants' accounts of how they relate their role as enforcers or interlocutors when providing guidance to others suggest they hold high regard of their professional roles and responsibilities to work safely.

Correspondingly, it is evident that the intention to work safely is also determined by how individuals relate or align with their roles and responsibilities in their private lives. Participants' narratives show that how individuals relate to the need for safe working is much influenced by how their personal experience, interest and pursuits such as family, pecuniary rewards, recognition and advancement for career progression, or personal safety resonate with the need to do so. For instance, being the sole provider for their family means that working safe is seen as a motive to also protect their personal safety at work. Participants' examples of experiencing workplace injuries also serve to remind and reinforce the need for them to work safe.

Overall, this case study has shown that learning to work safely is not merely about acquiring content knowledge or being technically skilful. It entails a process of meaning making through which individuals relate to their professional and personal identities to appraise how their roles and values are impacted. Two important implications are drawn here. Firstly, it indicates a need to examine those interactional processes in which interpersonal relationships are manifested, and to identify possible interventions that could promote greater intersubjectivity consensus. The concept of relational agency is pertinent here as it relates to how individuals make adjustments about their own thinking and interpretations to problems so as to align with those of others and accomplish organizational goals collectively and effectively. More importantly, theorists have posited that this process of negotiation and adaptation would eventually contribute to a common form of knowledge that is developed through shared understanding across distributed expertise (Edwards, 2011; Hakkarainen et al., 2004; Martin, Sokol, & Elfers, 2008). However, Edwards (2005) argues that relational agency is not a trait but a skill to be acquired where the learning that occurs in these spaces is not a matter of learning how to do the work of others, but of gaining insights to purposes and practices of others to enable collaboration. Secondly, the saliency of personal attributes also implies that learning and practice outcomes may vary across individuals though they may be subject to the same learning curriculum or pedagogical approach. As a whole, it is evident from this case study that consideration of agency issues is necessary as they shape individuals' intentionalities to realign their values towards the need to work safe.

5.3 RETHINKING WORKPLACE LEARNING FOR SAFETY PRACTICE

The conceptual framework to guide this research focused on a dual lens of the workplace and individual, drawing attention to examining the pedagogic qualities and affordances to learning,

and agency issues as important bases to understand how safety is learnt and practised in a process plant. How the different dimensions of learning are intertwined suggests that safety is very much socially constructed as workers observe, interact with, and participate in systems of interpersonal interactions, including the use language and other socially constructed conceptions and objects to facilitate the spread of ideas and practices (Baarts, 2009; Lave & Wenger, 1991; Weick & Roberts, 1993). This perspective about safety resonates well with what Gheradi and Nicolini (2002) conclude that safety is primarily a social construct which is situated in particular practices, and is a process of continuous practising and enactment. How individuals learn and subsequently enact safe behaviours and practices at work is therefore very much shaped and transformed by an assemblage of material, social, discursive, and historical conditions and relations which require reciprocal personal reflection, as well as collaboration with fellow workers (Kemmis, 2005; Svensson, Ellstrom & Aberg, 2004). In all, these insights address the research questions about understanding the different provisions of learning for working safe in perilous work settings. The findings show ways in which workers engage and participate in that learning process to advance their safety knowledge and skills.

5.3.1 A LEARNING FRAMEWORK FOR SAFETY PRACTICE

The case study highlights the need for learning to be contextual, interactional, relational, and to be supported with appropriate and legitimate guidance to reinforce safe working in perilous work settings. These insights are important for understanding how workplace learning can be augmented and how it can contribute to encourage safe work practices. Moreover, learning centres on how the interplay between workplace (structure) and agency contribute to the development of different forms of safety knowledge. The case study further advances understanding about how safety knowledge is verbalised and internalised that subsequently lead to enactment of safe work. The study establishes a need for recontextualization, reaffirmation, refinement and realignment to effect safe working.

Taking into account these insights, a revised learning framework is presented in Figure 10 where the key elements are summarised.

Figure 10. A framework for workplace learning and praxis for safety showing the interplay between workplace, context of safety knowledge, and role of learner agency that shape and guide safe work practice.

Building on from the initial framework, the revised framework illustrates how the nuances of learning, work, space and agency are intertwined to effect safe working in a precarious workplace and trade. In particular, it draws attention to consider the significance of the following dimensions of learning and work established from the study:

a) The role of workplace as a learning site (A)

The case study shows that consideration of the role of workplace as a learning site needs to account pedagogical qualities and learning affordances to support learning and practice. Three key attributes which include a) the utilization of tools and artefacts; b) quality of guidance; and c) the established practice arrangements that support or guide work practices, are considered to examine their contributions. The study has shown how workers leverage these different sets of affordances in their circumstances of work to enact safer work practices. While workers may learn through formal acquisition such as safety training and arrangement for guidance, they also advance their knowledge and skills through active engagement and participation in different goal-directed activities in circumstances of work. Concurrently, these attributes also form the bases which construct the structure and work context for learning and practice.

b) The role of learner agency (B)

The case study exemplifies how agency issues are pertinent to understanding workers' intentionalities for safe working (Billett, 2010). Learning to work safely requires workers to act beyond just rehearsing technical and conceptual knowledge. It involves engagement in a state of embodied learning as workers reflect, adapt and respond to an array of complex physical and social impetuses in their working environment. Safety literature that adopts a psychological perspective also suggests that what qualifies as dangerous is very much subject to varying levels of perceived risks interpreted by individuals (Ropeik & Gray, 2002). These perceptions are continuously negotiated and shaped by explicit and tacit dimensions in the physical and social contexts of the work environment. What is important here, and that underlies the described experiences and practices, is the tension between competing discourses emanating from institutional, social, and individual

influences that mediate negotiation in safety practices. The different learning experiences cited in this case study thus also reaffirm how individuals can be cognitively, socially and affectively affected as they engage in work situations.

c) The construct of safety knowledge (C)

The case study also attests that for workers to work safely, they need to possess distinct attributes, personal traits and capacities to apply declarative and conceptual knowledge effectively. As safe working entails both the thinking and doing, there is a need to consider how workers negotiate in practice to make adaptation to the context-dependent nature of their work (Beckett and Hager, 2002; Gheradi & Nicolini, 2002; Tissot, 2004). Inherently, this also means that there is a tacit aspect about safe working which may not be readily understood. Hence, the study establishes the need for learning to be contextual, interactional, relational and supported with legitimate and appropriate guidance to reinforce and deepen understandings for safe work practices.

d) The quality of learning (D) and safe work practices (E)

The nature of safe work is centred on how knowledge is effectively translated into safe work practices and behaviours. To effect this, the case study establishes that efforts and interventions will be necessary to recontextualise, reaffirm, refine and realign knowledge learnt to reinforce the need and practice for safe working. These could include re-examining the curriculum for safety training to enhance congruency with practice requirements; providing ready access to appropriate guidance and learning spaces for clarification and reaffirmation; refining effectiveness of sociomateriality aspects such as processes and artefacts to support appropriate learning; and finally, reinforcing relational agency to strengthening trust and positive work relations.

5.3.2 REINFORCING WORKPLACE LEARNING FOR SAFETY PRACTICE

Overall, this case study reaffirms that process workers learn to work safely in circumstances of work and learning is influenced by a myriad of complex factors that can be contextually, socially, and personally driven. Safety is not merely a specific subject matter to be learnt, but is about how

technical or content knowledge can be effectively translated into safe practices. To do so requires deliberate guidance and intervention that will reinforce the need for safe work practices.

While this research has provided insights to advance our understanding of how workplace learning contributes to learning for safe work, the study concludes that institutions should continue to leverage three important aspects of workplace learning to secure more enduring and effective outcomes. These interventions are reinforcement of safe working by providing learning spaces to recontextualise knowledge; reaffirmation of procedures; refinement of sociomateriality; and alignment between individual and institutional goals. Considerations of possible interventions to enhance workplace learning include three subsequent aspects. These are discussed below.

1. Workplace as a learning site for knowledge recontextualization

Safety practice is context-dependent in nature. It is therefore critical that the workplace continues to serve as a learning space where workers are able to meaningfully engage through authentic work situations. Such a learning space will provide opportunities for both the construction and transfer of knowledge which can only be acquired when individuals personally or directly experience the processes. Correspondingly, this will also strengthen the congruency between theory and practice. For instance, learning from safety classes can be adapted to better meet those situational requirements in the workplace.

However, earlier discussion has also highlighted that the context-dependent nature of safety practice may also pose as a learning constraint. Practices to improve transfer of knowledge should therefore be set in place, for instance, by providing opportunities for workers to experience and handle different job roles that provide opportunities for them to apply their knowledge and skills in different work situations and context; redesigning training and reference materials to address specific context requirements of the workplace and trade; providing spaces for clarification of ambiguities; and access to inter-professional guidance and co-participatory practices that offer rich learning for problem-solving. Conjointly, these interventions provide possible ways that will help to reinforce workers' learning and understanding of safe work.

2. Social-cultural imperatives for reaffirmation and refinement of practices

It is evident that much of workers' learning is socially constructed in a workplace context, through the utilization of social-cultural artefacts and important intermediaries as clues and cues to guide their practices. The pedagogical contributions of these social-cultural dimensions are significant. It is thus important that institutions continue to leverage these social and cultural aspects to reinforce, refine, or redefine workers' understanding and practices. Possible interventions may include strengthening the occupational efficacies of important intermediaries and social agents to effectively provide appropriate guidance; establishing rigorous systems to appraise quality and validity of sociomateriality including effectiveness of artefacts for knowledge circulation. Essentially, these efforts will contribute to strengthen workers' learning by refining processes and artefacts and providing linkages to align organisational and individual goals and interests that will help to reinforce the practice of safe work.

3. Reflective learning as a critical skill to seek realignment for safe work

The case study has shown learning from experiences can contribute significantly to individual learning. There are circumstances where guidance may not be readily available. This requires individuals to have the ability to critically reflect on their action and examine their practices reflectively and reflexively (Schön, 1983) to make critical judgments that are situationally appropriate. Hence, developing reflective learning is seen as critical where workers are able to relate and establish connections between past actions, events or responses and effectively adapt knowledge to work safely. This will lead to higher levels of understanding and enhance their occupational competencies. These resonates with the Vygostkian (1978) perspective of internalization and Billett's (1995) notion of appropriation.

Interventions to strengthen relational agency (Edwards, 2005) is also pertinent in view that personal and agentic impetuses can have significant influence on practice of safety. Spaces for individuals to engage in reflective learning is thus important. As they reflect, they also engage in a process of adapting their perspectives to realign with those of others to accomplish organizational goals collectively and effectively. Evidence of collaborative learning developed from work or community settings also implies that knowledge is largely socially constructed through group-based learning. Studies on group dynamics and its contribution to collaborative learning

have alluded to the interplay and influence of different dimensions about cognitive, affective, and social factors in shaping learning outcomes (Dillenbourg & Fisher, 2007; Gillies & Boyle, 2010). Hence, considerations on improving the quality of intergroup dynamics and interaction processes contribute to developing better learning communities and strengthen relational agency (Matusov, von Duyke, & Kayumova, 2015). As a whole, establishment of effective dialogues and well-mediated power relations are possible interventions that provide spaces for individuals and groups to align subjective perspectives and develop trust building relationships. All these are necessary and helpful to reinforce safe practices.

5.5 SUMMARY

The chapter presents a discussion on the implications for safety practice. How the participants learn and practise safe work in a perilous work context such as the petrochemical plant is characterized by four distinct qualities. These qualities advocate the need for learning to be contextual, interactional, relational, and supported with legitimate guidance. Implications of how these qualities affect learning and practice of safe work are discussed with respect to the role of workplace as a learning site, contributions to the particular kinds of knowledge for safe work, and learner participation and engagement that eventually guide their behaviours and work practices. These three important dimensions are foundational to understanding workplace learning for safety.

To conclude, this case study proposes continual efforts to develop the workplace for knowledge recontextualization and to deepen learning. It highlights the need for workers to develop reflective practice and make appropriate alignments to meet organisational goals. Considerations to leverage social-cultural impetuses as ways to reaffirm and refine knowledge and skills are equally pertinent. More importantly, rigorous appraisal of the efficacies and effectiveness of these learning provisions is critical to achieve the intended learning outcomes, address constraint and repercussion of inappropriate judgment. Nevertheless, institutional support continues to play a critical role to set the stage for effective interventions. These include provision of supportive structural processes, bridging practices, and workplace artefacts which provide rich pedagogical contributions that will create spaces for knowledge circulation and reaffirmation of practices within the bounded context of the work community.

CHAPTER 6: CONCLUSION

6.1 INTRODUCTION

This chapter provides a summary of the contributions of the thesis. It addresses the research purposes to advance workplace learning for safe work practices. The discussions highlight the limitations of current provisions for learning and suggest possible directions for future research.

A synoptic review of related literature was presented in Chapter 2 to serve two purposes. First, discussion on the development of workplace safety and health provides bases to understand how the changing role of workplaces and national agenda to strengthen and inculcate good workplace safety culture and practices warrant the need for the research. Second, theorization from an array of supporting literature relating to workplace learning and situated practices was examined to identify important bases that guided this study. The review suggests the need to examine three critical dimensions that are pertinent to the study by examining firstly, the nature of safety knowledge to give consideration to how different forms of safety knowledge are constructed through different learning approaches and how they translate into safe work practices; secondly, how workplace learning is distinct from classroom learning by drawing particular attention to the importance of pedagogical practices, qualities, and affordances contributed by the workplace as a learning site. The significance of contextual influences such as practice arrangement, artefacts, and mediating agents to provide proper guidance was discussed. Finally, the review examined the role of learner agency and disposition to understand individual engagement both physically and socially in those work processes, and how those individual experiences shape and guide their thinking and action to work safely.

In consideration of the research objective, Chapter 3 provided the justification for adopting a qualitative case-study approach to investigate the phenomenon. The research design supports in-depth inquiry to examine and unfold experiences by individuals and groups. The chapter also explicated how the use of a thematic approach to data analysis helps to identify key learning provisions and ways in which workers participate in workplace learning.

Findings from the study were presented in Chapter 4 and ensued with a discussion of the implications for safety practice outlined in Chapter 5.

The chapter is divided into three major sections. The first section provides a summary of the findings from the study. The second section states how the study contributes to advance our

understanding of workplace learning for safety practice, by re-examining how it aligns with literature and the conceptual framework used to guide the inquiry. The last section highlights key implications and possible tensions that need to be considered for effective workplace learning to advance safety practice.

6.2 KEY FINDINGS

To address the conundrum faced by high-risk work organizations in maintaining high levels of safety records and resilience to mitigate workplace accidents, this research examined how workplace safety is learnt and practised in perilous work environments. Overall, this exploratory case study affirms that learning to work safely through and in circumstances of work is complex, particularly in perilous workplaces where errors can lead to serious repercussions. Collectively, the findings from the study provide insights to address (a) critical learning provisions that support workplace learning for safety practice, (b) ways in which individuals and groups participate in the workplace learning process, and (c) distinct provisions that are pertinent to support workplace learning for the practice of safe work. These findings from the study align with the three research questions, hence are discussed along these lines.

Research Question 1: What are the current provisions of learning for safety and health in a process plant?

Findings from the study provide evidence that workers in a process plant learn to work safely through the support of different learning provisions, embedded in socially and situationally based practices in circumstances of work. Essentially, six themes were identified that indicate how these contributed to workers' learning and practice of safe work in a perilous work setting:

1. *Safety training*

The role of safety training remains an important learning provision for safety practice, particularly in perilous trades and workplaces as evident in this case study. While mandatory training serves to provide pre-employment preparation as both a regulatory and practice requirement, the contribution of safety training also extends to maintaining skills currency and improving workers' communication skills which are important attributes of safe work practices. In all, the findings show that safety training is necessary to provide workers with both pre-employment and

continuous learning as ways of developing their occupational competencies (Jaselskis, Strong, Aveiga, Canales, & Jahren, 2008; Storey, 2004).

2. Guidance from expert others

Another key learning provision which has contributed significantly to workers' learning at the plant relies on access to expert guidance. Guided learning, which was discussed from the perspectives of both those who receive and those who provide guidance, suggests the importance of the role of intermediaries, such as supervisors and knowledgeable workers, in providing support for learning (Billett, 2011). In most circumstances, guided learning was provided according to workers' job roles and seniority. It serves as valid and appropriate knowledge learnt from legitimate expertise.

3. Workplace practice pedagogies

Findings from the study have illustrated various participatory practices contributing to workers' learning and the practice of safe work (Billett, 2000b; Choy 2009).

Workplace activities such as mandatory safety intervention programs, shift handovers, work group meetings which encompass daily toolbox meetings, and opportunities to work in collaborative projects with other experts, provided important bases for learning as workers engaged in goal-directed activities in everyday work circumstances.

4. Everyday practice

Most of the workplace activities discussed in the findings were organised intentionally to reinforce practice requirements for maintaining safety at the plant. However, learning from everyday practice and engagement in unexpected problem-solving situations presented additional ways of learning and practising safe work. The enactment of daily work tasks in an authentic practice setting (Eraut, 2011; Marshak & Heracleous, 2005) was important to help workers refine their skills and develop problem-solving skills to make situationally appropriate and safe decisions.

5. Artefacts and materials

In this case study, pedagogical contributions of material artefacts were important learning provisions to support the practice of safe work. The array of text and inscriptions, signs and symbols, computer- and audio-visual-mediated tools formed sets of representations of good practice (Carlile, 2002, 2004; Resnick, 1987) at the plant to guide workers' learning and conduct for safe work practices. Participants' accounts indicated that the use of artefacts not only helped

to reinforce their awareness and mindfulness about working safely, but also provided access to past information to guide their decisions and actions.

6. *Disposition, values, and goals*

Participants' experiences suggested that institutional efforts in building positive working relationships and pecuniary rewards were pertinent to encouraging safe work behaviours. In other words, workers' sense of values - that is, how they relate to both their professional and private roles, their ways of thinking, and capacity to problem solve, were key to mitigating workplace incidents. Essentially, how individuals engage their agentic efforts (Billett, 2009; Hodkinson & Hodkinson, 2004) would depend on how learning and practice of safe work implicate their private life to align to their personal pursuits such as family, pecuniary rewards, recognition or advancement, including personal safety.

The case study concludes that these different provisions for learning are grounded on four important factors which resonate with research on workplace learning for safety practice. These include:

1. the practice arrangements which outline those deliberate and organised work processes to support learning and practice, that eventually form the bases of the structure and context for practice (Eraut, 2004; Eteläpelto, 2000; Fuller & Unwin, 2003; Wilson & Myers, 2000);
2. utilisation of intermediaries and social agents to validate and facilitate knowledge circulation (Billett, 2011; Cook & McSween, 2000);
3. utilisation of artefacts for the ordering and organisation of information (Carlile, 2002, 2004; Macpherson & Jones, 2008; Marshak & Heracleous, 2005);
4. the role of individual agentic efforts to enhance learning and improve work performance (Billett, 2009; Hodkinson & Hodkinson, 2004).

While investigating how these different provisions for learning contributed to safe working, participants' experiences also provide insights on the different agentic efforts in the learning process. These address the second research question.

Research Question 2: How do workers participate and engage in workplace learning for safety and health?

Findings from the study show that how workers' participation in workplace learning to develop their occupational competencies in a perilous work setting are premised upon three conditions:

1. a collaborative process that is co-constructed through social interaction to maintain a shared conception or understanding (Hager, 2004; Lipponen, 2000);
2. situated within a particular context which is dependent on how individuals cognize and make sense of the given context (Gruber, Harteis & Rehrl, 2008; Wilson & Myers, 2000); and
3. knowledge is developed from individual past experience and epistemologies (Billett, 2010b; Billett & Smith, 2007).

These three bases of learning imply that workers' participation in workplace learning is socially, contextually, and intrapersonally situated as they engage in different practice arrangements, artefacts, and guidance seeking from knowledgeable co-workers to mediate their learning and make appropriate adaptations to practise safe work. The study also indicates that overall, learning to work safely evolves through close supervision, controlled observation, routine practice, problem-solving and self-directing as workers engage in those social interactions and goal-directed activities in their circumstances of work.

Workers' learning is socially, contextually, and intrapersonally situated, therefore it is important to consider competing discourses emanating from institutional, social, and individual influences to negotiate safe work practices. The third research question was therefore developed to examine ways to optimize workplace learning that will advance the practice of safe work for workers and organizations, as outlined below.

Research Question 3: How can workplace learning be optimized?

In considering how workplace learning can be optimized to advance the practice of safe work, the investigation from this case study has suggested four key qualities that are pertinent to supporting workers' learning. That is, workplace learning needs to consider the following:

1. *Considerations for circumstantial and practice requirements*

The need for congruency between theory and practice in safety training; the disparity between the prescribed standards as represented in texts or inscriptions and actual circumstantial requirements; the authentic learning experience gained from everyday practice and actual doing of work; and the different examples of problem-solving situations provided strong arguments for workplace learning to be contextual. Experiences described by participants suggest that learning to work safely requires individuals to develop the capacity to respond effectively to circumstantial and practice requirements. What this also implies is that the capacity for acts of judgment is necessary and will determine individuals' decisions to act in a safe manner. Understanding markers such as personal experiences, past actions and patterns, and ongoing guidance from members of the practice community is helpful to develop critical reflection necessary for making situationally appropriate judgments to work safely.

2. Legitimate and appropriate guidance

The quality and legitimacy of guidance is critical to ensure appropriate knowledge is received to guide practices. Further examples of how participants select their mentors and the perceived role of trainer and supervisor as the qualified and appropriate persons from whom to seek guidance. However, the importance rests on how guided learning is being valued. The legitimacy and appropriateness of guidance received or provided mitigates unsafe practices in perilous work settings. As such, strong institutional support and adequate training to validate the qualities of those providing guidance, as well as the development of positive mentoring relationships, are important.

3. Interactive and informative pedagogies

It was evident that bridging practices enacted across the different work teams in the plant were salient to promote cooperative action, shared representations, collaborative reflection, exchanges of personnel, networking across boundaries, and collaborative inquiry (Carroll et al., 2002; Gruenfeld et al., 2000) as ways of practising safe work. Group interactions such as team meetings, intervention programs, and partnerships at work encouraged and generated mindful learning that the work community could recognize, value, and share. The array of artefacts such as documentation of observational findings, notes of meetings, and pictographic materials employed across participatory practices also provided clues to bridge knowledge transfer in participatory practices. Collectively, these socio-materials and participatory practices helped to construct a

common grounding of beliefs, meanings and understandings. Workers shared activity tasks which provided a common frame of reference to observe and act in a safe and uniform manner.

4. Relational and purposeful alignment with personal and organizational goals

The case study suggests that learning to work safely is not merely about acquiring content knowledge or being technically skilful. It entails a process of meaning making through which individuals relate to their professional and personal identities to appraise how their roles and values contribute to safe work practices. Hence, for workplace learning to be effective, there is a need for learning to be relational and purposeful. Two distinct dimensions of how safety learning is relational were observed. First, learning is interpersonally related which is influenced by how individuals relate to other social agents such as supervisors or peers. Second, learning is intrapersonally related which is influenced by individual personal factors such as values, experiences, and beliefs.

What the findings suggest is that consideration of how individuals construe meaning of the content knowledge and quality of those interpersonal relationships thus needs to be provided for learning to be effectively translated into desired practice outcomes. Yet often, as these personal influences may not be easily understood or readily accessible, the opportunities for clarification and validation of what is learnt and being interpreted by individuals are necessary and important. The notion of relational agency was discussed how interactional processes in which interpersonal relationships manifest can be strengthened, and to identify possible interventions that could promote greater intersubjective consensus. Understanding those underlying relational motives can have important implications, particularly in process work where individuals and groups work closely in those interconnected processes. How individuals relate to one another or the situated imperatives will determine whether congruency and agreement across different cultural and personal attributes can be collectively achieved to maintain consistent and appropriate behaviours. Table 8 provides a summary of the key considerations that are necessary to improve workplace learning.

Table 8
Key Considerations to Improve Workplace Learning in Process Work

<i>Qualities of workplace learning</i>	<i>Why is it important?</i>	<i>How can workplace learning be improved?</i>
Circumstantial and practice requirements	Develop the capacity for acts of judgment and critical reflection to guide decisions and act safely	Capitalise knowledge learnt from past experiences or actions; provide ongoing guidance from members of the practice community
Legitimate and appropriate guidance	Control and mitigate unsafe practices that may bring about dire consequences in a perilous work setting	Require strong institutional support to provide ready access to appropriate guidance; and adequate training to strengthen the knowledge and skills of those providing guidance
Interactive and informative	Provide common frame of reference to observe and act safely	Promote and strengthen learning opportunities through access to learning materials and artefacts; group interactions; intervention programs; and partnerships at work to generate mindful learning
Relational and purposeful	Promote greater intersubjective consensus to guide and promote safe practices	Provide opportunities for clarification and validation to achieve consistency in practices and strengthen interpersonal relationships among co-workers

6.3 CONTRIBUTIONS OF THE STUDY

Primarily, this case study enriches the understanding of how workers in perilous work settings learn to work safely as their learning occurs in those specific or situational work circumstances bounded by a myriad of rules and regulations that guide practices. The findings of this study suggest that learning to work safely entails more than just developing technical and theoretical knowledge. There is a need to consider competing discourses that can determine how individuals internalise those knowledge and subsequently translate them into safe work practices or actions particularly when operating in a perilous work context. The findings therefore suggest considerations for workplace impetuses for learning developed through circumstances of work. Contributions of this study are discussed with respect to how it expands current knowledge about workplace learning and safety practice with respect to the following aspects:

1. *Understanding safety practice beyond the act of doing*

One of the key contributions of this study is that it provides insights into different aspects of safety knowledge which is critical for developing learning interventions to reinforce safe work practices. The study helps to inform how instructional materials or training curriculum can be more effectively organised that will help to develop the learning for specific aspect of safety knowledge or learning outcomes.

It is evident that the conception of safety knowledge is inextricably bound up with action which resonate with what Gherardi and Nicolini (2002) recognise as “a doing’ and the competence to act (Beckett and Hager, 2002). The study shows that as workers learn to practise safe work, they need to develop the content and technical knowledge (which associate with the discussed declarative and procedural knowledge). In practice, workers are engaged in a process of seeking situational understanding, making intuitive decision and judgment making that is necessary for enactment of safe working.

This study therefore expands our perspectives to look beyond the conventional approach of didactic and classroom learning as ways to circulate safety knowledge. It reiterates the need to consider competing discourses that may contribute to individual repertoire of safety knowledge, both explicitly and implicitly as learning continues in circumstances of work.

2. Realising significance of workplace pedagogical and invitational qualities for supporting safety practice

Another significant contribution of this case study is that it provides rich insights into how workplaces that are bounded by myriad of rules and regulations can still afford rich pedagogical support for learning and practice through deliberate institutional effort and interventions. Dominant learning provisions that support safe working included the utilisation of materials and artefacts as representations and interfaces for knowledge construction and meaning generation (Carlile, 2002, 2004; Gherardi & Nicolini, 2002); deliberate instructions by knowledgeable workers and experts (Berliner, 2001; Billett, 2000) to provide appropriate guidance; and an array of deliberate practice arrangements established for workers to refine their skills, as well as providing bridge practices across pairs and groups for more coordinated action (Carroll et al., 2002; Gruenfeld et al., 2000). As a whole, these insights help to deepen our understanding how different learning provisions can contribute to augment workplace learning to reinforce safe working. This study also informs how workers engaged and participated in the learning process. The study informs about salient workplace discourses and agency issues that will impact workers' learning.

3. Recognising the role of learner agency to reinforce safety practice

Finally, the study draws attention to consider the significant role of agency (Billett, 2009, 2010a; Eteläpelto, Vähäsantanen, Hökkä, & Paloniemi, 2013) in shaping the learning and practice for safe work. The study provides insights into personal and agentic influences that underpin workers' intentionalities to learn and work safely. More importantly, as coordinated and safe practices is often a collective goal in safety practice, considerations of individuals' intentionalities are important to achieve intersubjectivity consensus (Alterman, 2007; Bober & Dennen, 2001) and understand how they align individual occupational trajectories to meet organisational goals for safe work practices.

6.4 IMPLICATIONS FOR PRACTICE

This case study has shown that workplace learning for safety is socially constructed. Though the array of learning provisions reported from the findings provide pedagogically rich learning, (such as access to direct guidance from expert others; learning spaces for clarification of ambiguities in those participatory practices; prevalent use of artefacts to reinforce learning), the study also

cautions possible tensions of competing discourses as workers learn to work safe through those socially, contextually and intrapersonally grounded bases. These include issues such as transferability and application of knowledge when learning is context-dependent, and the relative effect on learning as individuals engage in different learning provisions to mediate their learning. Understanding how safety knowledge is verbalised and internalised as work is important. Likewise, the need for validation through appraising the qualities of learning outcomes is critical for enactment of safe work practices.

The study establishes that ways by which safety knowledge is verbalised and internalised will be pertinent for workplace learning to effectively support safety practice. It emphasizes the need for work sites to continue leveraging four important aspects of workplace learning to secure more enduring and effective outcomes, including the recognition for the role of learner agency. Interventions should therefore aim to achieve the followings:

1. *reinforce safe working by providing learning spaces in workplaces to recontextualise knowledge so to achieve better alignment between theory and practice;*
2. *reaffirm procedures with expert guidance and rigorous appraisal systems;*
3. *refine effectiveness and quality of sociomateriality and skills through co-participatory practices to provide inter-professional guidance and practical insights;*
4. *deepen workers' reflective thinking through dialogic exploration and strengthening relational agency.*

In consideration of the above proposed interventions, a summary of pedagogical strategies to advance learning and practice of safe work in perilous work settings is presented in Table 9. The learning and practice outcomes which aim to enhance the qualities of workplace learning for safety practice are also outlined. As the study suggests, these interventions and the ensuing pedagogical strategies would need to be provided as an integrative approach to reinforce learning and practice rather than in isolation given that safe working is learnt and practised in circumstances of work.

Table 9

Pedagogical Strategies for Practice

<i>Proposed Interventions</i>	<i>Pedagogical Strategies</i>	<i>Learning and Practice Outcomes</i>
Reinforce safe working by providing learning spaces in workplaces to recontextualise knowledge to achieve better alignment between theory and practice	Use of interactive pedagogical strategies such as case studies, role play and simulation training to improve awareness of different possible situations and contexts to encourage problem-solving Promote job rotation arrangement to create learning opportunities in varied work contexts	To assist workers to develop connections across different work settings and generate appropriate problem-solving strategies.
Reaffirm procedures with expert guidance and rigorous appraisal systems	Develop a robust knowledge management system to document the knowledge transfer process Establish clear direction for accessing guidance such as a reporting framework Train and develop more expert co-workers as models for performance Train and develop coaching and mentoring skills of more expert co-workers in who provide guidance	To strengthen the legitimacy and quality of guidance.
Refine effectiveness of quality of sociomateriality, and skills through co-participatory practices that provide interprofessional guidance and practical insights	Use of artefacts and visual images to enhance learning visibility (pictographic materials and learning guides) Establish pair and group work arrangement to allow inter-professional knowledge transfer Establish periodic and appropriate appraisal system to document and validate knowledge sharing (such as records of past incidents, observational findings, notes of minutes)	To mitigate tensions resulting from different practices between work communities.
Deepen workers' reflective thinking through dialogic exploration and strengthening relational agency	Strengthen leadership competency and mentoring skills of more expert co-workers who provide guidance Use of interactive pedagogical strategies such as case studies, role play and simulation training to improve awareness of different possible situations and contexts to encourage problem-solving Establish trust building activities to promote solidarity	To strengthen intersubjective consensus and commonality of culture and values towards safe working.

Overall, the study has shown that safe work learning in a perilous work setting requires close supervision, controlled observation, routine practice, problem-solving and in some circumstances driven through self-directing as workers engage in those social interactions and goal-directed activities in their circumstances of work. The pedagogical strategies outlined above thus aim to strengthen the robustness and validation of knowledge transfer processes through:

- i. Effective use of artefacts to improve learning visibility and understanding
- ii. Employ interactive pedagogical strategies to improve awareness of different possible contexts and encourage problem-solving
- iii. Strengthen leadership competency and mentoring skills of more expert co-workers who provide guidance such as supervisors who are important intermediaries in contributing to workers' everyday learning
- iv. Effective use of cooperative learning groups in everyday workplace activities to promote inter-professional guidance and knowledge exchange

To support the above pedagogical strategies, it is also important to set in place proper appraisal and knowledge management system for validating the appropriacy and accuracy of the learning that may potentially implicate safe working.

As the study suggests safe work learning is very much context-dependent. This also implies that the efficacy of how each of the proposed pedagogical strategies contributes to workplace learning needs to be evaluated in consideration of the specific set of contextual requirements of the particular workplace. Further research is needed to conduct more in-depth investigation on how each of the pedagogical strategies such as the effectiveness of artefacts and different instructional strategies may effect learning and practice outcomes.

6.5 CONCLUSION

The purpose of this study was to understand how best workers can participate in workplace learning to provide continuous learning that will advance their skills and knowledge for safe working. The study concludes that learning to work safe in circumstances of work is a complex process. This is more so in precarious work environment and trade such as process work. Learning is observed as a deliberate, controlled and structured pathway where knowledge is circulated through effective utilisation of an array of physical and social artefacts; intermediaries and interlocutors; and co-participatory practices. Hence, safety practice as evident in this study is context-dependent. How workers negotiate their practice and make appropriate adaptation to meet those circumstantial requirements in a regulated work context suggest that their learning is inextricably entwined and shaped by the pedagogical qualities of the workplace. In other words, the congruence between structure and agency that is necessary to reinforce safe work practices.

It is important to reiterate that this study is not contesting the contribution of formal safety training which remains as an important approach for safety practice. The study reaffirms that workplace learning can provide ongoing learning for workers to hone their skills and knowledge through everyday practice. For workplace learning to be effective, those critical dimensions of workplace learning presented in the study should therefore not to be viewed as distinct entities of different ontological status, but in terms of recursive and mutual constitution to effectively guide and reinforce safe working. Such a collaborative view is useful and legitimate to further develop the scholarship of workplace learning and safety practice by informing aspects of the interdependence between structure and agency issues critical for safe working particularly in high risk industries.

In conclusion, this study contributes to the current understanding about workplace learning by examining the significance of the three key dimensions of workplace learning, that is, safety practice as a situated-based knowledge; the pedagogical and invitational qualities of workplace as a learning site which constitute the structure and work context for practice; and the role of learner agency in influencing individual intentionality to work safe. With the increasing attention to promote higher standards of safety and health in workplaces, understanding and appraising how these different dimensions of learning and work is thus important for Singaporean companies. Contributions from the case study thus, serve to provide possible considerations to

help companies develop interventions more effectively that will enhance occupational efficacies and organizational performance in safety practice. At a national level, the study contributes to the refinement of the continuing education and training (CET) framework with respect to development of instructional or curriculum design, and reinforcing those best practices to augment individual and organisational learning. Further research is recommended to investigate how the proposed interventions and pedagogical strategies effect learning and practice outcomes in similar high-risk workplaces, to draw more conclusive generalisations on ways to enhance workplace learning for safety practice.

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Appendix A
Workplace fatality injury rates by industry in Singapore, 2015 – 2016

Table 1.3: Number of workplace fatal injuries by industry, 2015 and 2016

Industry	As at end of June		2015
	2016 ^p	2015	
All Sectors	42	30	66
Construction	17	10	27
Marine	5	2	4
Manufacturing	6	2	6
<i>Metalworking</i>	4	1	3
<i>Manufacture of Food Products</i>	1	0	1
<i>Manufacture of Non-metallic Mineral Products</i>	1	0	0
<i>Manufacture of Petrochemical Products</i>	0	0	1
<i>Manufacture of Rubber and Plastic Products</i>	0	1	1
Water Supply, Sewerage & Waste Management and Remediation Activities	2	0	0
Wholesale & Retail Trade	0	1	2
<i>Wholesale Trade</i>	0	1	2
Transportation & Storage	6	9	15
<i>Logistics & Transport</i> ¹⁰	2	6	12
Food & Beverage Service Activities	0	1	1
Telecommunications	0	1	1
Security & Investigation Activities	1	1	1
Cleaning & Landscape Maintenance Activities	5	2	5
Office Administrative, Office Support & Other Business Support Activities	0	0	1
Repair & Maintenance of Vehicles	0	1	2
Activities not Adequately Defined	0	0	1

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Appendix B

Fire Explosions in Singapore 2011 – 2016

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Fire at Shell Singapore refinery intensifies

Photo: Reuters

Smoke and flames engulf the Royal Dutch Shell's offshore petroleum complex.

Reuters

Wednesday, Sep 28, 2011

Update: Shell and SCDF have said that there are sufficient containment measures in case of spillage into sea.

SINGAPORE - A fire has intensified at Royal Dutch Shell's largest refinery, its half-a-million barrel per day Singapore plant, sending a plume of black smoke over the city-state.

Shell has evacuated non-essential staff from the refining complex, Singapore's Civil Defence Force said.

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92

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1 dead, 7 injured in Jurong factory fire rocked by explosions

CFR of S. An explosion occurred during a factory fire that broke out in Jurong on Oct 12, 2015.
PHOTO: TWITTER/@LB494_93194

© PUBLISHED OCT 12, 2015, 12:09 PM SGT | UPDATED JAN 19, 2016, 3:45 PM

Lee Min Guk | [TikTok](#) | [Facebook](#) | [Twitter](#)

SINGAPORE — One person died and seven others were injured in a fire that broke out on the premises of a gas manufacturing firm in the Jurong industrial zone on Monday (Oct 12) morning.

In a press release issued at around noon, the Singapore Civil Defence Force (SCDF) said it received a call at 9:30am and dispatched four fire engines, two aid clinics, two fire bikes, eight support vehicles and four ambulances to 21, Tanjong Kling Road.

"Prior to SCDF's arrival, there was a fire and a few explosions were heard in the premises. The in-house Company Emergency Response Team (CERT) immediately located the fire, and conducted evacuation and firefighting operations," said SCDF.

"Upon our arrival, the fire had engulfed a laboratory measuring about 7m by 5m, in close proximity to a production and storage area."

Four rescue jets were deployed to contain the fire within the laboratory while SCDF personnel equipped with breathing apparatus sets conducted search operations within the premises.

SCDF said one person was pronounced dead at the scene by paramedics, while five people were sent to National University Hospital and two to Ng Teng Fong Hospital.

The agencies then suffered major losses to materials and equipment.

SCDF had first informed the public of the accident with a post on its Facebook page at 10:35am. "Worried for the happening now at Tanjong Kling Road, SCDF resources are currently on site. More updates coming up."

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SHOPPING

Fire at petrochemical plant rages for 5 hours

Q PUBLISHED APR 17, 2016, 5:00 AM SGT

Oil tank catches fire at Jurong facility but SCDF contains it; no casualties reported

Deepest Coverage

A fire broke out at a \$382.4-billion S\$1.5-billion petrochemical facility on Jurong Island around 3pm yesterday, causing a plume of smoke to reach skyward from a burning oil tank containing about 20,000 barrels of light crude oil.

The smoke from the fire at a facility owned by the Jangsan Petrochemical Corporation (JAC) was visible even from the West Coast Highway on the mainland.

There were no casualties, but the aged oil tank before it was put out by the Singapore Civil Defence Force (SCDF).

The fire was so intense that it caused the 40m-wide and 20m-tall tank to buckle in on itself, said the SCDF.

The fire was subdued only after firefighters surrounded the tank with machines that doused the flames with water and foam.

Smoke billowing from the fire at a facility on Jurong Island, as seen from Tuas South at 6:30pm. The burning tank was contained within a protective wall, so that two other nearby tanks would not be affected. ST PHOTO: SEAH JIAHANG-PENG

"They also had to deploy a 'large foam monitor' capable of spraying 6,000 gallons of foam per minute.

"This operation was a race against time in view of the tank that buckled, and the need to prevent the intense fire from spreading to its immediate surroundings," said an SCDF spokesman. He said 150 personnel were involved in the operation and noted that the oil was not toxic.

The burning tank was contained within a protective wall. There were two other tanks at the facility and "foam drencher systems" were activated to cool down these nearby tanks.

It is believed that a lightning strike could have ignited the fire.

The JAC is currently in re-evaluation under restructuring firm Borealis Walsh. A source at Borealis Walsh said the amount of crude oil inside the tank was "only a small quantity" and the plant was "fully sealed" at the time of the accident.

The Straits Times understands that the roof was encased within concrete.

As to-house company emergency response team was also activated - a member of this team had to be sent to the National University Hospital for bone examination.

"The fire was contained and it was just limited to that one particular tank, no other part of the facility was affected," the source said.

A security guard on duty at a shopfront just opposite the plant recalled the moment he saw flames erupting from the tank.

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The Straits Times

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ST VIDEOS

Padlight student who designed M's Lee Times Lang's dinner purse inspired by media attention

The Straits Times' News In A Minute: Aug 6, 2016

The Straits Times' News In A Minute: Aug 3, 2016

PM Lee Hsien Loong: dinner purse used by M's Lee designed by Padlight student

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Potential job opportunities around Woodlands

The Jurong story from overgrown to Jurong Gateway

Appendix C
Information Sheet and Informed Consent Form

School of Education and Professional Studies
Mt Gravatt Campus, Griffith University
176 Messines Ridge Road
Mt Gravatt
QLD 4122
Australia

Date

Griffith University, Mount Gravatt campus,
176 Messines Ridge Road
Mount Gravatt
QLD 4122 Australia

To whom it may concern,

Learning Safety In The Workplace: A Case Study Of Petrochemical Workers In Singapore

INFORMATION SHEET

Researchers' Particulars

Name: Dr Sarojni Choy Phone: +617 3735 1108 Email: s.choy@griffith.edu.sg

Name: Kristine Yap Phone: 6579 0172 Email: kristine.yap@griffithuni.edu.au

Why is the research being conducted

We are inviting you to participate in this research project that has been approved by your company, Griffith University Australia and the Institute for Adult Learning Singapore (IAL).

The purpose of this research is to understand how workers learn about workplace safety and health in their workplaces and how their learning can be optimised to maintain high standards in the company's WSH performance. The findings of this research will provide information about ways effective training and learning for WSH can be organised to build and

maintain your capacities for optimal WSH performance. This research will therefore examine such issues as:

- How you learn about WSH through your course of work; and
- How the workplace can best contribute to your learning for WSH.

What will you be asked to do

You are invited to share your personal experiences and views about workplace learning through face-to-face in-depth interviews with the researchers. The interviews will take about 45 minutes and with your consent, the conversations will be recorded using a digital recorder.

Confidentiality

The conduct of this research involves the collection, access and/or use of your identified personal information. As outlined elsewhere in this information sheet, your identified personal information may appear in the publications/reports arising from this research. This is occurring with your consent. Any additional personal information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded except where you have consented otherwise. For further information consult the University's Privacy Plan at <http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan> or telephone at +617 37355585.

Your participation is voluntary

Your participation in this research is entirely voluntary and you are free to withdraw from this research at any stage without disadvantage or penalty.

Questions/Further information

If you wish to enquire further about this research, you may contact the researchers at their stated contact numbers or email addresses. Alternatively, further information on ethical issues in relation to this project may be obtained by contacting either the Manager, Research Ethics, Griffith University at +617 37354375 or the Chair of the IAL Ethics Committee at johnny_sung@ial.edu.sg or telephone 6579 0351.

Learning Safety In The Workplace: A Case Study Of Petrochemical Workers In Singapore

INFORMED CONSENT FORM

Researchers' Particulars

Name: Dr Sarojni Choy Phone: +617 3735 1108 Email: s.choy@griffith.edu.sg

Name: Kristine Yap Phone: 6579 0172 Email: kristine.yap@griffithuni.edu.au

Please indicate that you consent to this process by agreeing to the following statements and then signing in the box below:

- I agree to take part in the above named research. I have read the above information about this study and understand the nature of the research.
- I understand that by signing this form, I am agreeing to participate in the study but that I can withdraw from the research at any point if I wish, without disadvantage or penalty.
- I consent to the material from my participation being used as research data as part of the research and forming the basis for reports and publications. I understand that the data will eventually be archived in a secure manner at the Institute for Adult Learning (IAL), Singapore and may be used for secondary data analysis by other IAL researchers and only as permitted by IAL.
- I understand that while information gained during the study may be published, I will not be identified and my personal details will remain confidential.
- I understand that an audio recording device will be used during the interview and I am happy for this to be used.
- I understand that I should keep a copy of this form and that, if I have any concerns, I should report these to the researcher if possible or to the Chair of the IAL Ethics Committee.

Full Name	
Contact Details <i>(phone number and email)</i>	
Signature	
Date	
I would like a copy of my consent form	YES / NO
I would like a copy of my transcript	YES / NO
I would like a copy of the research report	YES / NO

PARTICIPANT INFORMATION SHEET

This questionnaire is designed to gather some background information about you. It will take you about 10 minutes to complete. The information that you provide will be kept confidential. Your participation is greatly appreciated.

SECTION 1: YOU AND YOUR WORK

1. Name: (Optional)
2. Gender: ☐ Male ☐ Female
3. Age (in years):
4. Are you a Singapore citizen or permanent resident?

 ☐ Yes (please proceed to question 6) ☐ No (please proceed to question 5)
5. Are you holding any of the following work pass?

 ☐ Work Permit ☐ SPass ☐ Employment Pass
 ☐ Others:
6. Which of these roles best describes your current occupation/job title?

 ☐ Technician ☐ Supervisor/Foreman ☐ Safety Officer ☐ Engineer/Manager
 ☐ Others:
7. No. of years in current job:

 ☐ Less than 1 year ☐ 2 – 5 years ☐ 6 – 10 years ☐ More than 10 years
8. Employment status:

Permanent	☐	Full-time	☐	Part-time
Contract	☐	Full-time	☐	Part-time
Casual	☐	Full-time	☐	Part-time

9. Highest qualifications:

- ☐ None
 ☐ Primary
 ☐ Secondary
 ☐ College/Polytechnic/Trade certificate/NITEC
☐ Degree and above
 ☐ Other:

SECTION 2: YOUR LEARNING AND TRAINING AT WORK

10. How many WSH training sessions have you attended in the past 12 months? Please tick **one**.

- ☐ None
 ☐ 1
 ☐ 2
 ☐ 3
 ☐ 4 or more [Please state here.....]

11. If you have **not** attended any WSH training in the past 12 months, what were the reasons?

You may tick more than one from the list below.

- ☐ Not applicable
☐ Too busy at work
☐ Too expensive
☐ My employer does not support
☐ Language problem
☐ Too new on the job
☐ Others:

12. In general, what is/are your **reason/s** for attending WSH training?

- ☐ My employer sends me for training
☐ I believe the training is important for my own safety

- ☐ It is a requirement for my job (e.g MOM regulation)
- ☐ I want to attend the training to upgrade myself
- ☐ All of the above
- ☐ Others:

THE END
Thank you for your participation

Appendix D
Interview Questions

No.	Interview Questions	Further Prompts	Purpose	Research Questions
1.	Can you tell me about your typical day at work? What do you think are the key safety risks or hazards of your work?		Understanding how their job/functional role relates to WSH	
2.	Can you tell me <u>how</u> you learn about WSH in your company? Can you describe them? How useful do you think they are?	Classroom-based? On the job? Feedback or comments of their effectiveness?	Understand the different pedagogical practices available in the workplace	RQ1 & RQ2
3.	How does your company support your learning about WSH?		Explore possible issues relating to workplace affordances	RQ2
4.	Apart from what is offered and organised by the company, what other ways do you learn about WSH?	Ask supervisor?	Understand how worker participates or engages in workplace learning	RQ1 & RQ2
5.	Tell me about a classroom training session you have attended. Was it helpful? Not helpful? How come?		Explore possible ways that may enhance learning processes	RQ2
6.	Tell me about something you learnt from a peer? What happened? Are there other ways?		Understand how worker participates or engages in workplace learning	RQ2

7.	Is there a difference between what you learn from attending training or from previous employers and how safety is practised here? Different in what ways? Describe a situation and tell me what happened.		Understanding how learning can be shaped or influenced by contextual or situational issues at workplace	RQ1 & RQ2
8.	What are some difficulties that you have experienced in learning WSH and how do you overcome them? Can you tell me more or give an example?		Explore possible ways that may enhance learning processes and insights to agency issues relating to individual learning experience	RQ2 & RQ3
9.	Describe a situation where you are not sure how to do a job safely and need to get help. What did you do?		Understand how worker participates or engages in workplace learning and possible insights about agency issues	RQ2
10.	Was there a situation where you think there is a better way to do a job in a safer manner but is not according to the company's procedures? What did you do? Where did you learn or know about the safer way to work?		Understand how worker participates or engages in workplace learning and possible insights about agency issues	RQ2
11.	If you were responsible for a new worker, what would you tell them about WSH? How would you teach them and why such approaches?		Understand how worker participates or engages in workplace learning	RQ2

12.	As an overview, interviewer is to show / prompt the various possible ways of learning based on the table and seek the response if they use the current mode and rate what they think how useful these are:						Explore and understand the different possible ways of learning WSH and the pedagogic practices in the workplace	RQ1 and RQ2	
		Currently used	How useful?						
			Very useful	Useful	Not useful				Not sure
	Learning through the experience from doing my work on my own								
	Use my previous work experience and knowledge								
	Learn from someone experienced (supervisor, co-workers etc)								
	See and listen to how others do								
	Check SOPs								
	Discussion with supervisor								
	Discussion with work colleagues								

	<table border="1"> <tr> <td>Learn from my buddy</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Watching videos</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Own research (e.g. the internet)</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Attending training</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Others: _____</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	Learn from my buddy						Watching videos						Own research (e.g. the internet)						Attending training						Others: _____								
Learn from my buddy																																		
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13.	In your opinion, how can your company help you best learn about WSH?		Explore possible ways that may enhance learning processes and insights to agency issues relating to individual learning experience	RQ2 & RQ3																														
14.	What changes would you like to see to help you learn better about WSH at work? Can you provide more details on these?		Explore possible ways that may enhance learning processes and insights to agency issues relating to individual learning experience	RQ2 & RQ3																														
15.	Is there anything else you would like to share?																																	