THE IMPACT OF SAFETY CULTURE ON SAFETY PERFORMANCE:

A STUDY OF THE HIGH SPEED PASSENGER CRAFT INDUSTRY IN HONG KONG

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ABSTRACT

The premium speed and comfort of fast ferries make them attractive to the operating organizations and passengers, which accounts for the increase in the number of fast ferries in Hong Kong. Although the accident rates are reportedly low, safety has been a concern because of their high-speed in the crowded waters of Hong Kong, particularly at times of darkness or poor visibility in certain high traffic density areas, such as Hong Kong Harbour. The regulatory controls over the safety of fast ferries were exposed to critical questions as a result of some serious marine accidents in clear weather and traffic, especially the tragic sinking of the Lamma fast ferry in October 2012 with the highest maritime death toll of 39 lives lost in Hong Kong waters. An analysis of past serious marine accidents revealed that the seafarers involved were qualified and experienced, but failed to observe the written procedures of the company's safety management system (SMS). The success of the SMS is dependent on the effectiveness of the organization's safety culture. More importantly, safety culture can be analysed through investigating the beliefs of employees in the workplace environment, which in turn has cascade effects on the organization's safety performance. The SMS requires operating organizations to deliver safe operating practice ashore and afloat. There could be conflicts between the management's and seafarers' and management's perceptions of safety in the ways of what and how the seafarers should be supported. The gaps in the safety perceptions between management and seafarers raise the concern of safety culture. This study explains the effects of ten specific factors of safety culture upon the perceived safety performance of the operating organizations from the employee's perspective, with the aim of developing practical strategies to improve the safety performance of the operating organizations in the safe operation and management of the fast ferry fleet. The methodology required a self-administrated questionnaire for the survey research, and also proposed and tested a model of the relationship between safety culture and the perceived safety performance of the operating organizations. Both descriptive statistics and inferential statistics provided analyses of the 214 responses, and predictions about the target population of some 450 fast ferry officers. Through applying analytical methodologies, five significant factors underlying the safety culture were identified and sorted in the order of significance as communication, management commitment, employee empowerment, fairness, and learning. The study has yielded

valuable research results that may support other researchers to engage in a more complex research in future, with the intent of gaining deeper insights of different safety perspectives. More specifically, this study has provided recommendations for the stakeholders concerned (including operating organizations, fast ferry officers, governments, seafarers' unions, and training institutions), and managerial implications of using safety culture for sustaining the continuous improvement of organizations, based on the analyses of the influences due to the five significant factors. To the author's best knowledge, this has been the first study to investigate the effects of safety culture upon the employees' perceptions of safety performance of the operating organizations, and this study has contributed the knowledge of safety culture in the fast ferry context of the maritime industry in Hong Kong.

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed by **Chi Keung Ricky, CHAN**

Date: **28 July 2021**

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Where correction services have been used the extent and nature of the correction is clearly marked in a footnote(s). Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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Date: **28 July 2021**

STATEMENT 2

I hereby give consent for my thesis, if accepted, to be available for deposit in the University's digital repository**.**

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Date: **28 July 2021**

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
ABS	American Bureau of Shipping
A.D.	After Death
AI	Artificial intelligence
AIS	Automatic Identification System
ANSP	Air Navigation Service Providers
ATC	Air Traffic Control
ATM	Air Traffic Management
B	Unstandardized Coefficients
β	An estimate of the change in Y due to a unit change in X
βeta	Standardized Coefficients
β_0	Regression Constant
$\beta_1, \beta_2, \beta_3..\beta_n$	Regression Coefficients of Factor Scores
Cap.	Chapter
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
df	Degrees of Freedom
DOC	Document of Compliance
DP	Designated Person
DSC Code	Code of Safety for Dynamically supported Craft
ϵ	Error term of the Regression Model
ECDIS	Electronic Chart Display Information Systems
EFA	Exploratory Factor Analysis
e.g.	For example
et al.	With other authors
F	*F*-statistic
FA	Factor Analysis
GPS	Global Positioning System
H_A	Research Hypotheses
HK	Hong Kong
HK Waters	Hong Kong Waters
HSC	High-speed Passenger Craft
HSC Code	International Code of Safety for High-speed Craft
HSCSC	High Speed Craft Safety Certificate
IAEA	International Atomic Energy Agency
IMO	International Maritime Organization

ISM Code	IMO International Safety Management Code
KMO	Kaiser-Meyer-Olkin
MAISSPB	Marine Accident Investigation and Shipping Security Policy Branch
Mardep	Marine Department of the Hong Kong Special Administrative Region of the People's Republic of China
MARPOL	Convention on the International Regulations for Preventing Collisions at Sea
MSI	Maritime Safety Information
NC	Non-conformity
OCIMF	Oil Companies International Marine Forum
p	Level of Statistical Significance
PCA	Principal Components Analysis
PRD	Pearl River Delta
P-P Plot	Predicted Probability Plot
PTO	Permit-to-operate Certificate
%	Percentage
Sig.	Significance Value
SMC	Safety Management Certificate
SMM	Safety Management Operating Manuals
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SPSS	Statistical Packaging for the Social Sciences
SREP	Speed Restriction Exemption Permit
STCW Convention	International Convention on Standards of Training, Certification and Watch-keeping for Seafarers
Std. Error	Standard Error
t	*t*-statistic
TEUs	Twenty-foot Equivalent Unit
TOL	Collinearity Tolerance
TRC	Type Rating Certificate
TRCE	Type Rating Certificate Examination
R	Correlation Coefficient
R^2	Determination Coefficient
US	United States of America
▼	Volume of Vessel Displacement in Cubic Meters
VDR	Voyage Data Recorder
VIF	Variance Inflation Factors
$X_1, X_2, X_3 ... X_n$	Independent Variables
Y	Value of the Dependent Variable

CHAPTER I: INTRODUCTION

1.0 Introduction

This chapter begins with the background of the research study. It features the problem statement and defines the research aims and objectives. In addition, the chapter describes the contributions of the research study. At the end, it outlines the structure of all chapters of this dissertation.

1.1 Background of the Study

Marine accidents are unexpected but usually cause loss or damage to human lives, properties, and the marine environment. Before a serious accident occurs, there should be a high frequency of risks of accidents, and a series of small errors or mistakes according to the Swiss Cheese Model of Accident Causation by Reason (1990) and the theory of Serious Accident by Geller (1997).

Although the accident rates are reportedly low, risk of accident stays high in the crowded waters of Hong Kong. Looking at the traffic situations, there are different types of vessels coming into Hong Kong Harbour to approach their destinations such as cargo or ferry terminals. Hong Kong handled 17.96 million TEUs in 2020, making it one of the world's busiest container hub ports (HKMPB, 2021). In addition, there are more than a hundred departures of fast ferries daily from the ferry piers or terminals, and some 900 government vessels serving the community of Hong Kong, in addition to other miscellaneous vessels, such as pleasure craft, fishing boats, launches, tugs and tows, and the others (HKMPB, 2021).

Over the past years, there have been increasing concerns over the vessel speeds and the public put more attention on safety issues, particularly during the hours of darkness or restricted visibility in certain narrow waterways, namely the Admasta Channel between the Lantau Island and the Cheung Chau Island (Legislative Council, 1999).

Several serious marine accidents involving fast ferries did happen (See Table: 3.8.2 - *The Statistics of Accidents involving HSC between 2001 and 2016*), even the weather and traffic conditions were clear. The accidents raised the public safety concerns about the high-speed manoeuvres of fast ferries.

In October 2012, the tragic sinking of the local fast ferry "Lamma IV" shortly after colliding with another fast ferry killed 39 lives. The safety of fast ferries was called into court inquiry about the current regulatory regimes governing the safe operation and management of the fast ferry fleet. The Lamma tragedy was the deadliest ferry fatality in Hong Kong waters with the highest maritime death toll (Lunn & Tang, 2013).

In the aftermath of the tragedy, the Director of the Hong Kong Marine Department conveyed that even the Government tightened regulatory controls to govern the operating vessels and the working crew, accidents still happened (Liu, 2012). Whilst, the public criticized the lack of depth in the accident investigation, and the media pressed that an effective safety management system should be in place for operating fast ferries in Hong Kong (Pryke, 2012). Likewise, a similar case of accident abroad in the same year of 2012 involving the cruise ship "Costa Concordia", capsized and sank in clear weather after grounding in Italy (Seitelman, 2012).

An analysis of past serious marine accidents revealed that many seafarers involved were qualified and experienced. Although the mandatorily required safety management systems were put in place by the companies at the time of accidents, the seafarers applied their own expertise and experience more than following the safety procedures set by the management of organizations (Bhattacharya, 2012; Jung, 2017; Lunn & Tang, 2013; MAIS, 2011). It appears that there are gaps left unfilled between the seafarers' and management's perceptions of safety.

A study published in 2003 by Dr. Phil Anderson indicated that there could probably be conflicts in the perceptions between the land-based management and the crew of vessels in the ways of what and how the latter should be supported (Anderson, 2003; Cashman, 2013). Such a difference in perceptions make seafarers act against the written procedures of the safety management system (SMS). There should be certain grounds underlying the seafarers' choices of priority in relation to the perceived consequences. The gaps in the safety perceptions between management and seafarers could be the root of the problem.

1.2 Statement of the Problem

According to the ISM Code, safe operation and management of vessels are achievable through safety performance compliance with the individual company's SMS, while the

success of the SMS is dependent on the effectiveness of the organization's safety culture (ISM Code, 1994, 2002 & 2007). For example, when employees positively perceive the safety culture of organizations, they will follow the documented procedures of the company's SMS.

The SMS are sets of documented procedures required by the ISM Code, whether or not they are followed depends on the willingness of employees (Eurocontrol, 2006; Kennedy & Kirwan, 1995). When employees positively and highly perceive the safety culture of an organization, they will be committed to ensure that the operations comply with the company's SMS. In other words, the company's SMS will assure safety performance compliance. Hence, the ISM Code should support and promote safety culture by considering employees' behavioural issues (IMO Symposium, 2013; Veluplay, et al., 2015).

To reiterate the importance of safety culture, the Secretary-General of the International Maritime Organization (IMO) reinstated at a safety conference in August 2016 that the IMO would try hard to "*exert a benefit influence on the safety culture as a whole*" to promote the development of safety culture in shipping (Lim, 2016).

Several articles also indicated that deficiencies in safety culture might cause obstacles to vessels' safety performance (Kongsvik et al. 2014), and advocated that the SMS and safety culture should be complementary to represent an organization's safety competence in maintaining safe operation of ships and pollution prevention from ships (Anderson; 2003; Eurocontrol, 2015).

Fundamentally, safety culture refers to the underlying beliefs and values of employees in relation to safety (Glendon & Stanton, 2000). It is also the underlying philosophy of the ISM Code to influence how employees at all levels in an organization perceive, value, and commit to safety, thus having a direct influence on organization's safety performance compliance with the ISM Code (Eurocontrol, 2006; IMO Symposium, 2013; Kongsvik et al. 2014).

On the other hand, safety climate is not only "*a measure of safety culture, but a workplace environment having a direct influence on the employees' shared perceptions of an organization's safety culture*" (Gillen et al., 2002; Huang et al., 2006; Kongsvik et al. 2014;

Tohidi & Jabbari, 2012; Zohar, 1980). It reflects the beliefs of employees in safety, and influences employees' attitudes towards the safety policies, procedures, and practices relating to workplace safety, thus influencing employees' safety behaviours (Fleming, 2005; health & Nesset, 2009). Hence, employee's perception of safety climate is a measure of the prevailing safety culture at workplace, providing a meaningful predictive indicator of an organization's safety culture at a moment of time (Mearns et al., 2003).

Many previous studies have examined the effects of safety culture or safety climate on the safety performance or safety behaviours of employees in different industries (Cox & Cox, 1991; Kongsvik et al. 2014; Marsh et al., 1998; Neal et al., 2000; Zohar, 2002). Safety culture, which may consist of different factors, depends on individual authors, research perspectives, scopes and subjects of the studies.

To sustain a safety culture, it is necessary for the operating organizations to probe the safety beliefs of the HSC Officers who are employed and deployed to man the High Speed Passenger Craft or HSC, and consider their behavioural issues. This study will develop a questionnaire, based on a number of indicators to measure the effects of safety culture upon the perceived safety performance of the HSC organizations from the seafarers' perspective (Cooper, 1999, Cox & Flin 1998; Guldenmund, 2000; Huang et al., 2006; Neal et al., 2000).

In shipping, prior studies focused mostly on safety culture of conventional ships (e.g. cargo ships, cruise ships) trading worldwide. Few scholars have examined the effects of safety culture on the safety performance of the HSC organizations. The findings from this study are expected to shed light on this issue.

Through an analysis of the HSC Officers' perceptions of safety culture, this study intends to answer the research questions of (i) Which of the factors of safety culture will significantly influence the organization's safety performance? And (ii) How does the underlying causes behind the significant factors of safety culture influence the organization's safety performance in the HSC industry of Hong Kong?

1.3 Research Aims and Objectives

This research study aims to investigate the effects of safety culture on the safety performance of the HSC organizations in Hong Kong from the seafarers' perspective, and

to develop practical strategies to enhance the safety performance of the HSC organizations in the safe operation and management of the HSC fleet.

In answering the research questions, the research objectives are listed below:-

1. To provide an overview of the operating environment, inclusive of the marine traffic movements, the governing rules and regulations, for having a good understanding of the industrial practice in the safe operation and management of high-speed craft in the maritime industry of Hong Kong;
2. To review the relevant theories of safety culture and safety climate in association with safety performance, and related models of safety culture and safety climate, for understanding their influences and identifying the factors to construct a conceptual framework appropriate to this research study;
3. To formulate hypotheses, for measuring and analyzing the effects of the significant factors on the perceived safety performance of organizations;
4. To identify the research design on the quantitative approach and the strategy for data analyses, for carrying out the quantitative survey research;
5. To develop a self-administered questionnaire to serve as the survey research instrument, and to examine the process and results of the pilot study for preparing a large-scale survey research;
6. To examine the relationships between the independent and dependent variables through hypothesis testing, for identifying the significant factors influencing the HSC Officer's perceptions of the organization's safety performance;
7. To explore the causes underlying the responses to each significant factor of safety culture, for determining how the underlying causes behind the significant factors influencing the HSC Officers' perceptions of the safety performance of organizations in the HSC industry of Hong Kong;
8. To analyze the managerial implications of using safety culture to manage safety performance of organizations, and suggest sets of recommendations, for continuously improving the safety performance of organizations.

1.4 Contributions of the Study

This study has several contributions to the field of the HSC industry of Hong Kong. It is the first time for the impacts of safety culture on the safety performance of organizations in the high-speed craft industry of Hong Kong to be examined through a quantitative measurement. The study does not only identify the differences in the weight of impacts

from each of the significant factors upon the response variable, but also contributes to the knowledge of safety culture in the HSC context of the maritime industry in Hong Kong. The empirical results provide a picture of how the significant factors of safety culture will influence the safety performance of organizations, thus enabling stakeholders to better allocate their resources and efforts towards safety enhancement.

Second, the study establishes a theoretical model of safety culture in the HSC context to explain the relationships between safety culture and the safety performance of the organizations. Theoretically, the model provides a general framework. It may help the HSC organizations understand safety culture better, and how the factors influence the employees' perceptions of safety performance of organizations. More specifically, it highlights the significance of safety culture in enhancing the safety performance of organizations from the employees' perspective.

Third, the study develops a self-administered questionnaire with 48 items clustered into eight factors of safety culture in the practical context of the HSC industry of Hong Kong. The questionnaire may serve as a reference for any similar topics in future studies on the HSC. It is expected that instrument can provide accurate responses with a high response rate. Nevertheless, neither the model nor the questionnaire should be used as direct tools for measuring safety culture, unless otherwise appropriate corrections or alternations would be incorporated into their contents.

Last but not the least, organizations having understood the managerial implications of using safety culture can better manage safety performance of organizations, thus likely driving the stakeholders to pay a higher level of attention to the influences of safety culture. Moreover, the recommendations based on the conclusions may benefit the industry from mitigating risk of accidents, and monitoring the organizations' safety culture across, thus solidifying a good safety performance for continuous improvement of the HSC organizations.

1.5 Structure of the Dissertation

This study comprises seven chapters. This was the Chapter I to discuss the background of the research and the rationale for this research. Specifically, it brought out the research questions, and defined the research aim and objectives. It was then followed with the contributions of the research study, and finally outlined the structure of all chapters of the

dissertation.

The Chapter II provides an overview of the operating environment, including the marine traffic movements, the HSC organizations, governing rules and regulations in the safe operation and management of the high-speed craft in the maritime industry of Hong Kong.

The Chapter III begins with a review of literature on the relevant theories of safety culture and safety climate, in association with the dependent elements, including the Safety Management System, SMS continuous improvement, safety performance and human-related accidents. In addition, a review of literature on the influential models of safety culture and safety climate is included to understand their influences, and the dimensions for the composition of a conceptual framework appropriate to this research study in the practical context of the HSC industry of Hong Kong is further identified. Accordingly, hypotheses of the study are formulated for measuring and analysing the effects of safety culture on the HSC Officers' perceptions of organization's safety performance.

The Chapter IV mainly discusses the research methodology applied to the study. First, it briefly discusses the philosophical approach underlying the research study. Second, it describes research strategy and the research design on a quantitative approach. Third, target population, sampling and data collection methods, and sample size for this study are explained. Fourth, the pilot study is described and explained. Fifth, it addresses the measures adopted to ensure the validity and reliability of the data collection instrument. Then, it concerns with research ethics of informed consent, protection of confidentiality and the provisions of ethical approval. Sixth, both descriptive and inferential statistics are used to provide details of specific sample, and inferences or predictions about the target population are made. Lastly, statistical techniques for an analysis and interpretation of the quantitative data are addressed, and the strategy for data analyses of the quantitative survey research is given.

The Chapter V starts with the development of a new survey research instrument for the survey research, and it presents the process and results of the pilot study, and the descriptive analysis of the questionnaire items used in the pilot, and then it ends with the survey research instrument tested for the internal consistency of the items in the scale.

The Chapter VI presents the data collated primarily through questionnaires and the results derived statistically from the analysis of data for their relative importance and relevance to the research questions. It consists of two parts. In the first part, the data reduction technique by factor analysis is used to reduce the items to fewer sets of related factors, and to transform the variables into a simpler data structure for a measurement scale. Then, the author performs the reliability tests to confirm the internal consistency of the new measurement scale, using the Cronbach's alpha reliability coefficients. In the second part, the author presents the analyses of the responses, the demographic characteristics of the sample respondents, and the findings and analyses of the survey research including the outputs of descriptive and inferential statistics, and examines the relationships between variables through hypothesis testing.

The Chapter VII, which is the final chapter, concludes the major study findings of the quantitative survey. First, it presents the conclusions drawn from analytical results. Second, the managerial implications of using safety culture to manage safety performance of organizations along with sets of recommendations are suggested for continuous improvements. Finally, it addresses the limitations of this study and potential directions for future research before concluding the study.

CHAPTER II: HIGH SPEED PASSENGER CRAFT INDUSTRY, HONG KONG

2.0 Introduction

This provides an overview of the operating environment, inclusive of the marine traffic movements, governing regulations of safety in the high-speed craft industry of Hong Kong. Specifically, High-speed craft is unique in its operational mode in the maritime industry. Its operation encompasses specific technical know-how, and its safety management fills with distinctly maritime-related policies and laws. These exert significant effects on safety culture and safety performance of the high-speed craft operating organizations. Unless one is an industry practitioner, one may not seize a good understanding of the industrial practice easily.

2.1 High-speed Craft Traffic

Hong Kong is one of the busiest seaports in the world (Straits Times, 2015). Because of economic development, the number of high-speed craft maneuvering within Hong Kong waters (HK waters) (See Figure: 2.1 of Appendix: A – *Hong Kong Waters*) has been on an increase (Legislative Council, 1999).

Generally, the high-speed craft is a fast speed watercraft for transportation. Examples of the high-speed passenger craft are referred to as Jetfoils, Foil-cats, Catamarans and Mono-hulls in this study. In the late 1980's, Hong Kong was one of the world's busiest fast ferry markets for the shipbuilding traders, during which over thirty high-speed craft were delivered to meet the growing passenger demands (Austral, 2007; Lee, 2007). Such a rapid growth in this fast waterborne transport of passengers was largely attributable to the local demands from the out-laying Islands, such as Park Island, Discovery Bay and some new towns in the New Territories of Hong Kong (HK). In addition, the rapid economic growth of the Pearl River delta of the People's Republic of China (China) and the fast-growing tourism in Macau further accelerated the demands (HK International Press Release, 2009). Daily, there are about a hundred high-speed craft travelling in and out of HK waters (GovHK, 2018).

2.2 Passenger Throughput

As indicated in Table: 2.2 - *Passenger Statistics of the China and Macau Ferry Services between 2012 and 2021*, the cross-border passenger throughput of the "HK-Macau" trade

route has been the busiest, at about five times of the annual throughput of the “HK-China” trade route between the years of 2012 and 2019. For examples, the total passenger throughput of the “HK-Macau” and “HK-China” trade routes were 24,934,000 in 2017, 23,728,000 in 2018 and 14,388,000 in 2019 respectively, while the passenger throughput of the “HK-Macau” trade route reached 20,780,000 in 2017, 19,464,000 in 2018, and 12,050,000 in 2019, each of them was about 5 times of the annual throughput of the “HK-China” trade route for the said years (GovHK, 2018; Immigration, 2021; Mardep, 2016 & 2021). To maintain the service quality, the number of sailings remained unchanged, regardless of the sharp decline in passenger numbers in the year 2019.

Table: 2.2 - Passenger Statistics of the China and Macau Ferry Services between 2012 and 2021
Sourced from: Mardep (2016 & 2021); Immigration (2021)

Passenger Throughput ('000)	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
HK-China Ferry Trade-route	4,743	4,965	4,877	4,549	4,248	4,155	4,264	2,337	0	0
HK-Macau Ferry Trade-route	20,939	20,994	21,569	21,192	20,660	20,780	19,464	12,050	0	0
Total Passenger Throughput	25,682	25,959	26,446	25,741	24,908	24,934	23,728	14,388	0	0

Due to the Coronavirus Disease 2019 pandemic, the cross-boundary ferry terminals have been suspended since the beginning of 2020. Passenger throughput for the years of 2020 and 2021 recorded zero.

2.3 HK-Macau Ferry Trade Route

Ferry plays a key role in the passenger transport between Hong Kong and Macau. In 1963, the first passenger-carrying high-speed craft was introduced as the quickest transport alternative to the sea transport route between the territories of Hong Kong and Macau. The premium speed and comfort of the passenger carrying high-speed craft make them attractive to the operating organizations (thereafter referred to as the HSC Organizations) and their passengers. Presently, high-speed passenger craft have replaced all conventional ferries on this near-coastal voyage.

Geographically, Macau is situated, the West of Hong Kong with a distance apart of approximately 70 kilometers or 37 nautical miles. On average, passengers travelling by the HSC to Macau from Hong Kong take about an hour that is less than half the sailing time of

the conventional ferries.

2.4 HSC Organizations

Presently, there are two HSC organizations operating this short sea passenger trade route. They are the Shun Tak-China Travel Ship Management Company (referred to as TurboJet) and the Venetian's Chu Kong High Speed Ferry Company (referred to as CotaiJet) with a combined fleet of over fifty HSC of different types (Fast Ferry International, 2008). These two HSC organizations have employed some 450 HSC Officers to serve on the Hong Kong-registered HSC of different types.

2.4.1 TurboJet

Management of the TurboJet is the owner who enjoyed its monopoly on the carriage of sea passengers over past several decades, granted by the government of Macau. Today, it provides frequent ferry crossings daily to connect Hong Kong and Macau, with focus not merely on maximizing shareholder profits but embracing safety and its social responsibilities. A sizable workforce of more than 300 HSC Officers, equivalent to over 80 watch-keeping teams have been employed to mobilize its fleet of high speed ferries.

2.4.2 CotaiJet

Management of the CotaiJet is contract-based under the control of the Venetian owners. Its management’s approach towards this short-sea route is a derived demand driven by the casino businesses in the long-run. A workforce of more than a hundred HSC Officers, which is equivalent to about 25% of the entire population employed as HSC Officers. Management is business-centered, but operated to the requirements of the organization’s safety management system under the ISM Code.

2.5 Regulations governing High-speed Craft

Operating the Hong Kong-registered high-speed passenger craft has been governed by the Hong Kong Shipping Ordinances and their subsidiary legislations, entrusted to the HSC organizations, and controlled by the flag state administration, known as the Marine Department of the Hong Kong Special Administrative Region of the People’s Republic of China (Mardep), and policed by the Macau Port Authority (Kasoulides, 1993).

The Mardep is the port authority of Hong Kong, responsible for keeping the safety of the seaport, vessels, preventing pollution from ships, and the search and rescue operations for

large parts of the South China Sea. Daily, it closely monitors the marine traffic in waters of Hong Kong, and it conducts investigation in the case of marine accidents (Mardep, 2015).

Since 1967, Hong Kong has been an associate member state of the IMO (IMO, 2015). It has ratified and legislated many of the International Maritime Organization conventions into the Hong Kong Shipping Ordinances applicable to the HSC trading in and out of HK waters, e.g. Macau and the Mainland Chinese seaports (Busk, 2010).

Amongst the international conventions of the IMO, the major treaties adopted to govern the HSC have been "the International Convention for the Safety of Life at Sea, 1974" (SOLAS 74), "the International Convention for the Prevention of Pollution from Ships, 73/78, as amended" (MARPOL 73/78), "the Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended" (COLREG 72), and "the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers 1978, amended 2010" (STCW 2010), together with certain mandatory codes embodied in the SOLAS 74, particularly "the International Codes of Safety for High-speed Craft" (HSC Codes) and "the International Safety Management Code" (ISM Code).

2.5.1 International Codes of Safety for HSC

In 1977, "the Code of Safety for Dynamically-supported Craft" (DSC Code) was first adopted by the IMO. The code recognized that the design criteria for the HSC in the ways of construction and safety were quite different from those of conventional ships. It, in its recommendatory nature, introduced an appropriate set of international conventions applicable to the HSC (DSC Code, 1997).

Further realizing the growth in size & type and the development in design & technology of the HSC, the IMO adopted "the International Code of Safety for High-speed Craft, 1994" (HSC Code 1994), and later adopted "the International Code of Safety for High-speed Craft, 2000" (HSC Code 2000) to align the safety standards of the HSC with the amendments under the Chapter X (High-speed Craft) of the SOLAS 74, and some other conventions adopted by the IMO (Hoppe, 2005; HSC Code, 2000).

The HSC Codes are mandatory because they are included in the Chapter X - Safety measures for High-speed Craft of the SOLAS 74, and embodied in the Hong Kong Shipping Ordinances and their Subsidiary Legislation, namely the "the Cap.369AW-

Merchant Shipping (Safety) (High-speed Craft) Regulations", applicable to the HSC about their construction, equipment, fittings, systems, operation and maintenance (Mardep, 1999). Hence, the existing Hong Kong registered high-speed craft should comply with the HSC Codes and their amendments (HSCCC, 2015).

To an extent, the HSC can be exempted from certain provisions of the codes (HSC Exemption, 1999; HSCCC, 2004) that is left to the flag state administration to decide upon (Shea, 2005). Nevertheless, exemptions are specified in the Surveyor's Manual of the Mardep, known as the "Instructions for the Survey of Hong Kong registered High-speed Craft", supplied to the Mardep's surveyors of ships and the HSC organizations for their implementation and compliance accordingly (Mardep, 1999).

2.5.1.1 HSC Certificates and Permits

Both "the High-Speed Craft Safety Certificate" (HSCSC) and "the Permit-to-operate HSC Certificate" (PTO) are the statutory documents, issued to the HSC upon completion of an initial or renewal survey to meet the mandatory requirements of either the HSC Code 1994 or the HSC Code 2000 of the SOLAS 74, depending on the year of built (HSC, 1998).

The HSCSC relates to the surveys of structure, equipment, fittings, and the building materials of the HSC. The survey requirements are equivalent to the criteria of the first four chapters of the SOLAS 74 relating to conventional ships (HSC, 1998; PTO, 1999).

In addition to the HSCSC, the HSC must carry a PTO. The permit prescribes more details than the HSCSC, with specific trading routes stipulated therein. Unless a valid PTO is in place, the vessel shall not carry paid passengers onboard.

The PTO contains the operational conditions or restrictions imposed on the HSC, where the provisions in the PTO restrict the maximum number of passengers to be carried onboard; the maximum number of voyages to be undertaken by the HSC Officers on a day or night; the maximum number of hours of work to be undertaken by the HSC Officers when working on a duty cycle of 96 hours in every four day period, two consecutive nights on-duty followed by two full day off-duty should be arranged, taking into account "the Chapter 478D - Merchant Shipping (Seafarers) (Hours of Work) Regulation" for governing the minimum hours of rest given to an officer-in-charge of a watch in any 24-hour period. The provisions also control the minimum number of crew the HSC should carry according

to the provisions of the Minimum Safe Manning Certificate issued by the Mardep (PTO, 1999). For example, there should be a navigation team of three HSC Officers during the daytime hours and of four officers in a team during the period after sunset and before sunrise.

Hence, each HSC should keep a valid HSCSC and PTO onboard (HSC, 1998). The HSC are allowed to navigate on a specific route between Hong Kong and a destination port outside HK waters (Hoppe, 2005; PTO, 1999) according to "the Chapter 369AW - Merchant Shipping (Safety) (High-speed Craft) Regulations".

2.5.1.2 Type Rating Certificate, Examination and Assessment

The Type Rating Certificate (TRC) was introduced in the aftermath of the grounding of the Catamaran "Apollo Jet" in December 1989, which led to new requirements for the specific officers' training for any type of high-speed craft.

In addition to holding a trade Certificate of Competency appropriate to the rank to serve on-board a Hong Kong-registered vessel, each HSC Officer must hold a valid Type Rating Certificate (TRC) for any particular type of the HSC (PTO, 1999, HSCCC, 2010).

Before taking the Type Rating Certificate Examination (TRCE), each HSC Officer trainee is given an appropriate training specific to the type of craft by their employers, with a pre-approval from the Mardep.

The TRC training for the safe operation of the HSC covers the contents of the craft documents, including "the Craft Operating Manuals", "the Route Operating Manuals", "the Maintenance and Service Manuals", "the Training Manuals", "the Safety Management Manuals", and "the Stability Booklets" (PTO, 1999, HSCCC, 2010).

Duration of the TRC training for daytime HSC Officer Trainees takes about two weeks. Regarding the TRC training for the HSC Officers working at night, each HSC Officer has to complete at least three months of daytime navigation, while holding a valid TRC (HSCCC, 2004).

Then, the competency of each HSC Officer trainee is assessed prior to serving as an HSC Officer on any particular type of craft or a fleet of the very similar craft (PTO, 1999).

The HSC Officer trainees have to pass the TRCE, and the practicing HSC Officers are subjected to a TRC re-assessment at interval of every two years.

In 2003, TRC re-assessment was reviewed by the Mardep, and well-supported by the stakeholders of the high-speed craft industry in Hong Kong, e.g. the seafarers' unions including the Merchant Navy Officers' Guild and the Hong Kong Seamen's Union (HSCCC, 2004). Since then, the Mardep has left the TRC re-assessments to the HSC organizations, but conducting TRCE only.

2.5.2 Speed Restriction Exemption Permit

Vessels should always proceed at a safe speed not exceeding the maximum permitted speed-limit within HK waters according to "the Shipping and Port Control Regulations" (Cap.313A) and "the Merchant Shipping (Local Vessels) (General) Regulation" (Cap.548F).

With the Speed Restriction Exemption Permit (SREP) granted under "the Section 64 of the Shipping and Port Control Ordinance" (Cap. 313) of the Laws of Hong Kong, the HSC are exempted from the speed limit, except proceeding within the designated fairways of Hong Kong Harbour (See Figure: 2.5.2 of Appendix:A - *Traffic Separation Scheme and Principal Fairways*) where the HSC are subjected to a speed limit of thirty-five knots (Chapter 313A, 2007; Legislative Council, 1999).

Fairway is a narrow waterway or a harbour approach channel designed for vessels navigating in an orderly manner, either in one or two-way traffic. For example, the principle fairways in Hong Kong Harbour as a converging zone of all marine traffic movements are crowded with river-trade vessels, tugs-and-tows, anchored vessels undergoing the mid-stream cargo works, vessel-engaged in fishing, ocean-going ships, and the marine-related activities (See Figure: 2.5.2 of Appendix: A – *Traffic Separation Scheme and Principal Fairways*).

Nevertheless, the validity of the SREP will be uplifted when the visibility level falls below one nautical mile in HK waters (Mardep, 2005) or 500 meters in Mainland waters (HSCCC, 2016c).

2.5.3 HSC Recommended Tracks

To separate the HSC from other marine traffic movements, some specific routes for the HSC are designated. There are three types of the HSC trade routes, including 'Near-coastal routes between Hong Kong and PRD through the Pearl River', 'Domestic routes within HK waters', and 'River-trade routes between HK and Macau' (HSCCC, 2016). Amongst the River-trade routes, the cross-boundary trade route linking HK to Macau remains the one of the highest traffic density.

2.5.4 International Safety Management Code

In 1998, the IMO introduced an international standard for the safety management and operation of ships, and for preventing pollution from ships, known as the International Safety Management Code (ISM Code) into the SOLAS 74 as the Chapter IX of the Management for the Safe Operation of Ships (ISM Code, 1994; 2002; 2007). The ISM Code was reactively enforced in response to several very serious marine accidents happened between the late 1980's and early 1990's, with the shore-based management faults identified as one of the serious errors, for the very first time making the operating organizations ashore responsible for their mistakes in the marine accidents (Barnett, Stevenson & Lang, 2005; Shea, 2005).

In the meantime, the ISM Code was incorporated into the Hong Kong legal systems as "the Chapter 369AX – Merchant Shipping (Safety) (Safety Management) Regulations", applicable to the Hong Kong registered ocean-going ships including the cross boundary High-speed Passenger Craft (HSC) registered in Hong Kong (Chapter 369AX, 1998; IMO, 1997).

The ISM Code, which addresses the responsibilities of management ashore and afloat, requires the operating organizations to develop, implement and maintain an effective Safety Management System (SMS) (Resolution A.741 (18) – Preamble) for meeting the purposes of the ISM Code (Anderson, 2003; Chapter 369AX, 1998).

The HSC organizations should provide for safety practices in shipboard operation and a safe working environment. They should keep improving the safety management skills of employees working ashore and afloat, such as preparing for emergencies that may likely arise ashore or afloat for the continuous improvement of the organization's SMS (Chapter 369AX, 1998)

2.5.4.1 Safety Management Manual

The safety policies and safety practices are documented and compiled in the Safety Management Manual (SMM) which allows the HSC organizations to measure their safety performance against set criteria, and hence weaknesses can be identified and improved (ICAO, 2008).

The Safety Management Manual (SMM) is comprised of "the SMS Policy Manual", "the Company Operational Procedures Manual", and "the Company Emergency Procedures Manual" for the shore-based office, while the same SMS Policy Manual together with "the Shipboard Operational Procedures Manual" and "the Shipboard Emergency Procedures Manual" are being kept on board each HSC.

2.5.4.2 ISM Certification Compliance

To meet the certification requirements of the ISM Code, an HSC organization upon a successful audit of the shore-based SMS procedures is issued with an operator's certificate known as the Document of Compliance (DOC). A photocopy of the DOC should be displayed on each vessel, which indicates that the shore-based office has fulfilled the provisions stated in the ISM Code, subject to an annual verification audit. In addition, each vessel is issued with an operating certificate known as the Safety Management Certificate (SMC) by the flag state administration following an initial or a periodical compliance verification to prove that the shore-based office and its shipboard management are operated in accordance with the approved SMS (Chapter 369AX, 1998; ISM Code, 2007).

2.5.4.3 Approach to Managing Safety

Over two decades, the SMS has been a systematic approach to managing safety (ISM, 2007; Jackson, 2008), in which the safety policies and safety practices are established and transformed into written procedures by the HSC organizations for implementing and monitoring an organization's SMS. In addition, the SMS follows the principle of continuous improvement through audits, reviews and corrective actions (ISM Code, 2007).

The administration of the flag state also supports the concept of continuous improvement by periodically auditing the actual safety practices against an individual company's SMS (Fry & Killing, 1989). By the end of the safety audit, the administration draws conclusions about an organization's safety performance, based on the observations of safety practices in

the land-based office and vessels, thus enabling the HSC organizations to understand the outcomes for continuously improving their safety performance (IAEA, 1999).

Specifically, the ISM Code claims that improving an organization's safety culture is a way towards improving safety performance in implementing the SMS, thereby understanding safety culture is necessary for an effective safety management and the key to effect the continuous improvement of the SMS (Eurocontrol, 2006; Helmreich & Merritt, 2005; Reason, 2000; Williams, 2008).

CHAPTER III: LITERAURE REVIEW

3.0 Introduction

This Chapter begins with a review of literature on the relevant theories of organizational culture and organizational climate, safety culture and safety climate, and the related theories of safety culture in association with the dependent elements, including the Safety Management System, SMS continuous improvement, safety performance and human-related accidents.

An overview is also given to a few models of safety culture from the related academic and applied literature for understanding the influences of safety culture, and identifying the dimensions of safety culture for constructing a conceptual framework appropriate to this research study. Accordingly, hypotheses of the study are formulated for measuring and analyzing the effects of safety culture on the organization's safety performance

3.1 Organizational Culture and Organizational Climate

3.1.1 Organizational Culture

Over past decades, many different concepts about culture and its impacts upon organizations have come about. In a review of the literature, organizational culture was defined differently across various disciplines of myriad industries (Guldenmund, 2000). Due to conceptual diversity, some authors defined organizational culture as "*shared values, assumptions, belief and norms that could influence employees' attitudes and behaviours*" (Doherty & Chelladurai, 1999). Other authors expressed similar thoughts and believed that it would influence employees' attitudes and behaviours (Cooper, 1999; Guldenmund, 2000). Amongst other definitions, it was however viewed in a slightly different way by some authors who considered culture of an organization as "*an aggregation of symbols, heroes, rituals on different outer layers that were seen as visible practices, while the norms and values which were not visible at the central core*" (Hofstede, 1991).

In fact, there is no commonly agreed definition of organizational culture. Amongst the many definitions, Wilson (2001) describes that the elements of organizational culture are laid on two separate layers. An inner layer with the shared basic assumptions and values is invisible and characterized as culture, while an outer layer is observable and referred to as

climate (Wilson, 2001). Based on this, organizational culture can be viewed as a consistent behaviour pattern of employees who are characterized by their shared values and common beliefs that influence their attitudes and behaviours.

3.1.2 Organizational Climate

Due to the divergent views of different authors, there is no unanimity on the definition of organizational climate. For example, some authors defined organizational climate as a measure of the shared perceptions of an organization's policies, procedures and practices (Reichers & Schneider, 1990), and a few others referred it as a combination of the attitudes and behaviours that could affect different organizational processes, such as in the communication, learning, and other similar activities (Ekvall et al., 1983).

Having studied the views of different authors on the definition of climate in the organizational context, the present study views it as the shared perceptions of the workplace atmosphere that is created based on the culture of a particular organization. With a positive attitude towards safety, employees at all levels within an organization should care for their roles to play in safety and commit to safety.

In essence, organizational climate tells what happens in an organization by the visible practices and behaviours of employees, while organizational culture explains why something happen in a way by their latent assumptions and values (Schneider & Gunnarson, 1991). From the safety management perspectives, culture and climate of an organization impact the effectiveness of safety policies, procedures and practices, which in turn, affect employees' attitudes, behaviours, and an organization's on-going safety performance (Eurocontrol, 2008).

3.2 Safety Culture and Safety Climate

3.2.1 Evolution of Safety Culture

The concept of safety culture was coined by the International Atomic Energy Agency (IAEA), in the course of an initial analysis report into the nuclear reactor accident at the Chernobyl Nuclear Power Plant in 1986 (Hamaideh, 2004; Mearns et al., 2001). The disaster was attributed to the organizational errors and operator's deviation from the operating procedures, and it was concluded as an ineffective safety culture at workplace leading to the poor safety performance of the organization (Dupre & Le Coze, 2007).

The importance of safety culture was underlined after a series of disastrous accidents in different industries (Guldenmund, 2000). Investigation into some catastrophes, including the nuclear accident at Chernobyl in 1986, the fire at King's Cross Underground in 1987, the explosion on the oil production platform of "Piper Alpha" in 1988, and the sinking of "M.V. Herald of Free Enterprise" in 1987 in the maritime world, led to the conclusion that unsafe behaviours, such as deviating from the company's codes of practice and procedures were largely attributed to the ineffective safety culture of the organizations (ACSNI, 1993; Cox & Flin, 1998; Dupre & Le Coze, 2007; Flin et al., 2000).

Over the past two decades, research on safety culture has been one of the most important developments in a number of high-risk industries. The concept of safety culture has brought about new methods of conceptualizing the process of handling and managing risk in many contexts, including the aviation and maritime industries for continuous improvement in safety (Helmreich & Merritt, 2005; Mohaghegh, 2007).

3.2.2 Safety Culture as Subset of Organizational Culture

Safety culture is a subset of organizational culture (Ahmad & Gibb, 2003). This cultural subset is viewed as part of the organizational culture, which can influence employees' attitudes and behaviour (Eurocontrol, 2008; Mohamed, 2003).

Safety culture remains a cultural subset in organizations, unless otherwise safety is the dominant characteristic of the organizational culture. In certain high-risk industries such as the aviation or maritime industry, an industrywide homogeneous safety culture is thus required.

3.2.3 Safety Culture Defined

There are myriad safety culture definitions in the literature due to different research perspectives, scopes and subjects in many industries (ACSNI, 1993).

Some authors defined safety culture of organizations as "*reflection of values and beliefs, attitudes and perceptions of safety that employees would share*" (Cox & Cox, 1991), other authors viewed it as a shared perception throughout an organization, such as in Cooper (2002a)'s Business Process Model of Safety Culture.

Although the concept of safety culture was popular in the early 1990s, it had not been known until the enforcement of the ISM Code in the maritime industry in 1998. It was then defined by the International Chamber of Shipping as *"the values that management and employees should share and practice in order to reduce risks to a great extent"* (IMO Symposium, 2013).

For this study, safety culture refers to the employees' underlying values and beliefs in safety. In other words, it is the way that safety is perceived, valued, and committed by employees at all levels in an organization, thus having a direct influence on an organization's safety performance, and influencing employees' views on their preference in action.

3.2.4 Evolution of Safety Climate

The term safety climate was firstly defined in 1980 by Israeli Zohar as "*a summary of molar perceptions that employees would share about their work environments*" (Zohar, 1980). During the 1990s and early 2000s, many studies on safety climate were published, in which measures of safety climate were used as substitute measures for safety culture.

Practicality dictates that safety climate becomes a major determinant of safety culture due to difficulties in measuring safety culture per se (Zohar, 1980). Presently, scholars and researchers apply the concept of safety climate to many studies and reports on the issues of human resource management and safety performance in different nature of organizations in different industries (Reason, 1998; Sorensen, 2002).

3.2.5 Safety Climate Defined

Safety climate is conceptualized in a variety of ways. Over past decades, views of different scholars and researchers on the definition of safety climate were various. For examples, safety climate was defined by the Mearns et al. (1997) as "*a snapshot of an organization's state of safety providing an indicator of the underlying safety culture of an organisation*" (Mearns et al., 1997), while the Cox & Flin (1998) viewed it *as "a person's mood which would change in response to external events*" (Cox & Flin, 1998). Some others described it as a system of safety practices implemented by all levels within an organization (Cooper & Phillips, 2004), differently from Zohar (1980)'s.

Although the interpretation of safety climate varies with context, there are commonalities

and similarities amongst the elements (Lee & Harrison, 2000). Based on several scholars, safety climate is defined as "*a subset of safety culture having a direct influence on the employees' shared perceptions of the organization's safety culture, like company's policies, procedures, and practices relating to workplace safety*" (Huang et al., 2006; Tohidi & Jabbari, 2012; Zohar, 1980).

3.3 Safety Culture versus Safety Climate

Although the terms "Safety culture" and "Safety climate" look similar, they are two different concepts with their distinctions between the underlying beliefs of employee's attitudes versus employee's practices at workplace (Bhattacharya, 2012; Zohar, 1980). Hence, safety culture looks as if more embracing than safety climate, as safety culture is the underlying safety beliefs and values of employees at a deeper level than safety climate, while safety climate is more superficial than safety culture (Glendon & Stanton, 2000). However, some authors were confused with these two terms in the literature, so that they used them interchangeably in many areas of the safety literature (Guldenmund, 2000; Mohamed 2003).

3.4 Reflection of Safety Culture by Safety Climate Survey

Safety culture consists of the psychological, behavioural and situational components (Hashim et al., 2009). The psychological factors, like employees' attitudes and perceptions of safety are the measures of safety culture, capable of being measured intrinsically on a quantitative approach by questionnaire survey (Stewart, 2002), while behavioural factors are measurable extrinsically by the model components of safety culture, or safety checklists to verify whether safety performance is improving (Faridah & Torrance, 2004). As Cheyne et al. (1998) said, "*Employees' attitudes and behaviours remain important measures of safety culture, which form the environment for individual safety attitudes and behaviours to develop and promote*" (Cheyne et al., 1998).

Safety climate is not only a measure of safety culture, giving a meaningful predictive indicator of an organization's safety culture, it has a direct influence on the employees' shared perceptions of an organization's safety culture. Furthermore, employee's perception may serve as a guide to decide workplace behaviours, which is one of the factors' characteristics of safety culture under the Cooper (1993)'s Reciprocal Model of Safety Culture. Schneider and Reichers (1988) added that "*Perception is a frame of reference for gauging the appropriateness of behaviour*" (Schneider & Reichers,1988). Therefore, it is

important to identify employee's perception of organization's safety performance as it represents a major issue influencing human performance of safety, and a measurement for an organization's safety climate.

Hence, employee's attitudes and perceptions of safety in the workplace are used to provide measures of an organisation's safety climate, ultimately measures of safety culture underlay it (Flin et al., 2000; Guldenmund, 2000; Neal et al., 2000; Tohidi & Jabbari, 2012; Zohar, 1980).

For this study, measures of safety climate may be more appropriate on a quantitative approach by the questionnaire survey to reflect safety culture of organizations (Huang et al., 2006). The unit of sampling is the HSC Officers from whom the author collects data, and the unit of analysis is the safety performance at the organization level. The HSC Officers are the high-ranking shipboard employees, representing the key elements for measuring and assessing the shipboard safety performance of organizations. The author through investigating the HSC Officer's perceptions of organization's safety culture may understand how organizations can improve their safety performance.

3.5 Cultural Subsets

According to the Schein's theory of multiple cultures, cultural subsets co-exist with the dominating culture of an organization (Schein, 1996). Even safety is the dominant characteristic of organizational culture in certain high-risk industries, such as the aviation and maritime industries, there may be different work groups who have different levels of concern for safety in an organisation (Gherardi & Nicolini, 2000). Therefore, an industrywide homogeneous safety culture hardly exists (Cooper, 2002b) due to different cultural subsets that may exist in any discipline or department of an organization. It is likely that different cultural subsets may view risks differently, or even conflict with different subculture components, thus not unitedly striving towards the goal of maximum safety.

A number of studies identified the presence of different cultural subsets within an organization, and suggested an absence of cohesive safety culture. It was evidenced in the Chernobyl Nuclear Explosion 1986 that more than two cultural subsets, including management culture and worker culture were identified and supported the Schein's theory

of multiple cultures (Harvey et al., 1999; Schein, 1996). These two distinct cultural subsets initiated conflicts between management and workers of the organization.

Each cultural subset may have different goals, whereas different groups of employees may be of different perceptions, beliefs and attitudes in relation to safety, subject to their demographics. Hence, cultural subsets may arise from different working conditions, job positions, genders, ages, or even personal interests. For example, cultural subsets may develop when employees experience different working conditions in an organization. Often, the terms and conditions of the sub-contracted workers are inferior to those employed by an organization, such as not being entitled to any paid-holiday or sick leave pay. For this reason, employees in the same discipline or department of an organization may not act and respond in about the same ways to any given circumstance, though they have similar dress codes (Compton, 2007).

Professional subculture does exist within the HSC organizations. For example, the certificated HSC Officers of the Safety Department are in their beliefs that they should properly discharge the shipboard and navigational duties by exercising their own knowledge and skills ethically. In contrast, the traffic controllers of the Operations Department expect the HSC Officers to strictly follow the rules set in the company's code of procedures. Such a difference in perceptions makes the HSC Officers act and response differently from what the organization prescribes. The contrast is likely because of different beliefs versus practices between the two departments, as well as their different levels of risk, thus affecting the level of compliance with safety and the way safety is managed.

In essence, employees in different departments may see things differently, even though they are subject to the same policies and procedures. Due to different goals (e.g. the Safety Department may prioritize safety before productivity, while the Operations Department may perceive productivity more important than safety), cultural subsets within an organization may lead to misunderstandings, and ultimately conflicts amongst employees. It is thus arguable that all individuals within an organization share a common set of values and beliefs regarding safety.

3.6 Effective Safety Culture

Safety culture is effective when every employee believes that safety is a core value, not

prioritized nor sacrificed. In an effective safety culture, safe operation of ships and pollution prevention from ships remain the top priority in the agenda of any marine activities or meetings. To succeed, the employees ashore and afloat should understand the purpose of the safety procedures as documented in any code of safety practice, and the safety practice at all levels in an organisation should support the shipboard environment that encourages employees onboard to proactively care their own and others' safety. Rather than following the set procedures subserviently, employees should always think about safety implications of every action, and take a proactive stance to safety as opposed to a reactive attitude.

Authors, like Pidgeon and O'Leary (2000) identified 'Management commitment' and 'Organizational learning' as key factors that influenced the development of an effective safety culture (Pidgeon and O'Leary, 2000), while the Health and Safety Commission (HSC) and the Advisory Committee on the Safety of Nuclear Installations (ACSNI) agreed that organizations with an effective safety culture should exhibit the characteristics of "Shared perceptions of the importance of safety, Communication founded on mutual trust", and "Confidence in the efficacy of preventative measures" (ACSNI 1993; HSC, 1993). In contrast, organizations with an ineffective safety culture did not consider safety a value but prioritized profitability (Wiegmann et al., 2007).

Hence, management ashore and afloat if not sharing the same beliefs about safety, employees will not trust each other. Eventually, safety is believed to be someone else's responsibility. Such an ineffective safety culture may render an organization more vulnerable to accident.

3.7 Correlations of Safety Culture with Safety Management System, SMS Continuous Improvement, and Safety Performance

Since an enforcement of the ISM Code in 1998, the term "Safety culture" has been known to the maritime industry. According to the ISM Code, the code application should promote the development of an effective safety culture in the operating organizations for the success of the SMS continuous improvement (FAA, 2009; ICAO, 2005; ISM Code, 2002).

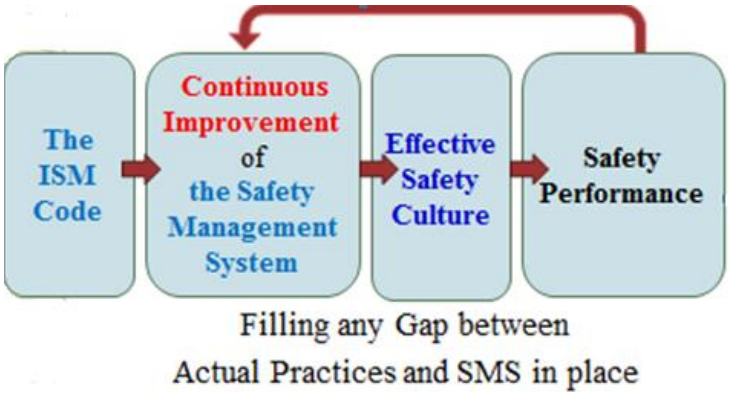
Von Thaden and Gibbons (2008) suggest that an effective safety culture leads to safety performance of employees, which in turn enables the continuous improvement of an organization's SMS, thus eliminating or mitigating human error in maritime casualties and

pollution incidents (ISM Code, 2007; Williams, 2008).

Figure 3.7 – *The Philosophy of the ISM Code* illustrates the philosophy underlying the ISM Code that the company's SMS can assure safety performance compliance when the safety culture is effective. In the flow diagram, continuously improving an organization's safety culture is an effective way to improve its safety performance when implementing the SMS, which in turn attains an effective safety culture to effect the SMS continuous improvement (Helmreich & Merritt, 2005; Reason, 2000).

To identify and bridge any gap, operating organizations should assess the actual practices at workplace versus the SMS in place. Hence, it would be better to know how the concept of safety culture relates to the SMS, the SMS continuous improvement, the safety performance, and the human error.

Figure: 3.7 – The Philosophy of the ISM Code



3.7.1 Safety Culture relating to Safety Management System

According to the ISM Code, each organization should compile own Safety Management System (SMS) which should include safety policies, procedures, and shared practice between management ashore and afloat for maintaining and improving the safe operation and management of vessels (Jackson, 2008).

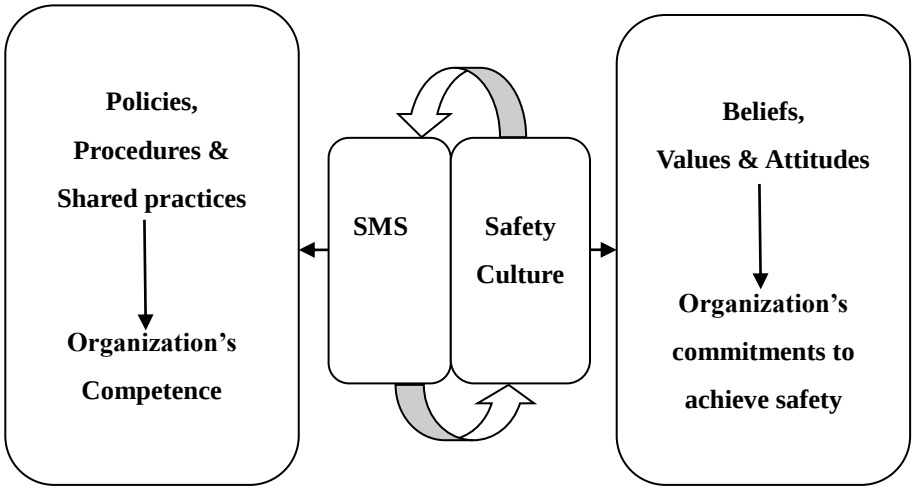
An effective SMS should promote and support a culture of safety practice which encourages and motivates employees to regard safety as their values (IMO Symposium, 2013). For example, the HSC organizations introduced a pre-departure checklist into the company's SMS for the HSC Officers to check all navigational equipment before vessel departure, so as to promote and support a culture of safety practice in the industry. Hence,

an effective safety culture may act as an engine driving employees to follow the safety management system in practice towards the goal of the ISM Code for the SMS continuous improvement (Reason, 2013; Skybrary, 2019). Meanwhile, the effectiveness of the SMS is dependent on, and influenced by the prevailing safety culture (Durham et al., 2006; Eurocontrol, 2006; Shappell & Wiegmann, 2006; Von Thaden & Gibbons, 2008).

Both safety culture and the SMS of an organization interact with each other to influence the way employees behave (Shappell & Wiegmann, 2006). As indicated in Figure: 3.7.1 - *Linkage between Safety Culture and SMS*, the company's SMS affects the effectiveness of the policies, procedures and shared practice of safety, and the safety culture influences an organization's commitments to achieve safety. They are closely related and inter-dependently complimentary to each other (Kennedy & Kirwan, 1998). For example, the company's SMS sets rules of conduct, while the safety culture supports the rules to be properly implemented. Their relationships imply that the SMS can be effectively implemented only if an organization's safety culture is highly and positively perceived by employees, and safety culture is effective only if everyone believes that safety is the value, and strictly follows the set procedures (Kennedy & Kirwan, 1995).

In essence, safety culture remains important even though the SMS is in place. It is because the SMS of an organization is only a documented system of risk control, which may not reflect the actual practice at workplace. Moreover, employees' safety attitudes, beliefs and perceptions are influenced by a safety culture of an organization.

Figure: 3.7.1 – Linkage between Safety Culture and SMS
Sourced from: Kennedy & Kirwan (1998)



3.7.2 Safety Culture relating to SMS Continuous Improvement

Safety culture referring to the concept of continuous improvement is an indicator of the continuous success of the SMS (Winchell, 1991). In other words, safety culture may be viewed as "*a process of striving for the SMS continuous improvement"* (Cooper, 2002a).

In the ISM Code, the concept of continuous improvement serves as the base for an effective safety culture (Anderson, 2003; ICAO, 2005). Weinstein (1997) claims that "*continuous improvement is a process of continually identifying problems, analyzing the performance of operation, and applying corrective recommendations to improve safety performance*" (Weinstein, 1997). For example, reporting hazardous occurrences or near misses remains an integral part of the SMS continuous improvement (Chapter 369AX, 1998; IMO, 2008a). As the ISM Code requires, an organization's SMS should have documented procedures for ensuring that non-conformities, hazardous occurrences or near misses, and accidents are continuously reported, investigated and analyzed (Anderson, 2002). Williams (2008) stresses that "*improving safety culture should optimize reporting and investigations*" (Williams, 2008). With an effective safety culture, all ranks of staff should feel responsible for their safety performance compliance to continuously improve the SMS of an organization (Eurocontrol, 2006; Helmreich & Merritt, 2005; IMO Symposium, 2013; ISM Code, 2014).

In essence, the SMS continuous improvement is an on-going effort to improve an organization's safety performance. In the HSC industry, the HSC Officers are crucial to the continuous success of the SMS. Without understanding their safety attitudes and behaviours, safety performance in terms of safety practice can hardly be improved. Thereby understanding the factors of safety culture is crucial to an effective SMS, which in turn, is the key to success of the SMS continuous improvement.

3.7.3 Safety Culture relating to Safety Performance

Safety performance is an indicator of safety culture grounded on the concept of the SMS continuous improvement (ISM Code, 2007; Winchell, 1991). In the workplace, safety culture influences employees' safety performance in terms of their attitudes and behaviours to comply with the SMS policies and procedures relating to safety.

Basically, safety performance in terms of safety practice is determined by examining the

level of safety culture against the objectives of the SMS (Gherardi & Nicolini, 2000; ISM Code, 2007). For example, adequate resources for safety should be supplied to support the shipboard functions. In an effective safety culture, safety performance is demonstrated when an organization can provide adequate resources to support safety performance of employees according to the safety procedures stated in the company's SMS.

Figure: 3.7.1 - *Linkage between Safety Culture and SMS* shows that when the company's SMS embodies an organization's safety competency in safety policies, procedures and shared practices of safety, and safety culture represents the organization's commitments to achieve safety, individual employees at all levels will be responsible for their safety performance to continuously improve safety, thus optimizing safety performance is achievable by improving safety culture.

He et al. (2012) suggests that there is a linear relationship between safety performance and safety culture. It was revealed in their study that accident rates declined significantly with the improved elements of safety culture, thus proving the effects of safety culture on safety performance (He et al., 2012). It was proposed by Griffin and Neal (2000) that the determinants of safety performance should be knowledge, skills and motivation that could be derived from the elements of safety culture. Hence, an effective safety culture can encourage knowledge and skill enhancements, such as through motivation to increase employee involvement in safety activities, like safety training workshops or courses, which in turn, may increase employee's safety performance compliance (Griffin & Neal, 2000).

Although the SMS is in force in a number of industries, including the maritime transport, the further enhancement of safety culture remains important for safety performance. The SMS of an organization is merely a written document that provides for expectations on the safety of operation and the skillful management of vessels, but it is incapable of assuring safety performance compliance. It is likely that employees do not properly follow the documented procedures. Anderson (2002) stresses that a good safety performance is about "*employees' behaviours building safety culture which ultimately promotes safe ships and clean oceans*" (Anderson, 2002). Hence, an approach to improving safety culture would better focus on the artifacts of human behaviour.

3.8 Safety Culture relating to Human Error

The maritime transport accounted for over 90% of the global trade (IMO, 2012), but

human errors held responsible for up to 80% of all marine accidents (Aldwinckle, 1990; Bradley, 1994; Hunt, 1995; Pyrke, 1995; UK P&I Club, 2005).

Several tragic marine accidents urged the enforcement of the ISM Code in 1998 (ISM Code), and reminded the maritime world of the human factors, the need to address human error in accidents and to promote safety culture for improving maritime safety (Lardner, 2003).

In the case of the Car Ferry "Herald of Free Enterprise", there was one missing element left to be blamed from the accident. It was human error (Goulielmos et al., 2012). In this accident, analysts could not blame the flag state, as the incident vessel flew the red ensign, and classed with the Lloyds Register. The ship was aged seven, managed, operated, and manned by a British operating organization known as the "Townsend Car Ferries Limited". The location of the accident was just several miles away from the Port of Zeebrugge, Belgium. At that time of accident, the weather was good and the sea was light. It sank with the loss of 193 lives in March 1987. The accident signified serious deficiencies or errors in the management of the operating organization. Human error was adjudicated as the direct cause (DOT, 1988; Gill & Wahner, 2012). It was judged by the court as "*the sloppiness from top down to bottom at all levels*" (Sagen, 1999). As a consequence of lacking safety culture among the ship's crew and the shore-based management, the court inquiry into the "M.V. Herald of Free Enterprise" placed a heavy blame on the management ashore (DOT, 1988; Gill & Wagner, 2012; Sagen, 1999).

In the same year, the sinking of the Ferry "M.V. Dona Paz" after collision with a tanker in the Philippines claimed 4,341 lives. It was the highest death-count of any marine accident in the maritime history. After two years, the US Tanker "Exxon Valdes" grounded as a conclusive result of human errors induced by managerial faults in the shore-based management. Several years later, two more cruise ships were lost. Respectively, fire in the Car Ferry "Scandinavian Star" caused the deaths of 158 people in April 1990, and the capsizing of another Car Ferry "Estonia" killed 852 people in September 1994 (Gill & Wagner, 2012; Worse Maritime Disaster, 2008).

The latest tragic crash of the Ferry "Thomas Aquinas" with a cargo ship off the Port of Cebu, the Central Philippines killed more than fifty lives in 2013 (The Sea, 2013). The accident was described as having the breakdown of the organization's safety culture. These

accidents remind the maritime industry of the importance of human factors, and the need to promote safety culture for ensuring maritime safety.

Decades ago, accidents were primarily caused by engineering failure in many high-risk industries (Lardner, 2003), such as in the field of aviation and the maritime world. Evidently, the engineering efforts have greatly reduced the rate of technical failure, and the effectiveness of the engineering solutions has highlighted the crucial role of human error in accident causation (Gadd & Collins, 2002; Hoyos, 1995).

Findings in the recent years revealed that accidents were mostly rooted in human error of omission or commission, initiated from a variety of causes, rarely attributable to unsafe physical or mechanical conditions (Ayres & Kleiner, 2002; Garavan & O'Brien, 2001; Goulielmos et al., 2012). Therefore, it is possible to remove the causes one by one, in order to reduce marine accidents.

Perrow (1984) relates safety culture to human error in accidents, and describes human error as a significant contributory factor in many maritime incidents or accidents at sea (Perrow, 1984). At workplace, safety culture influences employees' attitudes and behaviours in choice of action. Employees' behavioural issues should be properly addressed. Hence, a good understanding of the organization's safety culture is crucial in the safety management system for preventing human errors in accidents (Reason, 1990).

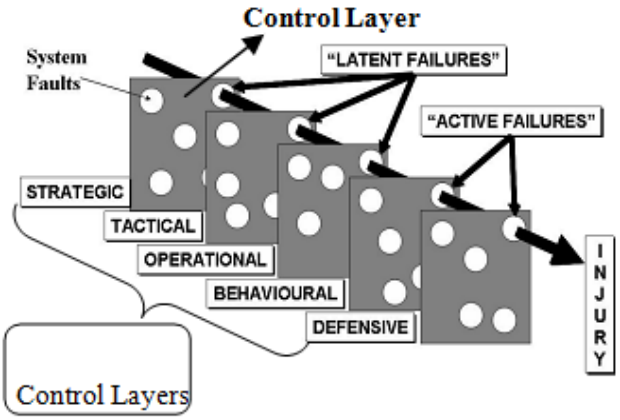
3.8.1 Accidents relating to Entire System

In history, accidents in different industries, such as in aviation was not caused by a single human error or technical failure, but attributable to multiple contributing factors or causes (Antao & Guedes Soares, 2003).

The Reason (1990)'s Swiss Cheese Model supports that accident is a chain of failures or errors in the system. As indicated in Figure: 3.8.1 - *The Swiss Cheese Model of Accident Causation*, a series of control layers serve as organization's defenses against failures. The holes in each layer represent weaknesses or faults in the system, which allow an accident to happen. To prevent accident from happening, there should an adequate number of layers without holes in each of the layers. Both latent and active failures are present in each layer. Latent failures can be the environment for unsafe acts, such as poor supervision or communication, while active failures are unsafe acts through making errors, like decision

errors.

Figure: 3.8.1 - The Swiss Cheese Model of Accident Causation
Sourced from: Reason (1990)



At workplace, employees may commit errors or unsafe acts that may not lead to catastrophic results or accidents (Helmreich & Merritt, 2005; Reason, 1990; Shappell & Wiegmann, 2006). On the other hand, Geller (1997) in his theory of Serious Accident suggested that there should be 30 minor injuries for every three hundred unsafe acts, and one serious injury for every thirty minor injuries (Geller, 1997). In this sense, there should be one serious injury for every 300 unsafe acts. Reason (1988) also thought it as an aggregate of small errors in either technical failure or human factors, or both (Reason, 1988).

In essence, an accident may not be one single human error or technical failure, but combined effects of human, technical and organizational factors of safety (Amaldi et al., 2007).

3.8.2 Accident relating to Frequency of Risk of Accident

Accident means any casualty or marine incident that endangers the safety of vessel, any person or the marine environment (MAIB, 2018), while risk is a hazard which is a matrix of frequency of occurrence and consequence of an event, known as a probability of accidents (ISO, 1999). It is arguable that low or zero rate of accident over a period may not be low risk, or indicates that risk of accident is being effectively controlled (Eurocontrol, 2015; Hudson, 2001; Thomas, 2001). As a matter of fact, the time-bomb disaster in the Chernobyl Nuclear Power Station was a typical failure of reporting risks. In a culture of silence, employees did not discuss any incidents, accidents, or even safety at the nuclear

power station. Everything appeared safe as if no accidents happened at all. A conspiracy of silence was more than three decades until the outbreak of the catastrophic explosion in 1986. The attitudes and behaviours of the Chernobyl's employees were the root cause.

Table: 3.8.2 - The Statistics of Accidents involving the HSC between 2001 and 2016 revealed a low rate of serious marine accidents involving the HSC. Only about one case per year on average was reported over the past 15 years, which was acceptable to the High-speed Craft Consultative Committee (HSCCC, 2016).

Table: 3.8.2 - The Statistics of Accidents involving the HSC between 2001 and 2016
Sourced from: the High-speed Craft Consultative Committee (HSCCC)

Incident fast Ferries	**Year of Accident**	**Nature of Accident**
Universal MK 2003	Aug 2016	Vessel Collision
HORTA	Oct 2015	Unknown submerged object
CACILHAS	June 2014	Aground
Universal MK 2013	May 2014	Collision
MADEIRA	Nov 2013	Underwater unknown object
URZELA	Dec 2012	Light Buoy
LILAU	May 2012	Vessel Collision
Local HSC	Oct 2012	Collision
Local HSC	In 2011	Collision
Universal MK 2011	Dec 2011	Collision
Universal MK 2008	Dec 2010	Man Overboard
Cotai Strip "Cota Gold"	Mar 2009	Collision
Cotai Strip "Expo"	July 2008	Vessel Collision
SANTA MARIA and FUNCHAL	Jan 2008	Vessel Collision
Universal Mk 2008 & Universal Mk 2010	May 2007	Grounding
Local HSC	June 2006	Collision
NAN SHA 38	Feb 2005	Collision
NAN HUA	Mar 2005	Collision
SAO JORGE	July 2003	Sudden Landing
TAIPAI	July 2003	Collision
URZELA	Oct 2002	Sudden Landing
CACILHAS	Aug 2001	Sudden Landing

In essence, accidents and risk of accidents are two separate circumstances in the context. Risk consists of both probability and severity. Though a relatively low death and injury rates of the Hong Kong registered-high-speed passenger craft industry are reported, risk of accidents stays high in the crowded waters of Hong Kong, such as maneuvering at high speeds in the Victoria Harbour (Dupree & Le Coze, 2007; Eurocontrol, 2015; Marx, 2009). A serious marine accident can be catastrophic leading to a large-scale maritime loss of lives

at sea (Antao & Guedes Soares, 2003). Hence, a low reported rate of accidents or even accident free in any period of years does not indicate a low risk of accidents (Thomas, 2001). The situation will be more concerning when people become complacent with less vigilance against safety measures because fewer accidents are reported (Yip, 2012).

3.8.3 Accident Investigation relating to Safety Culture

For investigating human factors in accidents, there are mechanisms available in the maritime industry. The IMO has a standard process for investigating human factors in accidents, known as the "IMO process for investigating human factors". This accident investigating process integrates several human factor models, including "the Hawkins' Model of SHEL" (Hawkins, 1987), "the Reason's Model of Accident Causation" (Reason, 1990), "the Rasmussen's Model of Taxonomy of Error" (Rasmussen, 1987), and "the Reason's Generic Error Modelling System" (Reason, 1987).

Although mechanisms are available, marine accident investigations do not often examine the underlying causes of accident. In a review of the accident investigation reports involving the HSC between 2001 and 2016, the contributory factors were judged on the count of defendant's negligence in compliance with the appropriate rules of navigation, without caring much for the impacts of safety culture upon human acts or errors of omission or commission (Preliminary Inquiry, 2008).

Examples as listed in Table: 3.8.2 – *The Statistics of Accidents involving HSC between 2001 and 2016*, the HSC "Universal MK 2003" was judged not observing the Rule 5 ("*to keep a proper look-out*") and the Rule 6 ("*proceeding at a safe speed*") of the COLREG 72, in collision with a fishing vessel while in Chinese waters in August 2016 where the visibility was poor during the thunderstorms. Other examples, the HSC "Urzela" was concluded violations from the Rule 19 ("*conduct of Vessels in Restricted Visibility"*) and the Rule 6 ("*proceeding at a safe speed*") in collision with a light buoy in poor visibility in December 2012. The HSC "Lilau" was determined not observing the Rule 5 ("*to keep a proper look-out*") and the Rule 17 ("*to take avoiding actions by the give-way vessel*"), in collision with a Chinese fishing vessel in May 2012. The HSC "Cotai Strip Expo" was convicted of failing to comply with the Rule 5 ("*to keep a proper look-out*") and the Rule 7 ("*to determine the risk of collision with a full appraisal of the situation and the risk of collision"*) of the COLREG 72, in collision with an overtaken local ferry in clear weather in July 2008.

Other than the reports of the inquiry into the stranding of the HSC "Flying Skimmer" in 1974 (Report of Marine Court, 1974) and the grounding of another HSC "Apollo Jet" in December 1989 (Report of Marine Court, 1990), marine accident investigation reports continued to be lacking for several decades until the last 20 years.

Except for the very serious marine accidents, the HSC organizations are responsible for analyzing the causes of any marine accident in accordance with the requirements of the International Safety Management Code (HSCCC, 2011; Marine Accident Investigation Reports, 2012). Whilst, an investigation report from any formal court of inquiry is not often published by the "Marine Accident Investigation and Shipping Security Policy Branch*"* (MAISSPB) of the Mardep under the "IMO Code of the International Standards and Recommended Practices for Safety Investigation into a Marine Casualty or Marine Incident" (Marine Accident Investigation Reports, 2012).

Whatsoever the causes of maritime casualties are studied, human error always comes high on the list of reports. The verdicts did not go deeper into the underlying causes for breach and / or omission of human beings. Traditional ways of improving workplace safety after accidents were to improve technical issues, impose more stringent rules, or even escalate penalty for individual human error. No wonder why as high as 80 percent of all marine accidents were traced back to human factors of safety that should be addressed and investigated (Wagenaar & Groeneweg, 1987).

3.8.4 Discussion

Traditionally, accident rates are used as the measures of an organization's safety performance. It is however arguable that accident rates are reliable outcome measures of organization's safety performance (Hudson, 2001). Thomas (2001) reminds that accident records are likely unreliable or even deceptive indicators of safety performance, as the data is likely not genuinely reported for some reasons, e.g. under-reporting (Thomas, 2001).

Accidents are mostly rooted in human error of omission or commission. The impact of safety culture influences employees' attitudes and behaviours in choice of action. Hence, safety culture relates to human error in accidents.

In fact, safety culture differs from safety outcome indicators. Safety culture influences

employees' safety attitudes and behaviours, while the safety outcome indicators present the safety results in terms of the severity and frequency of accidents, injuries, etc. Moreover, there is no evidence to suggest that organizations with a lower rated-score of organization's safety culture are less safe (Euro-control, 2015; Mitchell et al., 2002). Furthermore, an unsafe act if taken may not be the direct cause of an accident, but contributable indirectly. Such a latent factor in terms of safety culture may bring the accident rates to reach as high as 100%.

Good understanding of the organization's safety culture is crucial in the safety management system for preventing human errors in accidents, thus promoting safety culture, maritime safety can be improved.

3.9 Safety Culture Models

Presently, no prior research has been studied or any specific model has ever been built for the HSC industry of Hong Kong. A conceptual model can help facilitate the measurement and analysis of organization's safety culture.

To construct a model of safety culture for measuring the HCS Officer's perceptions for the Hong Kong context, a number of influential models of safety culture and safety climate from many scholars and researchers were studied. In a review of the literature since the 1980s, a wide range of factor composition of different models in the perception study of safety culture or safety climate was identified, with their similarities in general but uniqueness in the factor composition was observed. However, consistency in the factor composition of any model of safety culture or safety climate is hardly achieved in an industry or across industries (Cheyne et al., 2003; Flin et al., 2000).

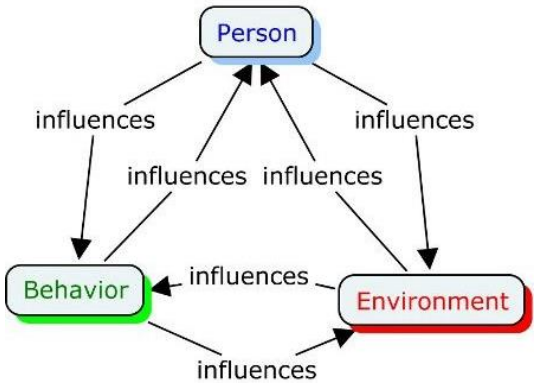
To determine the factor composition, the author constructed a table where the conceptual factors of the model of safety culture appropriate to the HSC industry of Hong Kong were assumed as the influences upon the workforce perceptions of organization's safety culture.

3.9.1 The Bandura (1986)'s Model of Reciprocal Determinism

The Bandura's Model of Reciprocal Determinism is used to reflect the concept of safety culture. It is composed of three components, operated in the theory of social learning. The theory is known as the Social Cognitive Theory (SCT) that applies to people who learn by observing others who are affected by social influences.

To determine if accident causation relationship exists amongst "Environment", "Person", and "Individual Behaviours", the Bandura's Model provides theoretical and practical frameworks for measuring and analyzing organization's safety culture, in which the three components interact with one another (Cooper, 1999; Cooper & Phillips, 1995). Through the social learning processes, behaviours of individuals will influence Environment and Person that will influence back Individual Behaviours, too (See Figure: 3.9.1 – *The Social Cognitive Theory*). Based on this model, it is found that individual employee's behaviours may influence the workplace environment that may also influence or even shape their behaviours.

Figure: 3.9.1 – The Social Cognitive Theory (SCT)
Sourced from: Bandura, A. (1986)



3.9.2 The Geller (1994)'s Total Safety Culture Model

The Geller's Model which is founded on the Bandura's Model of Reciprocal Determinism, consists of three dimensions, including "Environment", "Person" and "Behaviour". Specifically, the Geller's Model promotes the concept of Total Safety Culture, in which the dimensions of "Environment" (e.g. policy, resources at workplace), "Person" (e.g. knowledge, skills, perception), and "Behaviour" (e.g. complying, communicating, and caring) interact amongst one another (Bandura, 1986; Geller, 1994).

Basically, the Geller (1994)'s Model works in about the same way as the Cooper's Reciprocal Model of Safety Culture does in the measurement of an organization's safety culture, but replacing the Cooper's "Situation" dimension by "Environment" (Cooper, 1993; Geller, 1997). However, it is found that the Geller's "Environment" dimension is less extensive, concerned merely with engineering-related elements at workplace, compared to the Cooper's Model.

3.9.3 The Cooper (1993)'s Reciprocal Model of Safety Culture

The Cooper's Reciprocal Model of Safety Culture, which integrates three dimensions of safety culture, re-defines "Person" dimension in the Bandura's Model of Reciprocal Determinism as "Safety climate", "Environment" dimension in the Geller's Model as "Situation", and replaces "Behaviour" dimension with "Safety Behaviour" (See Figure: 3.9.3 of Appendix: B - *The Cooper (1993)'s Reciprocal Model of Safety Culture*).

Similar to the Geller's dimensions, the three Cooper's dimensions in the system interact to influence with one another for measuring and quantifying an organization's safety culture (Bandura, 1986; Cooper, 1993).

Compared to the Geller's "Environment" dimension, the scope of the Cooper's "Situation" dimension is more extensive, as the Cooper's Reciprocal Model of Safety Culture encompasses procedural and technical factors in its "Situation" dimension. Furthermore, the Cooper's "Person" dimension has other psychological elements, such as management commitment and employee's perceptions of the safety goals. Both of them are measurable by safety climate questionnaires.

3.9.4 The Cooper (1999)'s Extended Reciprocal Model of Safety Culture

The Cooper (1999) expanded his Reciprocal Model of Safety Culture, on the assumption that culture was a product of multiple interactions amongst the factors of "Person" (e.g. psychological factors), "Job" (e.g. behavioural factors) and "Organization" (e.g. situational factors) (See Figure: 3.9.4 of Appendix: B - *The Cooper (1999)'s Extended Reciprocal Model of Safety Culture*).

"Person" refers to psychological factors that are measurable by safety climate questionnaires. This construct incorporates "*individual and group values and beliefs*" with attitudes and perceptions of employees as the factors towards an organization's SMS (Schein, 1996). In practice, such psychological factors may want to know "*What employees feel safe at work?*" (Stewart, 2002).

"Job" refers to safety behavioural factors that are measurable by the model factors of safety culture, namely management commitment. Such observable behavioural factors may ask "*What employees do*?" (Faridah & Torrance, 2005).

"Organization" refers to situational factors in the model. This construct consists of internal and external factors. The internal factors measure an organization's SMS, while the policies, procedures and regulations are the external factors that influence an organization. Such situational factors may ask whether "*the organization has the Safety Policy, the SMS and procedures in place?"* (Cooper, 1999).

In this framework, each of these factors can be measured independently or in combination (Flannery et al., 2003). In which, Cooper (1999) emphasizes the interactive relationships amongst the factors of safety culture on the psychological, behavioural and situational issues (Cooper, 1999).

Similar findings from Hashim et al. (2009) reveal that safety culture is composed of the psychological, behavioural and the situational factors' characteristics of the Cooper's Extended Reciprocal Model of Safety Culture (Hashim et al., 2009), while the Hudson (2001)'s concept in the Cooper's Reciprocal Model of Safety Culture divides safety culture into intrinsic and extrinsic factors. The intrinsic factors are the psychological factors, for instances the basic assumptions and value, and the extrinsic factors are the behavioural factors, namely the norm, symbol, and behaviour (Hudson, 2001). Both the intrinsic and extrinsic factors are aligned with the characteristics of the psychological and behavioural factors of the Cooper's Reciprocal Model of Safety Culture.

In essence, Cooper (1999) distinguishes the concepts, and specifies three different factors of safety culture, including psychological, behavioural, and situational. The Cooper's Model may serve as a tool for measuring these factors of organization's safety culture (Cooper, 2000).

3.9.5 The Cooper's (2002a) Business Process Model of Safety Culture

The Cooper's Business Process Model of Safety Culture, which is founded on the Cooper's Reciprocal Model of Safety Culture, defines safety culture as a shared-perception throughout an organization (See Figure: 3.9.5 of Appendix: B - *The Cooper's (2002a) Business Process Model of Safety Culture).*

In the transformation process, an organization manages carefully the inputs (e.g. basic assumptions and values, safety behaviours) to the system where the inputs are assessed by

a set of criteria, known as the organization's goals, the SMS, safety practice, employees' attitudes and behaviours towards safety. After the process, they are transformed into a specific level of safety culture, known as outputs that create the outcome of an organization's safety culture.

In essence, employees' perceptions of the safety attitudes of management can largely influence motivation to behave safely. It is vital to know the perception of an organization's safety culture as it reflects the critical factors affecting employees' views on what are important and the organization's safety performance.

3.9.6 The Reason (1997)'s Model of Safety Culture

The Reason's Model of Safety Culture, which considers safety culture as an informed culture in an analysis of incidents, is an integration of four different cultures that interact with one another. The four sub-cultures of the informed culture are the "Reporting culture, Just culture, Flexible culture and Learning culture" (See Figure: 3.9.6 of Appendix: B - *Key Components of the Reason (1997)'s Model of Safety Culture*). They are thought to be subsumed within the psychological factors (e.g. just culture), behavioural factors (e.g. reporting culture) and situational factors (e.g. flexible and learning cultures) of the Cooper's Model (Reason, 2000), and combined to form an informed culture to affect the safety performance of an organization (Reason, 1998).

To be informed, there should be a reporting culture that is part of the informed culture to make information visible. An organization possesses a reporting culture, by which employees can report all incidents including near misses. For example, a study on the Danish and Swedish Air Traffic Control identified that the Swedish Air Traffic Control (ATC) had an effective reporting culture, while the Denmark ATC had not. It revealed that just culture was an organizational climate where a balanced blame approach encouraged and promoted employees' willingness to report, thus enabling an organization to introduce changes or even reform in the light of certain hazards.

To reflect sub-cultures of the informed culture, the Reason's Model of Safety Culture has ten factors of safety culture, including "Leadership commitment", "Open communication", "Just environment", "Employee involvement", "Learning throughout the organization, Effective decision-making process", "Actions/Implementation", "Follow-up", "Feedback" and "Reporting" (Reason, 2000; Eurocontrol, 2008).

Hence, the success of an informed culture relies on the interactive relationships amongst the four sub-cultures of the informed culture, whereas an effective safety culture of an organization should be informed, reporting, just, flexible and learning.

3.9.7 The Gordon (2007)'s Simplified Model of Safety Culture

Further to the Reason's perspective of safety culture, the Gordon's Simplified Model of Safety Culture highlights the two different situations of "*what is said about safety and what is done affecting the safety behaviour*" (Eurocontrol, 2008; Gordon et al, 2007). The conflict is underpinned by employees' beliefs about how an organisation values safety to influence their safety behaviours, and hence the observable safety outcome (Gordon et al, 2007).

As revealed in Figure 3.9.7 of Appendix: B - *The Gordon (2007)'s Simplified Model of Safety Culture*, the two different situations may lead to different tiers of safety performance in the context of reporting. In an effective safety culture, both employees and management believe that all occurrences should be reported because of "*what is believed, what is done and what is said*" in practice with a just culture supported. In contrast, management and employees do not have a common set of values and beliefs about safety if safety culture is ineffective. Their actual practice deviates from the safety policy as safety is de-prioritized and sacrificed.

In examining safety culture, focus should not be placed solely on documents, such as the Safety Management System (SMS) of organizations, it is necessary to probe employee's beliefs about safety. This is achievable through questionnaire survey or interviews.

3.9.8 The Fleming (2000)'s Safety Culture Maturity Model

The Fleming's Safety Culture Maturity Model, which is used to assess the levels of maturity of an organization's safety culture, is a sliding scale with five development levels to underpin the safety culture development from poor to excellent (Fleming, 2000).

Organizations can sequentially move to the next higher level of safety culture by increasing their strengths while eliminating the weaknesses of the previous level (Fleming, 2000). As indicated in Figure: 3.9.8, employees' responsibility for safety at workplace remains the core value of an organization. The Maturity Level One of the model is the emerging stage,

at which accidents are seen as unavoidable. The Maturity Level Two is to manage safety, at which accidents are seen as preventable. The Maturity Level Three is about involving, at which most employees accept personal responsibility for their safety. Hence, accident rates are low. The Maturity level Four is about cooperating, during which employees take responsibility for their own and the safety of others. Lastly, the Maturity Level Five is to continually improve safety culture. Hence, employees are more responsible for safety at a higher maturity level of an organization's safety culture, whereas safety performance of an organization is enhanced with an effective safety culture (See Figure: 3.9.8 of Appendix: B – *The Fleming (2000)'s Safety Culture Maturity Model*).

The Fleming's Safety Culture Maturity Model, which is commonly used to achieve a desired safety culture enhancement in the petroleum industries, has 12 factors of safety culture. It includes "Management commitment & visibility", "Productivity versus safety", "Safety resources, Participation and involvement in safety matters", "Industrial relations and job satisfaction", "Communication on matters of safety", "Focus on learning from problems rather than allocating blame, Training", "Empowerment of seafarers", "Shared perceptions about safety", and "Visible mutual trust between stakeholders" (Fleming, 2000). These factors can be used to develop a questionnaire for measuring the maturity of safety culture of organizations (ABS, 2012; Davies et al, 2001).

3.9.9 The Guldenmund (2000)'s Model of Safety Culture

Guldenmund's Model of Safety Culture is a three-layered framework, respectively the visible artefacts, espoused values, and the invisible basic assumptions at the core, by which the safety culture construct can be studied (Guldenmund, 2000). In the model framework, safety climate is distinguished from safety culture, with safety climate being the two outer layers of the safety culture construct (See Figure: 3.9.9 of Appendix: B – *The Guldenmund (2000)'s Model of Safety Culture*).

The basic assumptions of "*What is believed*" in the bottom layer form the core of the safety culture construct influence the espoused values. The espoused values of "*What is said and what is done*" in the next two layers are the employees' attitudes towards safety under the influence of safety climate, and the observable behaviour on the top layer to reflect safety performance, like evidence of safety reports (Cooper, 2000a; Guldenmund, 2000; Hashim et al., 2009).

An organisation with an effective safety culture has basic assumptions about priority of safety sharing amongst employees. To assess employee's attitudes towards safety culture, it is important to observe the behaviour and symbols while learning about the values and assumptions. It is however arguable that assessing the core basic assumptions of safety culture construct is subjective and highly dependent on the values and assumptions of the assessors (Guldenmund, 2010).

To study safety culture, Guldenmund's Model of Safety Culture has five factors, including "Management", "Safety arrangements", "Risk", "Procedures", "Training and work pressure" (Guldenmund, 2000).

3.9.10 The ATM (2007)'s Safety Culture Model

The ATM's Safety Culture Model, which is based on the organizations' practices in air traffic management (ATM), understands and enhances safety culture in the ATM.

To assess safety culture of the Air Navigation Service Providers (ANSP) in Europe, a safety culture measurement toolkit was used during the study phases. In Phase one, a review of the safety culture literature was carried out to identify the relevant factors of safety culture as a base for developing the safety culture measurement toolkit. In Phase two, employees from four different ANSPs were interviewed to identify and validate the themes relevant to the ATM. During the process, focus groups were followed to consolidate the themes, and develop an elementary set of questionnaire items. A total of thirteen themes which were identified in the interviews, served as a base for the safety culture measurement toolkit. In Phase three, the safety culture survey instrument was piloted with the ANSP's employees of the four European countries, during which the validity of the questionnaire was tested using factor analyses. Then, refinement of the questionnaire items was carried out to establish a safety culture model. Subsequently, another sample was surveyed to repeat the model. In the last phase, safety culture feedback workshops with the ANSP's employees in the study locations were conducted to further validate the themes as identified in the questionnaire.

As revealed in the survey results, the safety culture measurement toolkit was perceived as functional, and the factors of safety culture as identified in the model were supported. The model comprised 13 factors of safety culture, including "Commitment to Safety", "Resources for Safety", "Responsibility for Safety", "Management Involvement in Safety", "Teaming for Safety", "Reporting Incidents/Communicating Problems", "Learning from

Incidents", “Blame and Error Tolerance/Discipline and Punishment”, “Communication about Procedural/System Changes”, “Trust within the organization”, “Regulatory effectiveness”, “Real Working Practices”, “Involving Air Traffic Controllers” (ATCOs) in Safety” (Mearns, et al., 2013). Each of the factors influenced employees’ attitudes and behaviours in relation to safety, which in turn affected the safety performance of organizations (Eurocontrol, 2008; Gordon et al., 2007).

In essence, safety culture is crucial to influence the safety performance at the fleet level of organizations (Eurocontrol, 2006; Shappell & Wiegmann, 2006; Von Thaden & Gibbons, 2008), even though the SMS has been in force.

3.9.11 The ABS (2012)’s Model of Safety Culture

The ABS’s Model of Safety Culture, which is known as the American Bureau of Shipping’s Model, equips with a process to identify an organization’s potential leading indicators of safety. There are two approaches to conduct the process, either by correlating data of safety metrics with an organization’s safety performance data to identify the objective leading indicators of safety, or correlating responses of safety culture survey with an organization’s safety performance data to identify the subjective leading indicators of safety.

Objective leading indicators of safety are the safety metrics in association with the not desirable consequence, such as an incident or even injury. Examples include the scores of safety audit, number of safety inspections, incidents/near misses or safety meetings. Objective approach can identify which of the safety metrics are more in association with an organization’s safety performance. Hence, monitoring and improving these safety metrics can help maintain and improve safety performance (See Figure: 3.9.11 of Appendix: B - *The ABS (2012)’s Model of Safety Culture and Leading Indicators of Safety*).

In the case of subjective leading indicators of safety, the two groups are the safety culture survey responses and safety performance data. Subjective leading indicators are the employee’s safety culture perception about management supports for improving safety performance, such as the management responsiveness to safety issues. Comparatively, subjective leading indicators of safety are the preferred approach if an organization is not equipped with adequate safety metrics to support objective leading indicators of safety.

The ABS's Model, which is used in the assessment of safety culture of the maritime industry, has eight factors of safety culture in the model framework for improving safety performance. They are "Promotion of safety, Empowerment", "Communication", "Feedback", "Mutual Trust", "Problem identification", "Responsiveness", and "Safety awareness".

3.9.12 The Zohar's Model of Safety Climate

The Zohar's Model of Safety Climate proposes safety climate as employees' shared perceptions of organization's policies, procedures, and practices at a moment of time (Zohar, 1980), hence safety climate influences knowledge and motivation (e.g. expectancy, empowerment), attitudes and behaviours (e.g. participation, compliance) of individual employees at workplace.

In the Zohar (1980)'s Model of Safety Climate, there are six factors to construct the safety climate. They are "Strong management commitment to safety", "Existence of open communication links and frequent contacts between workers & management", "Distinctive ways of promoting safety", "Emphasis on safety training", "General environment control & good house-keeping", and "Stable workforce & older workers" (Zohar, 1980).

In essence, the Zohar's model refers safety climate construct as employees' perceptions of the current safety practices (Zohar, 1980), and confirms it as an impact on the factors, and through the factors of safety climate influences safety performance (e.g. safety compliance and safety participation of employees).

3.9.13 Other Models of Safety Culture and Safety Climate

More factors of safety culture and safety climate are identifiable from other influent models in different industries as follows:-

The Idaho National Engineering and Environmental Laboratory (2001)'s Total Safety Culture, which is known as the INEEL's Model of Total Safety Culture, possesses eight factors, including "Management commitment to safety", "Performance management", "Organizational commitment, "Worker Involvement", "Job satisfaction", "Training, equipment & physical environment", "Co-worker support", and "Personal accountability" (INEEL, 2001).

Pidgeon and O'Leary (2000) identified "Management commitment" and "Organizational learning" as the major components influencing the development of an effective safety culture (Pidgeon & O'Leary, 2000). While, Neal et al. (2000) in measuring organization's safety climate across different industrial sectors empirically tested a multi-dimensional model of safety climate, with focus placed on a set of factors including "Management values", "Safety communication", "Safety training", and "Safety systems" to assess the extent to which safety procedures were perceived to be effective in preventing accidents.

The International Civil Aviation Organization (1992)'s Safety Model, which is known as the ICAO's Model of Safety, maintains its effective safety culture by the factors of "Senior management placing a strong emphasis on safety", "Promotion of realistic & workable safety rules", "Senior management's willingness to accept criticism & openness to opposing views", "Emphasizing the importance of communicating relevant safety information", "Staff having an understanding of hazards at workplace", "Ensuring staff are well educated and trained so that they understand the consequences of unsafe acts", and "Senior management fostering a climate that encourages feedback" (International Civil Aviation Organization, 1992).

Other models, like Brown and Holmes (1986) after a questionnaire survey on a sample of production workers identified three factors of safety climate, including "Employees' awareness of management concern over their welfare", "Management's awareness of employees' concerns", and "Physical Risk of perception". Subsequently, Dedobbeleer and Beland (1991) validated the three factors on construction workers and found two more factors, known as "Management commitment" and "Worker participation in safety". Later, HSC (1993) and ACSNI (1993) indicated that organizations with an effective safety culture exhibited the factors' characteristics of "Shared perceptions of the importance of safety", "Communication founded on mutual trust", and "Confidence in the efficacy of preventative measures" (ACSNI, 1993; HSC, 1993; Wiegmann et al., 2007). Then, Cox and Flin (1998) identified "Management commitment to safety", "Workplace conditions", "Compliance with rules", "Personal responsibility", "Attitudes to hazards" as the main factors of safety climate.

Other scholars and researchers, including Sawacha et al. (1999), Flin et al. (2000), and Sorensen (2002) indicated in their reports of safety culture or safety climate about the influences of "Management commitment", "Involvement", "Empowerment", and

"Reporting system". Further findings from Wiegmann et al. (2002) indicated that "Organizational commitment", "Management involvement", "Employee empowerment", "Reporting systems", and "Reward system" were the most commonly recognized factors of safety culture (Wiegmann et al., 2002). Lastly, Williams (2008) revealed that "Management commitment" and "Involvement" should remain as obstacles to the SMS continuous improvement of organizations (Williams, 2008).

3.9.14 Discussion

The theories of various models of safety culture and safety climate, as well as the accident analyses have illustrated the importance of psychosocial dimension of safety culture, in which the psychosocial dimension indicates that the causes of accidents are not usually engineering failures, but mostly human factors relating to their errors of omission or commission.

It is widely agreed that safety climate reflects the psychological dimension of an organization's safety culture. In the social learning theory, the Bandura (1986) describes a triad relationship amongst the "Person", "Environment" and "Behaviour" in the model of reciprocal determinism. The Bandura (1986)'s Model of Reciprocal Determinism describes the mutual influence amongst three sets of functions where the individual's internal psychological factors, the environment where they are, and the behaviour they engage, all interact with one another in a loop.

The Geller's Model applied the Bandura's Theory, and developed the Total Safety Culture Model to explain the descriptive composition of safety culture by the three constructs (e.g. Person, Behaviour, and Environment) but the relationships among the domains were not specified. However, the Cooper's Model further developed a reciprocal safety culture model of the three constructs based on the Bandura's Model to explain the "Safety climate" as the personal construct, the "Safety Management System" as the environment construct, and the "Safety Behaviour" as the logic of the reciprocal determinism. The main differences between the Geller's and the Cooper's interpretations of the triad constructs reside in the use of the term "Environment" and "Situation". The Geller adopts "Environment" on an engineering approach, while the Cooper emphasizes on the organizational strategies and policies.

The Reason's informed culture is subsumed in the factors of the Cooper's Model to

influence the safety performance of an organization (Reason, 2000), and the Gordon's Simplified Model of Safety Culture relies on two different situations to identify different levels of safety performance. To assess the levels of maturity of an organization's safety culture, the Fleming's Safety Culture Maturity Model can also be a reference, as employees at a higher maturity level of an organization's safety culture do feel more responsible for safety.

In the Guldenmund's Model of Safety Culture, safety climate is distinguished from safety culture, with safety climate being the two outer tiers of the safety culture construct. The two outer layers represent the employees' attitudes towards safety under the influence of safety climate, and the observable behaviour on the foremost layer to reflect safety performance, like evidence of safety reports (Cooper, 2000a; Guldenmund, 2000; Hashim et al., 2009).

To examine how the operative factors affect employees' safety attitudes and behaviours, the ATM's Safety Culture Model can be based, and the ABS's Model of Safety Culture is a reference model in the assessment of safety culture of the maritime industry. Like other models, the Zohar's Model of Safety Climate refers safety climate construct as employees' perceptions of the current safety practices, and uses safety climate as an impact to influence safety performance (Zohar, 1980).

Amongst the safety culture and safety climate models in the review of literature, safety climate is a psychological indicator that reflects the internal psychological construct of safety culture. Moreover, an organization's safety climate relates to employees' perceptions of safety, which can be measured and undertaken through responses of the quantitative questionnaire survey, and then analyzed through hypothesis testing (Ooshaksaraie et al., 2009).

3.10 Conceptual Model

With no prior research previously studied or any specific model ever built for the HSC industry in Hong Kong, a review of various models of safety culture and safety climate across different industrial sectors was carried out to identify the factors appropriate to constructing a conceptual model of safety culture for the Hong Kong context.

The theoretical backgrounds underlying the various models were conceptualized differently

by different scholars and researchers due to different study purposes. Hence, different factors compositions of the models were observed. For example, some of the factor compositions of the models are comparable. They can be merged to a specific theme to reflect a factor characteristic of the new model for measuring safety culture. Namely, 'Co-worker support (INEEL, 2001)', and 'Teaming for Safety (Euro-control, 2008)' are worded differently but having about the same meanings, capable of being merged as a theme of 'Team work' for this new safety culture model.

As few as ten conceptual factors of safety culture, which are common to many organizations, have been identified appropriate to this quantitative survey. The factors are regarded as the influences upon the HSC Officers' perceptions of organization's safety performance, and are useful for the development of a conceptual model of safety culture for the Hong Kong context, by which hypotheses can be formulated for quantifying and analyzing an organization's safety culture.

The frequencies of occurrences for each factor under different models are counted (See Table: 3.10 - *Frequencies of Occurrences in Factors of Models of Safety Culture*). The conceptual factors of safety culture are management commitment, employee involvement, employee empowerment, communication, reporting, fairness, learning, teamwork, reward system, and training**.**

Table: 3.10 - Frequencies of Occurrences in Factors of Models of Safety Culture

Code	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Factors of Safety Culture / Models of Safety Culture and Safety Climate	Management Commitment	Employee Involvement	Employee Empowerment	Communication	Reporting	Fairness	Learning	Teamwork	Reward System	Training
	Frequencies of Occurrences									
Ming Jung (2017)	✓		✓	✓	✓		✓		✓	
ABS (2012)'s Model of Safety Culture and Leading Indicators od Safety (2012)	✓		✓	✓		✓	✓			
Williams (2008)	✓	✓								
ATM Safety Culture Model for the Air Traffic Management (Gordon et al., 2007a)	✓	✓		✓	✓	✓	✓	✓		✓
Sorensen (2002)	✓	✓	✓		✓					
Wiegmann et al. (2002)	✓		✓		✓				✓	
Idaho National Engineering and Environmental Laboratory (2001)'s Total Safety Culture Model	✓	✓	✓					✓		✓
Flin et al. (2000)	✓	✓	✓		✓					
Guldenmund (2000)'s Model of Safety Culture	✓		✓			✓				✓
Fleming (2000)'s Safety Culture Maturity Model	✓	✓	✓	✓		✓	✓	✓		✓
Pidgeon and O'Leary (2000)	✓						✓			
Sawacha et al. (1999)	✓	✓	✓		✓					
Cox and Flin (1998)	✓									
Reason (1997)'s Model of Safety Culture	✓	✓	✓	✓	✓	✓	✓			
ACSNI (1993)				✓				✓		
HSC (1993)				✓				✓		
International Civil Aviation Organization (1992)'s Safety Model	✓			✓						✓
Zohar (1980)'s Model of Safety Climate	✓		✓	✓						✓
Total	**12**	**8**	**11**	**9**	**7**	**5**	**6**	**5**	**2**	**6**

Regardless of the frequencies of occurrences for each factor, low frequency does not indicate less important or insignificant. For examples, management commitment has the highest frequency of occurrence which means that this factor is the most common factor in each study, while reward system has the least occurrence but proved to have significant impact upon the perceptions of the subjects in a couple of the models over the past years. Hence, there is no evidence to suggest that a factor with the least occurrence is inferior to others. It is however proved to be true for its significant role to influence safety culture of

organizations.

3.11 Related Factors of Safety Culture

The ten factors adopted and incorporated into the conceptual model of safety culture for measuring the HSC Officers' perceptions of the safety performance of organizations are discussed in the following sub-sections.

3.11.1 Management Commitment

"Management commitment", which refers to the safety value and commitment of the shore-based management, reflects an organization's ability to demonstrate safety performance with a positive attitude toward safety, and consistently promote safety within the organization.

Under the ISM Code, management commitment is the corner stone of an effective safety management system. In managing safe operations of ships and preventing pollution from ships, "*commitment, competence, attitudes and motivation*" are the keys to determine an organization's safety performance (ISM Code, 1994).

To have a good safety performance, management commitment should be positive and highly visible. As an example of ship-management, the Maersk Shipping Line incorporated additional safety measure 'Heavy Weather Checklist' in the company's SMS to facilitate ship's crew to complete risk assessment before encountering heavy weather, so as to promote a culture of safety practice in support of its core safety value (Browne, 2009). With an effective safety culture, safety performance outcome was achieved. Conversely, a few activities in the mid-nineteenth century of the royal navy were rather strange or even bizarre to polish the watertight doors of a warship until the she was no longer seaworthy. Shipmasters preferred spending large amounts from their budgeted resources for the paintwork on ships (Cashmore, 2008). It seemed to be the path to job promotion during the peacetime display culture, but undermining the Royal Navy's fighting ability from the maritime safety perspective (Cashmore, 2008). Hence, a clear commitment that safety is a value, not priority should be conveyed from the management to employees of all levels in an organization.

To maintain commitment as top priority, management should be equipped with competency. The SMS can reflect the competency of an organization in managing safety

(Eurocontrol, 2006), such as in an effective SMS, adequate resources and land-based supports to ships are continuously provided.

An effective SMS is dependent largely on the safe attitudes and behaviours of management, while the employees' perceptions of safety culture are largely related to the management's attitudes and behaviours towards safety. As O'Toole (2002) said, "*there is a close association between the management approach to safety and the employees' perceptions of the safety management*" (O'Toole, 2002). Toellner (2001) adds that conducting safety tours is a sign of commitment to the safety management, and remains an effective way. Hence, management should take an active role in promoting and keeping workplace safe by physically attending the workplace for thoroughly understanding the environment to ensure that employees are able to action all safety procedures as stated in the code of practice.

To motivate and praise employees for working safely, it was suggested that management should make safety their top priority and care for the safety of employees (Davies et al., 2001), and should act promptly to correct unsafe practices at workplace and express serious concern if safety procedures incapable of being strictly followed (HSE, 2019).

Moreover, it is the management commitment of an organization to influence the deployment of safety resources and the effectiveness of policies, procedures and practices of safety (Kennedy & Kirwan, 1998). Hence, "Resources for safety", "Responsibility for safety", and "Management involvement in safety" form parts of the management commitment.

"Resources for safety" is a kind of management commitment to make safety resources available adequately for supporting the safety operation and management of ships (Wiegmann et al., 2007). Flin (2003) considers resources for safety as a major factor of safety culture in managing an organization's safety performance, and Pun & Hui (2002) even view it as a key determinant for an organization's success in safety management.

As required by the ISM Code, there should be sufficient resources to get all works done properly and safely. To demonstrate this part of management commitment, adequate supports in terms of resources (e.g. labors and tools) and time for employees to perform the safety roles or functions in achieving the desired safety performance outcomes should be continually provided at workplace (Khan, 2017). For example, the HSC Officers are

supplied with binoculars and radar sets of equipment for maintaining an efficient lookout while on a navigational watch at sea.

"Responsibility for safety" lies with management who is the controlling mind (Petersen, 2013). Management sets the safety policy where an organization's management commitment to safety is declared. Whether the safety policy is top priority or not, depending on the employee's perceptions of management commitment (Khan, 2017). For example, management should be clear about their responsibilities for safety, while should also be strictly adhering to the safety rules in all conditions and circumstances, even under productivity pressure, such as accepting late departure or arrival of ferry schedules in adverse weather, such as poor visibility.

"Management involvement in safety" is demonstrated by the managers' participation in safety activities, such as attending safety seminars, training, in addition to their contribution to deal with the risks involved in daily operations. Hence, management involvement in safety issues is regarded as the life-and-soul of the SMS, crucial to the success of an organization's SMS (ABS, 2012; Jung, 2017).

Management involvement is also part of management commitment, which refers to the extent to which management gets personally involved in the daily safety activities (ABS, 2012; Jung, 2017). Under the ISM Code, management of an organization should designate an employee(s) as Designated Person(s) known as DP who should strictly abide by an organization's safety policy to make safety the highest priority in every safety decision (Petersen, 2013), such as ensuring adequate shore-based resources and support provided for the safety of ship operations (Hansen, 1993; ISM Code, 2007).

In essence, management commitment has been a major influence on the employees' perceptions of an organization's safety performance to build its safety culture. How employees perceive management commitment to safety in the daily operation should remain crucial (Reason, 2013; Zohar, 2000). Hence, the hypothesis is proposed as H_1: Management commitment has a significant effect on an organization's safety performance.

3.11.2 Employee Involvement

"Employee involvement" relates to employees' participation in safety activities and their discussions over safety issues which are encouraged through attending safety meetings,

risk assessments, safety audits, and incident or accident investigation by employees. All these can help improve safety performance in the workplace.

To encourage employees' participation, such as in the development and review of safety procedures and instructions, or in the decision-making process of any safety initiatives, like imposing any change on the work patterns of duty-roster, management should get employees involved in the different phrases of planning to implementation (DuPont, 1999). Then, employees are given a fair opportunity of influencing the decisions of management before implementation (Davies et al., 2001). They are consulted about their views on the safety practice, or even any change to the current procedures. It is likely that employees may feel satisfied with the workforce involvement in safety at work, and may feel obliged to attend any safety activities or discussions.

To maintain employees' enthusiastic participation, employee's safety concerns if raised in safety meetings or workplace should be timely responded to and with feedback. Organizations can be benefited from the engaged employees with higher levels of responsibility for safety and safety performance at workplace, because of their loyalty to organizations and absence from their anxiety and psychosocial issues that may arise (HSCCC, 2006; Khan, 2017).

Employee involvement is reported as one of the key factors underpinning an organization's safety performance to build its safety culture (Harvey, 2002). Hence, the hypothesis is proposed as H_2: Employee involvement has a significant effect on an organization's safety performance.

3.11.3 Employee Empowerment

"Employee empowerment" refers to the authority given impliedly by laws or expressly by contract, or employees' perceptions of delegated responsibility or authority given to them by management for improving safety performance.

Under the ISM Code, organizations should define levels of authority, from which a clear delegation of, and accountability for the job responsibilities is explicitly stated (Stevenson, 2011). For this reason, the administration of the flag state concerned believes that the ISM Code has given an adequate support for the HSC organizations to safeguard against incidents, accidents or hazardous occurrences, and the HSC Officers are expressly

empowered in the safety management operating manuals (SMM) of the SMS.

For example, the HSC Officers are empowered with responsibility and authority in all kinds of shipboard functions, including but not limited to developing plans for shipboard operation, and preparing contingencies to respond with identified emergencies (ISM Code, 1994, 2007 & 2007). Unless otherwise, they can make decisions on any safety issues that may lower productivity, without reprisal taken by management. For example, when the ferry departure or arrival is far behind schedule due to adverse weather or engineering problems, management may override their authority by scarifying safety for productivity and profits.

Empowering employees can increase employee morale, and the empowered employees feel proud of their work being valued by management, their deserved recognition being given and ultimately their sense of accountability being fostered (Ranney & Deck, 1995; Ruvolo, 2003). Once employees feel supported and empowered, they are responsible and accountable for their performance in safety, and feel obliged for the mistakes of other work-mates, too (Petersen, 2013).

Empowered employees have an active control over the safety outcomes of their job (ABS, 2012), whereas employee empowerment is a key factor that can underpin an organization's safety performance to build its safety culture. Accordingly, the hypothesis is proposed as H_3: Employee empowerment has a significant effect on an organization's safety performance.

3.11.4 Communication

"Communication" refers to a dual process of reaching mutual understandings between employees and management, through which both parties exchange information and share the feelings with each other.

Under the ISM Code, the SMS clearly defines the lines of communication between the shore-based management and shipboard personnel, where a culture of communication between ship-and-shore is established to keep the ship operation running safely and effectively (Stevenson, 2011).

In practice, there may be an extent of discrepancy in the culture of communication from

ship-to-ship, crew-to-crew, or even shift-to-shift due to the effect of cultural subsets. In the Piper Alpha disaster, there was a lack of communication between workers to report duty and workers to be relieved, despite the fact that a shift hand-over system was in place (Mearns et al., 2001).

An organization with an effective safety culture is characterized by an effective communication. Effective communication with employees can be strengthened if viable information can be taken into account according to the Gittell (2013)'s Theory of Effective Communication. As indicated in Table: 3.10.4 of Appendix: B - *the Gittell (2013)'s Theory of Effective Communication*, it is explained by the Gittell (2013)'s theory of effective communication about viable information that the dimensions of "*shared-goals, shared-knowledge and mutual respect*" can facilitate the exchange of knowledge in the communication process (Gittell, 2013).

An interactive dialogue between management and employees remains crucial to the management processes. As long as management adopts an open-door approach to communicate with employees (HSE, 2019) through an effective communication channel in place, there should be a continuous interactive dialogue between management and employees (Khan, 2017). For example, regular meetings with employees should be arranged for the purpose of establishing an effective communication (Dyer, 2001), and employees should be given the feedback about the outcomes of safety meetings (Davies et al., 2001). Sometimes, daily meetings are non-productive if the attendance of a team of employees is required for merely identifying an issue. To speed up decision making process, the information to be presented in any forthcoming meeting can be forwarded to all concerned for understanding, analyzing and interpreting the contents beforehand, with the probable solutions to be discussed only during meeting.

Communication is vital to an organization's effectiveness, and is also a tool of managing safety performance. For example, employees are timely and accurately informed of the safety knowledge, such as they are updated closely with the Maritime Safety Information (MSI) essential to their decision-making for safety performance in navigation, so that the HSC Officers can make a full appraisal of the traffic situation before making any collision avoidance decision appropriate to the prevailing conditions and circumstances (HSE, 2019).

Hence, communication is a key factor that underpins an organization's safety performance. Accordingly, the hypothesis is proposed as H_4: Communication has a significant effect on an organization's safety performance.

3.11.5 Reporting

"Reporting" is a culture in an organization where employees are willing to report incidents, accidents, or even near misses. According to the ISM Code, the goal of reporting is to avoid re-occurrence of events or serious events, such as incidents or accidents for improving safe operation of vessels and pollution prevention from ships (Pidgeon & O'Leary, 2000).

Organizations with a reporting culture consider near misses, incidents or accidents as valuable opportunities of learning lessons to prevent future incidents or accidents from happening. Hence, the role of management to play in supporting and encouraging a reporting culture is important. An effective reporting culture is dependent on how an organization handles the follow-up measures after accidents, incidents or near misses, with due regard to the treatments, whether they are either punishment or rewards.

It is arguable that employees are willing to report their mistakes (Anderson, 2003; Mearns et al., 2001; Withington, 2006). When there is an accident, the wrongdoers try to protect their integrity, as they fear that reports can be used as evidence in civil or criminal prosecutions, or even for dismissal (Anderson, 2003; Gatfield, 1999).

In practice, laws strictly judge the liability of an offender with hardly any flexibility permitted in the finding of faults. The fact speaks for itself that two local fast ferry Captains were accused of unlawfully killing 39 victims by gross negligence due to sinking after vessel collision off the Lamma Island of the Hong Kong (Chan, 2013). Similarly, a foreign HSC "Condor Vitesse" hit and sank a fishing boat off the East Coast of Jersey of the British Isles, killing the boat's skipper. Eventually, the HSC Captain was convicted of manslaughter by a French court (Davies, 2013). When applying to a more complex area of human behaviours, such regulatory regimes may lead to problems, particularly when human error is a factor of occurrence (Anderson, 2003; Hamilton, 2009). The time-bomb disaster in the Chernobyl Nuclear Power Station is a typical failure of reporting behaviours.

To encourage reporting, management should ensure that employees are familiar with the organization's system for reporting safety issues. When an employee reports a safety issue, management should act and react promptly, attend and correct the safety issue quickly, and timely communicate to all individual employees about the safety outcomes in a reasonable time (Jung, 2017).

Reporting deficiencies and non-conformities are regarded as an effective way to increase employees' safety awareness for continuously improving safety performance of an organization (Gatfield, 1999; IMO, 2008b). Hence, reporting may serve as an indicator for identifying the vulnerability of the SMS in the maritime industry (Lappalainen, 2008).

Reporting is believed to be a key factor that underpins an organization's safety performance to build its safety culture. Hence, the hypothesis is proposed as H_5: Reporting has a significant effect on an organization's safety performance.

3.11.6 Fairness

"Fairness" refers to a just culture, in which everyone is fairly treated and evaluated using the same measurement scale, e.g. an organization's performance appraisal system is used for evaluating an employee's performance against a job requirement.

An organization on a fair approach to human error in safety requires employees to be accountable for their mistakes, such as reckless non-compliance, while management handles their mistake from a coaching but not blaming perspective. It is important that management accepts liability for the mistake brought about by the managerial instructions, whereas employees in the workplace will report or uncover unsafe behaviours, and consider themselves deserving of punishment. For example, the employees of the BC Ferries reported as many as 4,500 near misses in 2013. Employees felt safe to uncover their unsafe behaviours and the mistakes of others at workplace with no fear of reprisals, as the employees were handled fairly for their mistakes in judgment (Marshall, 2013). In contrast, management with a blame culture blames human error in safety (Gatfield, 1999). Management ignores technical or system errors that are likely to cause the failure, but emphasizes errors or omissions of employees, or even finger-points to look for scapegoats (Gatfield, 1999; Mearns et al., 2003).

Blame culture exits in many organizations (Veiga, 2002). Often, blame shifts downwards in

a hierarchy or laterally between peers. If blame moving upwards from the frontline level to management, it implies that management is accountable for their instructions given to the employees.

In the maritime industry, many organizations keep counting the number of incidents as the determinant of safety performance of employees, while the SMS is regarded as a risk management strategy to manage the risks of accidents (Gatfield, 1999). Apparently, the use of accident rates for measuring safety performance alone is not a fair judgment. The number may not tell whether employees took risks to complete their jobs. In addition, management does not accept deficiencies in its risk management strategies (Shealey, 1979), but blames individual employees' mistakes without looking for the underlying cause(s) of incident or accident (Mearns et al., 2003).

Blame culture discourages reporting, but promoting the defensive behaviours of employees, not to report (Gatfield, 1999). In the psychological sense, individuals when feeling fearful or stressful are likely to display defensive behaviours (Collinson, 1999; Roberts et al., 1994). Hence, employees are not willing to report incidents because they perceive that they are not treated in a fair manner (Gordon et al., 2007).

To get rid of employees' perceptions of blame culture, management should identify the root causes and verify if any other errors that may cause the failure, rather than blaming human error without further investigation (Davies et al., 2001). Most importantly, employees understand the expected safety behaviours at workplace.

Trust is the base on which a just culture builds (Reason, 2000). In an organization, there should be a culture of mutual trust between management and employees (Jung, 2017). To build trust, management's attitudes and behaviours should demonstrate the elements of competency, fairness, integrity, and openness. For examples, management should practice a fair performance appraisal system by applying a consistent disciplinary measure to all employees who are in breach of the safety-related rules (Gordon et al., 2007). Management should make employees trust the system that it is safe to report by ensuring the confidentiality of the reporting and investigation processes (Gordon et al., 2007). And also, management should encourage free communication environment by openly conversing with employees about workplace safety, while employees can freely express their views about the safety performance of organizations.

In essence, an organization's just culture is based on a climate of trust between management and employees (Weick, 1987). As David Rock's Brain research reveals that people are influenced by those they trust. Once employees believe, they think and act accordingly. Therefore, management should care for the trustful relationships with employees.

In the ABS's Model, trust was used in the assessment of safety culture, while trust within an organization was a factor of the Fleming's Safety Culture Maturity Model, and in the ATM's Safety Culture Model (Mearns, et al., 2013).

Hence, perceived fairness is part of an organization's safety culture, playing an important role in the process of sustaining positive safety performance of organizations. Accordingly, the hypothesis is proposed as H_6: Fairness has a significant effect on an organization's safety performance.

3.11.7 Learning

"Learning" is a process of capturing, creating and transferring knowledge for continuous improvements (Gordon et al., 2007). Organizations on a proactive approach support learning (Lee and Harrison, 2000; Gatfield, 1999; Wake, 2009), such as taking the unintentional unsafe behaviours (e.g. honest mistakes) as an opportunity for learning, while the intentional unsafe behaviours (e.g. reckless non-compliance) to be subjected to the required level of sanction (Reason, 1998).

Organizations in the maritime industry have been operating on a reactive approach to safety management, rather than a proactive stance for continuously improving safety (Gatfield, 1999). In this traditional style of managing safety, risk management strategies are based on the shore-based management perception of risks to vessels. Such approach was described as in-appropriateness and insufficiency in safety, leading to the possibility of risks left un-identified (Hansen, 1993; Gatfield, 1999). What's more, organizations are rule-followers who feel worried about safety often after an incident or accident (ShamRao, 1999). For example, the port administration of Hong Kong in the aftermath of the Lamma ferry crash drafted the safety-belt provisions without taking further investigation into the underlying causes of the accident or other errors that might cause the failure (HSCCC, 2016), and organizations had no queries about the measures but put themselves in strict

compliance.

The willingness and ability of an organization to proactively learn from incidents or near-misses is critical to improving safety performance of organizations. To improve a learning culture, management should build trust that management gets to the root-causes of incidents or accidents, and handles mistake from a coaching but not blaming perspective. Naturally, it is the human nature that humans hide the evidence for self-preservation, and avoid reporting when a mistake is made (Anderson, 2003). Such an inappropriate human behaviour was learnt early at school, and was being carried on at workplace. The time-bomb disaster in the Chernobyl's nuclear power station is a typical failure of reporting non-conformities. In a culture of silence, employees did not discuss any accidents or even safety at the nuclear power station. A conspiracy of silence was over 35 years until the outbreak of the catastrophic explosion in 1986. Everything appeared safe, as if no accidents took place at all. The attitudes and beliefs of the Chernobyl's employees were the very root cause. Nevertheless, nobody admits own mistakes, lapses, or lack of awareness attributed to the failure.

To promote learning, lessons learned from incidents can be published in a newsletter or a notice to be displaced in the bulletin board (Gordon et al., 2007), while other issues of safety are shared amongst employees through reviews and/or analysis (Jung, 2017).

It has been reported that management should support learning from near miss occurrences, incidents or accidents by encouraging employees to report unsafe behaviours (HSE, 2019), thus improving an organization's safety performance to build its safety culture. Hence, the hypothesis is proposed as H_7: Learning has a significant effect on an organization's safety performance.

3.11.8 Teamwork

"Teamwork" relates to co-operation and sharing of information between the members of a team, while teaming for safety is a joint effort of a team to reach the common goal of safety, such as teaming for the safe operation and management of a vessel, like the HSC.

Benefits anticipated from teamwork are integrating efforts in solving problems, sharing of information within a team, and cooperating for continuously improving the safety practice (Waldman, 1994). In a team-based organization, employees have dual responsibilities.

Individual employees have own assigned duties to contribute towards the process of achieving a common goal, and a sense of dual responsibility for caring the safety of others (Culbert, 2003).

To achieve the common goal of safety, employees concern co-operation, support and appreciation of others (Zohar, 1980). Hence, employees work together, help others, and appreciate support from others in a team (Gordon et al., 2007; HSE, 2019; Khan, 2017).

Teamwork is likely to enhance an organization's safety culture, and is regarded as a condition for safety performance (Waldman, 1994).

Often, employees' responses are under the influences of shared-perception of safety practice (Donnelly & Kezbom, 1993). This shared-perception has a significant impact upon an organization's safety performance. For example, each of the HSC Officers in a team exercises the required ethics in performing duties of maintaining the safe operation and management of vessels. Under the peer pressure, they work safely to keep the respect of others in a team (Khan, 2017).

In a traditional organization, employees only look after own work and safety (Ranney & Deck, 1995). The mission statement may be written as "*everybody is the own safety officer*" to promote that organizations with one-sided accountability have no teamwork or obligation to help others (Culbert, 2003), while management of traditional organizations operates on a "*Command and Control approach to schedule & control, reward & punish, and hire & discharge employees*" (Donnelly & Kezbom, 1993).

Teamwork is required in the safety-critical industries, such as in the field of aviation and the maritime world. However, teamwork is hard to survive if lacking adequate resources and accountability. For example, the crash of a Korean cargo plane shortly after her take-off in 1999 was an example of no team-work spirit. The cockpit culture made the air pilots reluctant to accept interference from others. The fact that the navigating officers did not question the Captain's course of action even warnings was given from the control console due to fear of being embarrassed or reprimanded (Halsey, 2013).

To encourage co-operation and sharing of information within a group of people, management should reward each, based on group performance rather than individual

performance. Teamwork is a key factor that underpins an organization's safety performance to build its safety culture. Hence, the hypothesis is proposed as H_8: Teamwork has a significant effect on an organization's safety performance.

3.11.9 Reward System

"Reward system" in organizations is a motivating mechanism to increase employee's performance by rewarding them on the individual or group levels. It is usually tied to the outcomes of the performance appraisal scheme.

Reward system serves as the motivating mechanisms to encourage workers' safety behaviours. It may include rewarding workers' safety behaviours, praising workers' safety behaviours, setting up a safety incentive system. For example, bonus can be of a kind awarded to individuals for their fulfillment of any specific achievement, like a quarterly or half-yearly safety bonus resulting from zero accident record. Another example is that workers' participation in safety decision is encouraged. In other words, management may offer profit sharing to employees who contribute the most to the success of a company's safety campaign in navigation.

Reward system comprises the extrinsic and intrinsic natures of rewards to influence employee's commitment to organizations. Extrinsic rewards are tangible, usually financial in nature but not a part of salary. Examples include a pay rise in wages or salary, a bonus for meeting certain performance criteria, fringe benefits, paid time-off, job advancement or promotion, and recognition by others. These tangible material rewards may be explicitly encompassed in the company's reward policy.

Intrinsic rewards, which are the psychological wants, are not found in the policy. They generate motivating force associated with personal interest in the work itself, which tend to enable employees to become proactive, creative, productive, and keen for self-improvement or further development. Hence, they are the more powerful rewards.

The psychologist, Frederick Herzberg's workplace motivation theory supports that intrinsic rewards are more satisfied and stronger than extrinsic rewards for employees, and Vroom's Expectancy theory adds that employee's motivation is the outcome of how much an individual employee wants a reward. Hence, the employees are self-motivated to work at a high level of productivity to reach an expected performance.

To motivate employees intrinsically, management should provide a meaningful work with a high level of autonomy for employees. When an employee experiences one or more of the positive feelings of autonomy, accomplishment, and personal growth, the job is intrinsically rewarding.

A motivated workforce is a significant factor in organizational success. Until recently, organizations relied on extrinsic rewards as their key influence to drive motivation. Though extrinsic rewards are powerful to motivate the majority of employees to achieve the outcome, employees still expect intrinsic rewards from their jobs. To relate job satisfaction with rewards, employees feel more satisfied when they acquire a sense of accomplishment from their jobs (Amabile, 1993).

In essence, reward system has dual consequences for both individual satisfaction and organizational effectiveness. Management should understand the power of reward system, and how it is used to influence employee's behaviours. The extrinsic and intrinsic rewards are synergetic for improving performance of employees. They are said to be strategic as they influence attitudes, behaviours, performance and well-beings of employees, which in turn, affect organizational sustainability. To build a high-performing workforce, organizations should strike a balance between the intrinsic and extrinsic rewards.

Hence, reward system is a key factor that underpins an organization's safety performance to build its safety culture. Accordingly, the hypothesis is proposed as H_9: Reward system has a significant effect on an organization's safety performance.

3.11.10 Training

"Training" is a systematic activity conducted to enhance the attitudes, knowledge and skills of employees for performing a specific job, while safety training can enhance employees' safety awareness and responses, hazards and hazardous actions, and the consequences.

Training is required in any organization, as organizations rely on employees' knowledge and skills to handle problems, to initiate changes in work procedures or methods, and to take responsibility for safety. When employees' attitudes towards safety get improved, safe behaviours are likely to follow.

Identifying training needs remains the responsibility of management. Training needs are identified through the analyses of the present and future challenges in terms of trade practice under the influence of technological advance, regulatory regimes, working environment and work force competencies of an organization. To effectively identify the training needs of employees, management is familiarized with the day-to-day operation of employees. In addition, employees are consulted to establish their specific training needs (Davies et al., 2001). Once training needs are identified, adequately training up employees to meet specific job requirements with knowledge and skills is an obligation of management (Khan, 2017).

Management encourages and supports employee participation in training workshops or courses, such as providing approved training program to enable the HSC Officers to serve on each specific type of fast ferries, as required mandatorily by the administration of flag state.

After training, employees achieve the desired learning outcomes and follow the set rules and procedures in the SMS, thus helping them to reduce risks of accident and human error in accident (IAEA, 1999). The gap between the employee's performance specifications and the standard job requirements can be bridged (Griffin & Neal, 2000), and hence an improvement in the safety performance compliance of an organization can be attained.

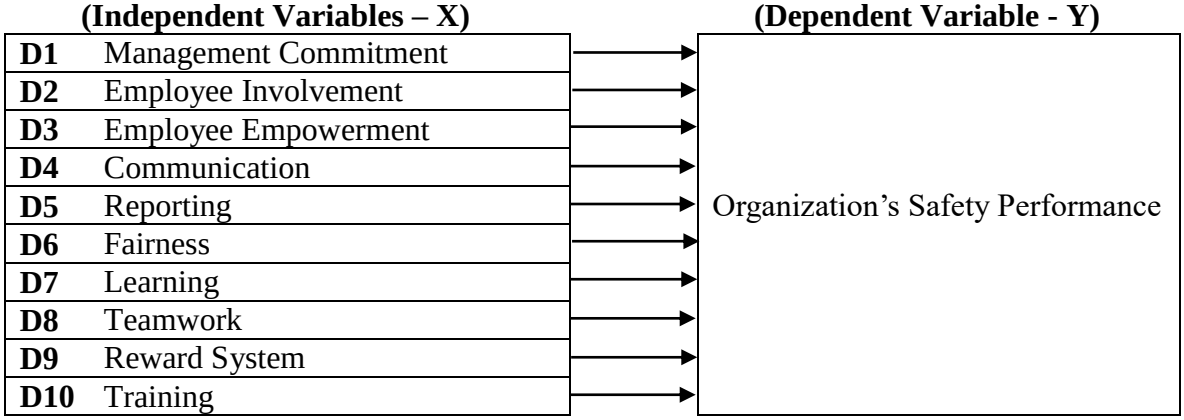
To improve safety for all employees, organizations should develop a systematic, comprehensive safety-training program for them. In the SMS, training is a factor of safety culture influencing employees' capabilities in performing a specific job in a correct and safe manner, which is vital for an organization's on-going safety performance (Eurocontrol, 2008). According to IAEA (1999), there is a correlation between training effectiveness and safety performance of an organization, whereas safety performance of an organization is an indicator of training effectiveness. Hence, the hypothesis is posited as H_9: Training has a significant effect on an organization's safety performance.

3.12 Conceptual Framework

A conceptual framework, which comprises the ten factors in the Hong Kong context, is constructed as a flow diagram to indicate the relationships between safety culture and the organization's safety performance.

As shown in Figure: 3.12 - *Conceptual Framework*, each of the factors is equated as an independent variable (X), with the arrows to indicate possible influences on the dependent variable (Y). The relationships between X and Y are mathematically equated as H_1: ($Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + ...\beta_nX_n$), β is an estimate of the change in Y due to a unit change in X. The conceptual framework allows the author to apply hypothetical tests for the effect analysis.

Figure: 3.12 – Conceptual Framework



3.13 Conceptual Hypotheses of the Study

The effects of safety culture on the organization's safety performance are quantitatively measured and analyzed through hypothesis testing.

H_1: Management commitment has a significant effect on organization's safety performance.

H_2: Employee involvement has significant effect on organization's safety performance.

H_3: Employee empowerment has significant effect on organization's safety performance.

H_4: Communication has significant effect on organization's safety performance.

H_5: Reporting has significant effect on organization's safety performance.

H_6: Fairness has significant effect on organization's safety performance.

H_7: Learning has significant effect on organization's safety performance.

H_8: Teamwork has a significant effect on organization's safety performance.

H_9: Reward system has significant effect on organization's safety performance.

H_{10}: Training has significant effect on organization's safety performance.

3.14 Definition of Terms

Certificate of Competency

Certificate of Competency is a trade certificate issued by the Director of Marine, Hong Kong under the Merchant Shipping (Seafarers) (Certification of Officers) Regulations to

the Deck Officers and Engineers who have successfully passed the qualifying examinations.

Flag State Control and Port State Control

Flag state of a merchant ship is the state or authority under its laws the ship is registered. The flag state administration has the authority to enforce the regulations over the ship flying its national ensign (Flag Sate, 2015), while a seaport has the Port State Control to inspect any foreign vessels in its territorial waters for verifying that the competency of the seafarers and the seaworthiness of the ship, and its equipment comply with the international conventions.

Hong Kong Harbour

Hong Kong Harbour is so-called the Victoria Harbour where the waterways are rather restricted, with converging traffic movements from different directions of traffic flow, including but not limited to the HSC, pleasure craft, sailing vessels, vessels engaged in fishing, foreign-going ships, and anchored vessels undertaking mid-stream works.

Hong Kong Shipping Ordinances

The Hong Kong Shipping Ordinances and their subsidiary legislation applicable to the HSC include “the Cap. 313, Shipping and Port Control Ordinance”, “the Cap. 313A, Shipping and Port Control Regulations”, “the Cap. 369 Merchant Shipping (Safety) Ordinance”, “the Cap. 369AW, Merchant Shipping (Safety) (High-speed Craft) Regulations”, “the Cap. 369AX, Merchant Shipping (Safety) (Safety Management) Regulations”, “the Cap. 478, Merchant Shipping (Seafarers) Ordinance, and the Cap. 478D, Merchant Shipping (Seafarers) (Hours of Work) Regulations”.

Hong Kong Waters

Hong Kong waters is within the geographical boundaries of Latitude 22°37' North and Longitude 113°52' East to Latitude 22°8.5' North and Longitude 114°30' East, including the adjacent waters (HK waters, 2001).

High Speed Craft

High-Speed Passenger Craft (HSC) within the content of this study are fast ferries. While, in the meaning of the Merchant Shipping (Safety) (High-speed Craft) Regulation (Chapter 369AW) of the Hong Kong Ordinances, it is a vessel capable of travelling at top speed in meters per second, equal to or above 3.7 times the one-sixth power of the volume of vessel

displacement in cubic meters, corresponding to the ship's waterline. For example, the fast ferries plying between Hong Kong and Macau are classed as the HSC, determined by a technical formula of Speed-to-Displacement Co-efficient ($3.7\blacktriangledown^{0.1667}$) (HSC Code, 1994).

HSC Organization

HSC Organization means the HSC owner(s) or the management of the HSC operating company, who is in charge of the fleet operation, overseeing the safety and competency of the employees deployed to the Operation or Safety Department of an HSC Organization. It has agreed to take over all duties and responsibilities for the safe operation and management of a fleet of the HSC from the owner(s) (ISM Code, 2007).

International Convention for the Safety of Life at Sea (SOLAS)

The International Convention for the safety of Life at Sea (SOLAS 74) was adopted by the International Maritime Organization (IMO) in November 1974 by the IMO (IMO, 1994; SOLAS, 2019) in response to the tragic sinking of the White Star Liner "RMS Titanic" involving heavy loss of lives in 1912 (SOLAS, 1974). It was the very first and oldest version of the SOLAS adopted in 1914 (IMO, 1994; SOLAS, 2019).

International Convention on the Standards of Training, Certification and Watch-keeping for Seafarers (STCW Convention)

In 1978, the IMO adopted the very first common standards of competency and training for seafarers working on the sea-going merchant ships, named as "the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978" (STCW 78), which Hong Kong either met or exceeded the standards. In 1995, the STCW 78 was claimed for more emphasis on the man-and-equipment relationships. As a consequence of the emerging technologies, "the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978" was largely amended (STCW, 1995). In 2010, the STCW 78 was further amended, referred to as "the STCW Manila Amendments 2010" (STCW, 2010). Seafarers including the HSC Officers must be trained to the required levels of competency with the technological and operational requirements for the shipboard competencies to work safely on the existing vessels.

International Maritime Organization

The International Maritime Organization (IMO) is the international rule-maker (Kasoulides, 1993; Mitroussi, 2004). It is a specialized agency of the United Nations, concerned

exclusively with the development and maintenance of the maritime conventions, setting international standards for the safety, security and environmental performance of the maritime industry for vessels trading worldwide, while the responsibility of enforcing the conventions rested on the governments of the member countries.

Knot

Knot is a unit of speed commonly used in marine navigation, expressed in nautical mile or kilometer per hour.

Mardep

The Mardep is known as the Marine Department of the Hong Kong Special Administrative Region of the People's Republic of China (Mardep). It is the port authority responsible for maintaining marine safety and marine pollution from ships, and monitoring the marine traffic in waters of Hong Kong, including the search and rescue responsibilities in most of the South China Sea. Furthermore, the Mardep also conducts accident investigations (Mardep, 2015).

Non-conformity

It is "*an observed situation, in which the objective evidence indicates the non-fulfilment of a requirement*" specified in the company's SMS (ISM Code, 2007).

Safety Management Manual

The safety management system is turned into a set of manual, known as the Safety Management Manual (SMM). A full set of the Safety Management Manual is comprised of "the SMS Policy Manual", "the Company Operational Procedures Manual", and "the Company Emergency Procedures Manual" for the shore-based office, while the same "SMS Policy Manual" together with "the Shipboard Operational Procedures Manual" and "the Shipboard Emergency Procedures Manual" supplied exclusively to each HSC.

Safety Management System

The safety management system (SMS) is a continuous improvement process that reduces hazards and prevents accidents. This system enables employees to implement the safety and environmental protection policies of an organization, and to ensure compliance with the mandatory rules and regulations by the HSC operating organizations.

Traffic Coordination Centre

Traffic Coordination Centre is a land-based station serving as a communication link between the HSC and shore-based management round the clock. It monitors vessel movements, provides information regarding weather, marine traffic and berthing arrangements through a radio-communication network to the HSC Officers.

3.15 Chapter Conclusion

After the literature review, factors of safety culture linking safety performance were derived from the prior studies. The factors were used as key dimensions for constructing a conceptual model for the Hong Kong context, based on which the research hypotheses were formulated, and the research questions were concluded for guiding the research process to situate the methodological discussions in the next chapter.

CHAPTER IV: METHODOLOGY

4.0 Introduction

This chapter presents the methodological approach to the research. As Miles and Huberman (1984) exposit that "*knowing what you want to find out leads to the question of how you will get the information*" (Miles & Huberman, 1984). In this chapter, there are seven sections. Each details specific methodological or research concern.

Section 4.1 briefly discusses the philosophical approach underlying the research study. Section 4.2 describes an adoption of the specific research design on a quantitative approach. In Section 4.3, target population, sampling and data collection methods, and sample size for this study are explained. Section 4.4 introduces the pilot study, and Section 4.5 addresses the measures adopted to ensure the validity and reliability of the data collection instrument. Section 4.6 concerns with research ethics of informed consent, protection of confidentiality and the provisions of ethical approval. In the last Section 4.7, statistical techniques of quantitative data analysis are addressed, and the strategy for data analyses of the quantitative survey research is given.

4.1 Research Philosophy

Research philosophy, which is an important part of the research methodology, determines the approach to research design, data collection and analysis.

Individual researchers have individual worldview and practical consideration. Their different assumptions in the understanding and development of knowledge may lead to different research strategies and methods in achieving specific study purpose.

Researchers' philosophical stance taken will lead the way in which researchers bring about new knowledge, and influence the ways to deal with the research questions (Jackson, 2013). Hence, researchers need to understand the research philosophy of a study, as the choice of a specific research philosophy does influence the choice of methodology. In research philosophy, several dominant philosophical paradigms are positivism, interpretivism, and pragmatism (Jackson, 2013).

In positivism, positivist approach to organizational research builds on natural science

(Johnson & Onwuegbuzie, 2004). It was the dominant philosophical worldview in the 20th century. The positivist paradigm assumes that there is a single objective truth, and that can be measured in number and explained through scientific relationships (Creswell, 2009).

In the belief of positivist researchers, everything can be measured and calculated. Hence, universal truths are waiting to be uncovered. Based on this assumption, a research if grounded in the positivist paradigm is associated with quantitative research method (Creswell, 2009). Being deductive, researchers focus on formulating and testing the research hypotheses, as well as analyzing and verifying the quantitative data statistically (Jackson, 2013). In this sense, a quantitative approach tends to be inflexible, and an error in data is likely to affect the results of hypothesis testing (Johnson, 2014). Compared to qualitative research, the quantitative research method requires a larger sample size to make the sample representable.

In interpretivism, interpretivist approach claims that there is no absolute truth. The fundamental belief of the interpretative paradigm supports the concept of subjective reality, based on different interpretations of reality by different researchers, thereby allowing multiple realities to exist (Jackson, 2013).

In the belief of researchers, there is no objective reality, and so-called truth is subjectively constructed by individuals. Based on this assumption, a research grounded in the interpretivist paradigm is associated with qualitative research method. Being inductive, researchers study how various claims for truth or solution to the problem with focus on investigating the complexity, describing, decoding and interpreting the meanings of phenomena (Creswell, 2009). However, its time-consuming and labor-intensive nature in collecting, analyzing and interpreting the textual data, as well as the possibility of overlooking some important issues due to subjectivity are the drawbacks of qualitative research. Compared to quantitative research method, a large population is not desirable for small purposeful samples and subjectivity in qualitative research.

In pragmatism, pragmatist approach is in association with mixed methods research (Creswell, 2013). Pragmatism originated in the United States around 1870, and now presents as a third alternative to the philosophical worldviews (Creswell, 2009).

Pragmatism combines different methodological approaches in a study, where quantitative

and qualitative research studies rely on different paradigmatic assumptions in the nature of reality and the methods of data collection (Creswell, 2009). Johnson and Onwuegbuzie (2004) support that a mix of different worldviews holds good for its practicality and outcome-orientation, and a middle position between the philosophically and methodologically purist approaches is immediately provided. It was however arguable that the two approaches should not be used together because of differences in the worldviews or philosophies associated with the two approaches. Compared to other approaches, mixed methods of research are grounded in different philosophical paradigms, not linked to one single paradigm.

4.1.1 Choices of Philosophical Approach

Given the above philosophical paradigms, researchers should determine the choice of a specific research philosophy amongst the positivist, interpretivist and pragmatist approaches.

Researchers may take a purist stance, such as adopting the quantitative research method to look for breadth by measuring the problem quantitatively. For example, a study conducted by Lu and Yang (2011) about the influences of safety climate on safety attitudes and behaviours of employees in the ferry context that the researchers adopted a positivism approach, separating themselves from the objects being studied (Lu & Yang, 2011).

Researchers may either adopt qualitative research method if looking for depth and meaning, or take mixed methods of research as an alternative to positivist or interpretivist approaches, particularly when answering a specific research question which is of utmost importance to the pragmatist (Creswell, 2009). While in the interpretative framework, researchers themselves are the measuring instruments for collecting data and analyzing the qualitative data. Researchers and the researched are not separated because researchers are the source of reality (Johnson & Onwuegbuzie, 2004).

In essence, philosophical assumptions affect the choice of research methodology, which in turn, affect the research outcome. Hence, understanding the philosophical paradigms before deciding the research philosophy is fundamental to articulating the rationale for the research design or strategies.

4.1.2 Chosen Philosophical Approach

The philosophical approach chosen for this study corresponds to positivism employing a quantitative research method. Amongst the several dominant types of research philosophies, positivism is more related and appropriate than other approaches in the domain of research philosophy. Firstly, the nature of study from the author's worldview primarily concerns facts, true reality associated with safety performance, which is vessel seaworthiness. Secondly, the philosophical stance taken influences the approach to the method used in dealing with the research questions. The author clearly defines and specifies the dependent and independent variables in the research questions, from which quantitative answers are sought. With the reliability, the survey can then be replicated. Thirdly, the research itself is independent of the author who does not interact with the objects studied. Furthermore, positivist approach is good at providing information in breadth from a larger sample size through numbers and statistics, deriving consistent results to sustain an objective conclusion through hypothesis testing. Compared to other philosophical paradigms, positivism is objective and reliable. Hence, positivism is chosen as the research paradigm for this study.

4.2 Research Design

Having assumed the research approach to the study, the research design needs to be resolved next. A research design is a set of methods and procedures, or so-called research strategies adopted by researchers for collecting and analyzing data of a study.

Researchers' philosophical stance taken will influence the choice of methodology. Generally, a positivist paradigm is associated with the use of quantitative research design. The quantitative research design emerged around world history 1250 A.D. Since then, it has been dominant in social sciences for several decades (Williams, 2011). According to Williams (2011), quantitative research design is a process of collecting quantifiable data, applying mathematical and statistical techniques to make predictions and generalize results to populations. Over the past years, it helped create meanings and new knowledge through objectively measuring reality, and supported decision-making in the transport fields of work, including supply chain management, logistics, and transportation (Williams, 2011).

The quantitative research design of this study maintains the philosophical assumptions of positivism underlying the research methodology (Creswell, 2013). Sikes (2004) also

supports that the choice of a philosophical paradigm is related to the research design chosen for a study, rather than the personal view from researcher's perception of reality. As shown in Figure: 4.2 - *Steps to develop, commission, and implement on a quantitative approach to the main survey,* the design of a quantitative research is a plan of actions that lists specific steps to take in achieving the research objectives.

Figure: 4.2 – Steps to develop, commission, and implement on a quantitative approach to the main survey
Adapted from OECD (2012)

Steps to develop, commission, and implement the pilot and main surveys:-

- Define research aims to achieve;
- Adopt research approach to determine research design;
- Identify target population and sample to respond questions for delivery of desired data;
- Choose sampling and data collection methods, and determine adequate sample size to draw conclusions from the survey results;
- Develop and validate a new survey instrument for the survey research;
- Carry out a pilot study to identify and correct weaknesses in the survey questionnaire, and verify the process and results of the pilot study to prepare for the main survey research;
- Analyze data by descriptive statistics to understand details of specific sample, and by inferential statistics to make inferences or predictions about the population, and through hypothesis testing to examine the relationships and differences between variables for answering the research questions;
- Report the results of the empirical findings, including the key determinant factors.

4.2.1 Characteristics of Quantitative Research Design

Based on the quantitative research design, some prior research studies examined the relationship between safety culture and safety performance or safety behaviour of organizations (Lu & Tsai, 2008; Lu & Yang, 2011; Luria, 2010; Siu et al., 2004; Zohar, 1980). In their studies, features of the quantitative research were identified.

For example, Lu and Yang (2011) conducted a quantitative survey to examine the effects of safety culture upon the employees' safety behaviours in the ferry context from the employees' perspective (Lu & Yang, 2011). Several distinctive characteristics of the quantitative research were identified from the research design of the study.

First, the research itself was independent of the researchers without influencing respondents, and the quantitative data were objectively measured and statistically analyzed to draw inferences about the respondent's preferences in numerical terms. Second, the research outcomes were valid. A structured questionnaire was used to collect respondents'

preferences, irrespective of the geographical locations. Respondents who were not part of the research process themselves filled in the questionnaire. Third, the research outcomes were reliable. Responses to the close-ended questions, which were constructed according to the research objectives, were specific and right to the questions than the open-ended questions, hence more reliable answers in numerical terms could be achieved. Fourth, the research outcomes were generalizable to the entire population by the sample size. The outcomes could be used multiple times, and repeated with reliability.

From the above discussions, it is observed that the characteristics of quantitative research design, including its validity, reliability and generalizability, can affect the research outcomes. Hence, the characteristics should be taken into consideration when designing a research.

4.2.2 Reasons for Choosing Quantitative Research Design

For this research study, the descriptive nature of the research questions and the advantages of the quantitative research approach as specified in Section 4.2.1 support the adoption of the quantitative research design.

Regarding the nature of the research questions, the quantitative research approach intends to answer the what, where, when and how questions. For this study, the research questions specifically look at associations between independent and dependent variables and demand quantitative answers to arrive at objective conclusions for generalizing the outcomes to represent the population.

A quantitative research design can better cope with this sort of relationship-based research questions. Hence, the author adopted a research design on a quantitative approach of positivism to facilitate collecting, measuring, assessing and inferring the data collated from the respondents for measuring the effects of safety culture on safety performance for this study.

4.3 Target Population and Sample

For this study, the target population was the HSC Officers, of whom the sample should meet the basic criterion of having one year or more HSC experience in the HSC industry of Hong Kong. Thus, it was believed that the sample with the experience could demonstrate the general safety knowledge and practice at workplace under the influences of the

organizational culture, and capable of properly answering the survey questionnaire to deliver the desired data.

Presently, there are approximately 450 HSC Officers or equivalent to about 130 HSC watch-keeping teams serving on the Hong Kong-registered HSC of different types, employed by the two HSC organizations in Hong Kong (See Table: 4.3 - *Population of the HSC Officers*). Each watch-keeping team is composed of three HSC Officers in different ranks, including the Master, Chief Officer and Chief Engineer. In night sailings, an additional HSC Officer, known as the Night Vision Officer (NVO) is deployed to the watch-keeping team for keeping navigational watch on any close-range floating objects.

Table 4.3 - Population of the HSC Officers (Updated to June 2019)
Sourced from: the HSC Officers' Monthly Duty Rosters of the two HSC Organizations

HSC Organizations	Master	Chief Officer	Chief Engineer	NVO	Total
Turbojet	89	91	92	54	326
CotaiJet	34	37	35	18	124
Total	123	128	127	72	450

There were several reasons for choosing the HSC Officers as the unit of sampling for this study. First, there were high-risk concerns over the safety management of the HSC fleet. Second, the HSC Officers were the high-ranking shipboard personnel, holding key managerial roles in shaping and sustaining safety culture onboard, and bearing the key elements for measuring and assessing the safety performance of an organization.

Several prior studies evidenced that measuring employee' safety attitudes and behaviours was an appropriate approach for measuring safety performance of organizations (Griffin & Neal, 2000; Hayes et al., 1998; Lu and Tsai, 2008; Luria, 2010; Siu et al., 2004; Zohar, 1980). Their studies reflected a consensus that any effort to improve safety was based on the employee's perception.

For this study, the HSC Officers were taken as the unit of sampling. The HSC Officers were treated as the role model to display the desired attitudes towards safety to represent the safety performance of an organization. Glick (1985)'s sampling strategies indicated that if the same type of informants was used in the sampled organizations, sampling bias could likely be controlled (Glick, 1985). Hence, the survey targeted at the HSC Officers with the HSC experience of one year or more, including those ranked as Master, Chief Officer, Chief

Engineer and Night Vision Officer.

4.3.1 Data Collection

Data collection is a procedural process of collating data from the relevant sources to answer the research questions. In this section, the sampling methods, data collection methods and sample size are explained.

4.3.1.1 Sampling Methods

In quantitative research, sampling methods are classed into probability and non-probability sampling. In the probability sampling, samples are randomly selected from a target population, but it is not the case in non-probability sampling. Due to convenient accessibility, the procedures used in non-probability sampling to select units for inclusion in the sample are feasible. Compared to probability sampling, the savings in time and cost, particularly the ease of implementation often lead to the use of non-probability sampling.

4.3.1.1.1 Sampling Technique Chosen

There are five common non-probability sampling techniques, including "purposive sampling", "self-selection sampling", "quota sampling", "snowball sampling", and "convenience sampling" (Etikan, 2016). Samples can be selected from a population by any of the techniques. It is however crucial for researchers to determine which of the sampling techniques is more appropriate to a study.

Amongst the non-probability sampling techniques, convenience sampling is a widely-used method, particularly in clinical research (Elfil & Negida, 2017). In convenience sampling, samples should meet certain practical criteria, such as geographical proximity, easy accessibility, time availability, and most importantly the willingness to participate in the survey (Etikan, 2016).

In an example of convenience sampling, a cohort study was conducted by Elfil & Negida (2017) to study the Egyptian patients with Hepatitis C (HCV) virus infected. It was given that the accessible population for the research team was the HCV patients in the two Egyptian university hospitals, the Zagazig University Hospital and the Cairo University Hospital. Hence, convenient samples were confined to the HCV patients who attended any of the hospitals within the study period (Elfil & Negida, 2017).

Another study was conducted by Bhattacharya (2015) to investigate the shipboard safety culture perceived by the ship's officers. Convenient samples were recruited from two Indian maritime institutes where the signed-off ship's officers attended certain IMO's short trade courses or workshops there (Bhattacharya, 2015).

For this study, sampling decision was to recruit a larger sample size within a short time-frame. In view of the unstable situation of the Coronavirus Disease 2019 (COVID-19) pandemic, convenience sampling technique was a better option to recruit primary data, with which subjects could be easily and quickly selected due to close proximity with convenient accessibility when compared to other sampling methods and techniques.

In essence, the criteria of practicality and convenient accessibility set for non-probability sampling techniques were met, and the units that could be included in the sample should be the easiest to access. Hence, convenience sampling should be adopted as the sampling strategy for this study.

4.3.1.1.2 Sampling Locations

For this study, convenience sampling was carried out at two survey locations, one was the Maritime Services Training Institute (thereafter referred to as the Institute) where the HSC Officers were learners of the short trade courses or workshops. They attended the short trade courses or workshops held at the Institute. The other location was the Merchant Navy Officers' Guild Club (thereafter referred to as the Association Club) where participants were guests or members of the Association Club. They generally met up for causal gatherings at the Association Club. Hence, samples were accessible and conveniently recruited at one place at a time.

4.3.1.1.3 Response Rate

Survey distribution is an important aspect of the survey process for this study. Methods of survey distribution may influence the response rate. To increase the response rate, the author adopted multiple survey locations. In addition, the author personally distributed and collected the surveys at two different survey locations, 'the Institute and the Association Club'. On the other hand, the author had close ties with the Institute and the Association Club where he could recruit many potential participants to the survey, such as during class breaks, or even before or after class of the learners at the Institute, and during gathering at the Association Club. Furthermore, the author personally contacted the potential

participants beforehand through the professional network of the author to improve participant recruitment.

4.3.1.1.4 Sampling Bias and Errors

Whilst the advantages of convenience sampling made it a preferred choice for the survey, the inherent selection bias should be taken into account. It was likely that chosen participants might have too much or too lean the effect to cause either over or under representation of certain groups within the sample, leading to incorrect conclusions.

Sampling bias is a type of selection bias, with which the sample is less likely to be representative of a population being studied. For example, the author while selecting may miss the viewpoints of other groups of the HSC Officers who do not attend any short trade course or workshop held at the Institute during the survey periods for this study. Hence, the sample may not be able to reflect certain characteristics of the population.

Whilst sampling errors in statistics likely arise when difference exists between the numerical factors of a population and the factors derived from the sample of the population. The difference may distort the statistical result, leading researchers to draw incorrect conclusions. It is however advised by Etikan and Babatope (2019) that when the sample size comes close to the population, sampling errors diminish with the result validity increases (Etikan & Babatope, 2019; Johnson & Onwueghuzie, 2004).

To safeguard against the sampling bias and errors, the author collected data by selecting samples from more than one survey locations, thereby increased the sample size and improved the response rate.

4.3.2.2 Data Collection Methods

There are three common methods of data collection, which are observational method, case study method, and survey research method.

Observational method is known as field observation where human behaviours are closely observed in real-life situations, such as in the workplace. Researchers gather data based on their own judgement on the subjects' behaviours and characteristics without asking subjects to respond any direct questions or controlling variables.

Case study method is used to obtain in-depth information from an individual, group or event, so as to explore the causes of underlying principles. Usually, case studies focus on specific or unusual cases to reveal something new about research problem. Researchers gather data sourced from personal interviews to identify the characteristics of specific subjects.

Survey research method is an efficient way to collect data from a large sample. In a survey research, researchers construct a survey and distribute it to a group of respondents to answer. Survey research method is often used in governments to learn about populations, in business world to learn about the markets, and in academia where surveys are applied to social research.

In essence, case studies provide detailed descriptions of specific subjects, while observations allow understanding of human behaviours in real-life situations. Compared to survey research, the way to derive findings in these two methods is subjectively based on personal judgement of researchers, and is not appropriate for making objective predictions or conclusions about a population.

In contrast, survey research assembles a large volume of data that can be statistically analyzed for frequencies, averages and patterns across time or locations to determine validity, reliability, and statistical significance for drawing conclusions and generalizing population. It aligns with the underlying positivist research philosophy of quantitative research methodology.

4.3.2.2.1 Choices of Questionnaire-based Survey Research

Survey research, which is questionnaire-based data collection method, asks a structured set of questions or statements to measure attitudes, beliefs and tendencies of a sample of population (Goodwin, 2005; Zikmund & Babin 2010). Survey questionnaire can be either self-administered or interviewer-administered in collecting primary data about respondents' preferences (Saunders et al., 2009). In the self-administered questionnaire survey research, questionnaires are the measuring instruments. Researchers themselves distribute the questionnaire to individual respondents for them to complete. Whilst in the interviewer-administered questionnaire survey, interviews are completed by the interviewers who are part of the measuring instrument.

On the one hand, interview-based questionnaire survey is relatively impracticable for large samples. Only one participant at a time can be interviewed. On the other, self-administered questionnaire survey is less time consuming but effectively getting respondents to participate, though it still requires the author to be present while each participant completing the survey.

Over past years, questionnaire-based survey research has been widely accepted as the dominant approach to study safety culture (Dedobbeleer & Beland, 1991; Mearns et al., 2003; Zohar, 2000). In addition, the self-administered questionnaire survey was applied to a number of previous studies on safety culture in the maritime industry, which yielded higher percentage of response rate (Bhattacharya, 2015; Lu & Tsai, 2008; Lu & Yang, 2011; Saunders et al., 2009).

In essence, self-administered questionnaire survey research is a time-and-cost effective option, which is considered as a practical method of questionnaire administration. This study adopted this method of administering questionnaire to gather data from the employees' perspectives for investigating the effects of safety culture on the HSC Officers' perceptions of safety performance of organizations.

4.3.2.3 Sample Size

Sample size refers to how many respondents should be recruited to a survey. It is widely agreed in the literature that the larger the size of sample drawn, the more representative of the population it is (Etikan, 2016). In this sense, the study result can be generalized to the population by increasing the size of sample.

According to Winter, Dodou and Wieringa (2009), a sample size of 50 could yield reliable results for an "Exploratory factor analysis" (EFA), and a sample size of 100 could be an adequate number to work with a regression model. Hair et al. (1998) and Matsunaga (2010) further suggested that a sample size of 200 participants or greater and the number of factors with a minimum of five participants per questionnaire item should suffice the robust result of a survey (Hair et al. 1998; Matsunaga, 2010).

On the other hand, it was opined that sample size of a study could be identical to that of similar studies. For example, a questionnaire survey conducted by Bhattacharya (2015) to study the perceived shipboard safety culture. A sample size of 433 ship's officers on study

leave was recruited with a high response rate of over 95% during the survey period (Bhattacharya, 2015). In contrast, a similar study conducted by Lu and Yang (2011) on the perceived shipboard safety culture, out of 600 questionnaires distributed to the ferry crew, only 155 questionnaires were returned, representing a response rate of 25.8% of the target sample (Lu & Yang, 2011). Hence, deficiencies in the survey results of similar studies due to low response rate should be seriously taken into consideration when the same or similar sample size is going to be adopted for another study (MacCallum et al., 1999).

Given the above, there are no stringent criteria to justify sample size sufficiency for a survey (MacCallum et al., 1999). Taherdoost (2016) suggests that availability of time, cost and labour has impacts on the size of sample, and the expected level of precision is regarded as an issue, and sometimes referred to as sampling error (MacCallum et al., 1999). Hence, it is advised that researchers should balance amongst all the issues upon deciding the sample size for a survey.

For this survey research, the author planned to select a sample size of as many as 200 respondents. The number should stay well above the suggested threshold of 200 respondents, and could be representative of the population studied for this questionnaire-based survey research, while a sample size of 50 was deemed appropriate for the pilot study, identical to the results for the exploratory factor analysis (Winter, Dodou & Wieringa, 2009).

4.4 Pilot Study

Pilot study is a small scale study that intends to examine the feasibility of the research design for a larger scale study (Leon, Davis & Kraemer, 2011). The author used the results to identify any weaknesses or deficiencies in the survey research instrument, and to confirm the feasibility of the study process, such as refining certain items in the questionnaire or improving certain procedures in the study process, when required. According to Hassan, Schattner and Mazza (2006), pilot study process may help explain how to implement a larger study to reality (Hassan, Schattner & Mazza, 2006). Hence, the main questionnaire-based survey research would follow the study process, including the sampling method and the technique of those of the pilot. The process and results of the pilot study are presented in the Chapter V.

4.5 Validity and Reliability

"Validity" relates to the ability of an instrument to measure what it claims to measure. In other words, validity is about the accuracy of a test measure. Whereas, "Reliability" refers to the degree to which the result of a study can be replicated by other studies carried out by other researchers (Trochim, 2001). It is thus vital for a test to be valid in order that the result can be accurately applied and interpreted. Equally important, a test ought to be a reliable measure which generates the similar result under similar conditions.

For this survey research, the survey questionnaire should be able to accurately measure the variables, and to consistently provide the result with the least deviations. Although the questionnaire items were adapted from various source questionnaires and slightly modified to reflect specific situations that the author intended to measure, the precision of the questionnaire should be checked and tested for its validity and reliability.

To ensure validity and reliability of a survey questionnaire, researchers should undertake validity and reliability tests (Trochim 2001). Initially, the author would check the validity of the survey questionnaire through a small-scale interview for expert's comments, and then he would pilot test the validity and reliability of data on a subset of the target population. Throughout the process, data collated from the pilot test was analyzed through the Statistical Package for Social Sciences version 22.0 (SPSS).

4.5.1 Validity

To assure that the survey questionnaire items are realistic, able to get to the right issues, easily and clearly understood by respondents, the validity of the survey questionnaire should be established and maintained.

4.5.1.1 Face Validity

"Face validity" relates to the items that measure exactly what they intend to measure. The author, having selected an initial set of questionnaire items from the source questionnaires, established and verified the face validity of the items.

Face validity was established by continuous assessments on the items during the process of questionnaire development. Instrument validation is an iterative process. Subsequent to an initial assessment conducted by the author, several of field experts who were interested in the topic of study and conveniently accessed was individually invited to validate the items in

the questionnaire. Interviewing as few as five practitioners or ex-HSC Officers resulted in several minor modifications to the wordings of the questionnaire, and some examples were additionally provided for some items.

However, it was arguable that face validity was an informal and subjective assessment with several experts' consensus reached on the items after several rounds of interviews (Trochim 2001). Nevertheless, expert feedbacks led to an initial verification of the questionnaire items for the HSC context, in respect of feasibility, consistency of style, and the clarity of the language used for easy comprehension by respondents (Trochim 2001). Hence, it is still necessary to establish face validity (See 5.1.3 for the changes in the questionnaire items).

Compared to content validity, face validity is more susceptible to bias, as the face validity test requires an intuitive judgement to measure the questionnaire items superficially, while content validity requires rigorous statistical tests (Anastasi & Urbina, 1997).

4.5.1.2 Content Validity

"Content validity", which relates to a measure, is used in a research to cover all of the content in the underlying construct. In other words, a measurement scale, which is used to assess a safety culture construct, should include all items related to the construct. Otherwise, it is not a valid measure.

Similar to face validity, content validity is a subjective measure for testing whether the content of a measure actually covers all the contents. Content validity of the survey questionnaire was verified through reviews before and after piloting to obtain feedback (Lu & Tsai, 2008; Mearns et al., 2003). After piloting, several identified typographical errors were rectified to confirm content validity.

4.5.2 Reliability

"Reliability" refers to the consistent and repeatable characters of the result of a survey research, even if the same instrument is used for more than once. In quantitative research, there are several ways of assessing the reliability of a measure. Researchers are more concerned with the "Test re-test Reliability" and "Internal consistency reliability" (Bryman & Bell, 2007; Burns & Burns, 2008; Saunders et al., 2009).

4.5.2.1 Test Re-test Reliability

The approach of the test re-test reliability is to measure the same group of subjects using the same old questions at two different points of time (Burns & Burns, 2008). Though the author recruited participants at other survey locations, namely the Association Club or other public places, few participants would attempt answering the same questionnaire twice. Hence, the author did not consider the test-retest reliability assessment as a choice for verifying the reliability.

4.5.2.2 Internal Consistency Reliability

"Internal consistency reliability" is about whether the items are consistent, inter-correlated in the measurement of the same construct (Hyman, Lamb & Bulmer, 2006). To measure the internal consistency reliability of the questionnaire items for the survey research, a reliability test may be adopted.

Cronbach's alpha is a widely used objective measure of reliability (Bryman & Bell, 2007; Burns & Burns, 2008; Saunders et al., 2009). Cronbach's alpha values range from zero to one, with a value at 0.00 representing an instrument having no internal consistency reliability where none of the items are inter-correlated, while a value of 1.00 indicating perfect internal consistency reliability, in which all the items are perfectly correlated (George & Mallery, 2003; Kline, 1999).

According to some well-regarded journals, the Cronbach's alpha level of greater or equal to 0.7 is an acceptable level of reliability (Nunnally, 1978). Hence, Cronbach's alpha value for each factor should be above 0.7 for the measurement scale attaining an acceptable level of internal consistency reliability (Davies et al., 2001; Nunnally, 1978). Otherwise, the author should refer to the "Alpha if item deleted" to delete one or more items of a construct with low internal consistency to increase the Cronbach's alpha value (Davies et al., 2001). In essence, the internal consistency reliability of the items was verified by conducting reliability tests for the instrument's accuracy.

4.6 Research Ethics

Research ethics govern how the research activities are executed without harming others. When a research involves human subjects, research ethics should be seriously taken into account (Bryman & Bell, 2007). The major ethical issues in conducting this survey research concerned with informed consent and protection of confidentiality.

4.6.1 Informed Consent

Joffe et al. (2001) warns that an informed consent is required from each of the participants in a survey research, though there is no standard informed consent process to follow (Joffe et al., 2001).

For subjects participating in the pilot and the main surveys, all of the participants were given an invitation document, in which a cover letter stating the topic and purpose of the questionnaire survey, and the terms of participation consent for seeking their agreements. Though a signed informed consent form was not expected from each participant, as soon as the participants completed and returned the questionnaires, an informed consent was assumed according to the terms of consent specified in the cover letter (See Appendix C: *Questionnaire Survey*). Upon completion of the questionnaire, the respondents either handed it to the author or dropped the returned questionnaires at a designated point of the Institute or the Association Club.

To assure anonymity, the author declared to the participants by the terms of consent printed at the back of the cover letter that all information provided by the participants was kept strictly confidential. To achieve this, all efforts were made to ensure that participant's identity was not traceable in any documents. Anonymity was demonstrated by not including the name of each participant in any forms.

The author himself delivered the invitation document to the participants at the two survey locations, the Institute and the Association Club. Participants were free to withdraw at any time without giving a reason, and they had the right not to answer any questions as participation was voluntary. Upon request of participants, survey was also conducted at an agreed time in any public places, for example coffee shops and restaurants. This kept participants away from the sense of discomfort or the worry of potential physical harm they deemed required.

4.6.2 Protection of Confidentiality

ANA (2001) reminds that researchers should address confidentiality if they are not able to promise anonymity. In fact, subject's right to anonymity arises only if subject's identity is linked with the personal responses of a survey (ANA, 2001).

To assure protection of confidentiality, researchers should demonstrate how they would manage the private data given by respondents, in order to protect subject's identity (Foukal & Mantzorou, 2011).

To ensure data confidentiality, the author himself collated all data that were stored anonymously and securely in the author's desk-top computer at home, while files of temporary nature being kept in the laptop computer were erased after each use.

For data protection and security, both the home computer and the laptop computer were password-protected, while hard-copied materials for the purposes of data analysis and interpretation were secured in a locked place where was only accessible by the author. All documents as required by data anonymity would be destroyed after the conclusion of the research study.

4.6.3 Ethical Approval

To ensure that the survey research was free from ethical issues, the author did not start the survey research unless ethical approval was sought from the Ethics Committee of the University of Wales Trinity Saint David.

During the survey process, the author followed specific ethical guidance documents, including the "University's Research Data Management Policy" and the "Hong Kong Personal Data (Privacy) Ordinance". Therefore, the author did not contravene the legal or regulatory provisions when collecting or using the collated data. Besides, the author referred to the "Research Integrity and Ethics Code" of the University to avoid any potential risk to the University.

To conclude, the research was free from ethical issues. The author upon receipt of ethical approval, strictly abided the ethical guidelines, sought informed consent of participants, promised anonymity of individuals and protected confidentiality of the collated data.

4.7 Data Analysis of Quantitative Survey Research

Quantitative data analysis is about analyzing a data set by various statistical techniques to draw meaningful insights.

4.7.1 Statistical Techniques of Quantitative Data Analysis

For this research design, the survey research adopted a deductive approach to data analysis and used a mix of quantitative data analyses for analyzing and interpreting data, inclusive of the two major branches of statistics. They are descriptive statistics and inferential statistics. Descriptive statistics describes sample, whereas inferential statistics makes predictions about the population (Cavanagh, 1997).

4.7.1.1 Data Analysis of Descriptive Statistics

Descriptive statistics is used for descriptive analysis that provides absolute numbers for summarizing individual variables and identifying patterns. In other words, descriptive statistics facilitates the understanding of the demographic profile of respondents and the analyses of responses.

In the initial data analysis of the survey, descriptive statistics was used to report numerical information about the participants and the results of statistical analyses. Several common descriptive statistics were presented, including 'Frequency and Percentage' to indicate rates of occurrence (See Table: 6.2.2.3 - *Demographic Profile of the Respondents*), 'Mean' to determine the overall trend of the data set (See Table: 6.2.2.4 of Appendix: D - *Breakdown of Means, Mean Scores and Standard Deviations*), and 'Standard deviation' to determine the spread of numbers from the mean (See Table: 6.2.2.4 of Appendix: D - *Breakdown of Means, Mean Scores and Standard Deviations*).

Compared to inferential statistics, descriptive statistics was concerned with the properties of the observed variables but not providing reasons behind the numbers.

4.7.1.2 Data Analysis of Inferential Statistics

Inferential statistics is used to generalize results about associations between variables, and to make predictions about a population.

For this questionnaire-based survey research, statistical techniques including, factor analysis, reliability test and regression analysis were carried out, and a set of hypotheses was statistically tested for the relationships between variables to answer the research questions.

4.7.2 Strategy for Data Analyses

In the survey research, both descriptive and inferential statistics were involved in the analysis and interpretation of the quantitative data.

Firstly, collated data was checked for data suitability. Then, exploratory factor analysis (EFA) was conducted to reduce the items into a fewer number of factors, and to explore the relationships among the items, and also a simpler structure of the data set. It was followed by the reliability tests to confirm the internal consistency reliability of a new measurement scale, using the Cronbach's alpha reliability coefficients.

To identify the relative impact of different factors of safety culture on the HSC Officers' perceptions of safety performance of organizations, multiple regression analysis was conducted.

Prior studies revealed that conducting the multiple regression analysis after factor analysis could help interpret the multi-variate relationship between variables (Saunders et al., 2009). Moreover, the Likert scale responses, having been analyzed as the summated scales of the respective items for each independent and dependent variable, could be generally robust and practically applicable to measure perceptions and behaviours (Carifio & Perla, 2008; Sullivan & Artino, 2013).

The author calculated the summated scores of the items for each factor, and used them as predictor variables in multiple regression analysis for predicting the dependent variable. Hence, the factors of safety culture were entered as independent variables, while perceptions of the organizations' safety performance as dependent variable into multiple regression analysis.

Eventually, the author through testing the research hypotheses predicted the relationships between the influences of safety culture and the perceived safety performance. Throughout the process, the SPSS was used as an analytical tool for computing and analyzing the data collated from the survey questionnaires, and for proving the effects upon the dependent variable due to each of the independent variables (Creswell, 2009).

4.8 Chapter Summary

This chapter explained the research methodology. This study adopted the philosophical approach to the research design, data collection and analysis, based on the philosophical assumptions of positivist paradigm.

The HSC Officers were the unit of sampling. After pilot testing, survey research was conducted with due regard to the research ethics. The author distributed and collected the self-administered questionnaires at two different survey locations.

For quantitatively analyzing the collated data, different statistical techniques, including both descriptive statistics and inferential statistics for giving details of the specific sample, and making predictions about the target population were used. The exploratory factor analysis for trimming down and grouping variables into a simpler factor structure was carried out, and the reliability tests for confirming the internal consistency reliability of a measurement scale, using the Cronbach's alpha reliability coefficients was followed. Then, the regression analysis was carried out for identifying the relative impact of different factors of safety culture on the dependent variable, and through hypothesis testing to examine the relationships and differences between variables for answering the research questions. Throughout the process, the SPSS was used as an analytical tool for computing and analyzing the data collated from the survey questionnaires, and proving the effects upon the dependent variable due to each of the independent variables.

The next chapter describes the development of a new survey questionnaire for the survey research, and the process and results of the pilot study.

CHAPTER V: DESIGNING & VALIDATING SURVEY RESEARCH INSTRUMENT

5.0 Introduction

This chapter consists of two parts. In the first part, the design process of the survey research instrument is described. The second part presents the process and results of the pilot study, and the descriptive analysis of the questionnaire items used in the pilot.

5.1 Designing Survey Research Instrument

In survey research, different types of measurement tools are available for assessing safety culture across different transport domains (Hofoss & Deilkas, 2008). Over past years, survey questionnaire has been a common tool for measuring employees' perceptions of an organization's safety performance.

With no off-the-shelf survey instrument available for measuring safety culture within a domain or across domains, it was the purpose and reason for the author to choose appropriate items from the source questionnaires, so long as the author considered them fit for the specific needs of this study (Cox & Flin, 1998; Sexton et al., 2006).

For this study, a survey questionnaire associated with a new set of questionnaire items was developed from the existing questionnaires. The perceived effectiveness of safety culture was measured in terms of respondents' opinions about the safety performance of organizations. For measuring respondent's perceptions, respondents were asked from this survey questionnaire to indicate their degree of agreement on a Likert scale.

5.1.1 Sourcing Existing Questionnaires

In designing a survey questionnaire, the author began with the existing measurement tools. After a review of the literature within the transportation sector and across different fields in other industries, several relevant measurement tools tested in past studies were deemed appropriate for this study.

Therefore, selected items for this survey research were derived from the source questionnaires, including the "Safety Climate Assessment Toolkit" (HSE, 2019) and "Summary Guide to Safety Climate Tools" (Davies et al., 2001) for measuring safety

climate in the health industry. In addition, the "ATM's Safety Culture Questionnaire" (Gordon et al., 2007) and the "ABS's Guidance Notes on Safety Culture and Leading Indicators of Safety" (ABS, 2012) for measuring safety performance in aviation management. Other relevant questionnaires in the domains of other industries included the "Khan's Investigation into the Safety Climate and Safety Performance" for the building industry (Khan, 2017). While in the maritime industry, several studies were conducted in recent years. For examples, Shang et al. (2011)'s study on the impact of safety management upon the perceived safety performance in container stevedoring operations, and Jung (2017)'s study on the seafarers' awareness of safety culture (Jung, 2017) were the appropriate sources.

Amongst these source questionnaires, they were distinguished from one another in the dimensions of study, subjected to the trade characteristics of industry. Hence, they could not directly apply to this specific context due to their specific aims or cultural differences (Zhou et al., 2011). Nevertheless, those existing measurement tools provided a rich source of survey items for designing this survey research instrument. In addition, survey items adapted from prior studies could help enhance validity.

5.1.2 Formulating Questionnaire Items

Several sets of existing questionnaires from different industries were adapted as the sources to formulate a new set of questionnaire items for the factors of safety culture in the Hong Kong context.

After an initial screening of the source questionnaires, selected items were edited by the author to better reflect the subjects and the context of study.

To ensure the design of the survey questionnaire and the appropriateness of questionnaire items align with the trade practice, small-scale expert interviews with several practitioners in the HSC industry were done to assist in the reviews of its presentation, contents, wordings, so as to validate the survey questionnaire prior to conducting a pilot survey.

To improve respondent's interpretation for the accuracy of responses, the questionnaire items were written in simple English within the local context, with translation equivalence supplemented for some key words into Chinese. At the same time, it was desirable to complete the questionnaire in less than 30 minutes. To achieve this, the author kept as few

as five items per factor of safety culture, to retain respondent's interest, and to enable respondents to finish the survey questionnaires within the timeframe.

Formulating questionnaire items was an iterative process. For content relevance, the author revised the items to be close to the research objectives subsequent to each expert's opinions given. For clarity of wordings and impeccability, the survey questionnaire items were checked again for grammatical mistakes, leading or biased items, double-barreled items, and redundancy with similar meanings within and across different factors of safety culture. Hence, the author continued the process until informational correctness was reached.

5.1.3 Changes in Questionnaire Items

Changes in the original items of the source questionnaires were tactically imposed on the factors of safety culture, including management commitment, employee involvement, employee empowerment, communication, reporting, fairness, learning, teamwork, reward system, and training. In addition, several self-created items were customized, and incorporated in some factors of safety culture. Those changes and additions are listed in the following sub-sections and a summary of the questionnaire items before and after adaptation, ready for piloting is also given in Table 5.1.3 - *Summary of Questionnaire Items Before and After Adaptation*.

Table: 5.1.3 - Summary of Questionnaire Items Before and After Adaptation

Factors of Safety Culture & Item Code	Adapted Items	Original Items (Sources) * Self-created Items
Management Commitment (D1)		
V1	Management really cares about the safety of employees who work here.	The company really cares about the health and safety of the people who work here. (Davies et al., 2001)
V2	Management motivates and praises employees for working safely.	Management always motivates and praises the employees for working safely. (Khan, 2017)
V3	Management is willing to invest money and effort to improve safety.	Management is willing to invest money and effort to improve safety. (Jung, 2017)
V4	Management shows concern if safety procedures are not followed.	Managers and supervisors express concern if safety procedures are not adhered to. (HSE, 2019)

V5	Management does all it can to prevent accident or incident from happening.	Management does all it can to prevent accidents or incidents. (Jung, 2017)
V6	There are enough employees available to get the job done according to the safety procedures.	There are always enough people available to get the job done according to the health and safety procedures. (Khan, 2017)
V7	Employees can get the equipment that they need to work according to the safety procedures.	People can always get the equipment which is needed to work according to the health and safety procedures. (Khan, 2017)
V8	Management has excellent safety maintenance standards.	This company has excellent maintenance standards. (ABS, 2012)
V9	Management involvement in safety issues has a high priority in the organization.	Management involvement in safety issues has a high priority at my company. (Jung, 2017)
V10	Management gets personally involved in safety activities or events.	My company's safety department is doing a good job. Upper level management gets personally involved in safety activities. (Jung, 2017)
Employee Involvement (D2)		
V11	Employees are involved in informing management of important safety issues.	I am involved in informing management of important safety issues. (Davies et al., 2001)
V12	Employees feel involved when safety procedures / instructions / rules are developed or reviewed.	I feel involved when health and safety procedures / instructions / rules are developed or reviewed. (Davies et al., 2001)
V13	Employees have an opportunity of influencing the decisions to be made by management.	I have a fair opportunity of influencing the decisions to be made by my superiors. (Davies et al., 2001)
V14	Employees clearly understand their responsibilities for safety.	I am clear about what my responsibilities are for health and safety. (Khan, 2017)
V15	I am satisfied with employee involvement in safety at work.	Indicate the extent to which you are satisfied/dissatisfied with workforce involvement in safety on your installation/rig. (Davies et al., 2001)
Employee Empowerment (D3)		
V16	Employees are consulted on matters that affect how they do their job.	I am usually consulted on matters that affect how I do my job. (ABS, 2012)
V17	Employees are actively encouraged to improve safety.	Crew members are actively encouraged to improve safety. (ABS, 2012)
V18	Employees have good control over the safety outcomes of their job.	I have good control over the safety outcomes of my job. (ABS, 2012)
V19	Employees can make decisions on safety issues, even if the decisions may lower the productivity.	Employees can make decisions on safety issues, even if the decisions may lower the productivity*.
V20	Management ensures that employees are responsible and accountable for safe operations.	Management ensures that all crews are responsible and accountable for safe operation. (Jung, 2017)
Communication (D4)		
V21	Employees are informed of the meeting outcomes that address safety.	I am always informed about the outcome of meetings which address health and safety. (Davies et al., 2001)
V22	Safety information is brought to employees' attention by management.	Safety information is always brought to my attention by my line manager/supervisor. (HSE, 2019)
V23	I am satisfied with the way I am kept informed of safety at work.	I am satisfied with the way I am kept informed about what takes place on this installation. (Davies et al., 2001)

V24	There is mutual trust between management and employees based on honesty and truthfulness.	There is mutual trust between the manager and crew based on honesty and truthfulness. (Jung, 2017)
V25	Employees trust the confidentiality of the reporting or investigation process.	I trust the confidentiality of the reporting and investigation process. (Gordon et al., 2007)
V26	Employees are willing to report near misses.	People are willing to report near misses. (Davies et al., 2001)
V27	Employees trust the systems that they need to use and follow in their job.	I trust the systems that I need to use in my job. (Gordon et al., 2007)
Reporting (D5)		
V28	Employees are familiar with the systems for formally reporting safety issues.	I am familiar with the system for formally reporting safety issues in my company. (Jung, 2017)
V29	Management acts quickly to correct the safety issues, when an employee reports a safety problem,	When a crew member reports a safety problem, management acts quickly to correct safety issues. (Jung, 2017)
V30	Safety issues raised by employees are communicated regularly to all employees.	Safety issues raised by crews are communicated regularly to all crews in the company. (Jung, 2017)
V31	Employees do not hesitate to report minor injuries or incidents. *For example, when there is an incident, the prevailing culture will encourage employees to report the incident to management.*	Crew hesitates to report minor injuries and incidents. (Jung, 2017)
V32	I am satisfied with the way management deals with the safety reports. *For example, when there is an incident, the employee's incident report about the causes does not affect the job security or management will not count the number of incidents as a measure of the employees' safety performance.*	I am satisfied with the way this company deals with safety reports. (Jung, 2017)
Fairness (D6)		
V33	Investigation team members are trained to identify the root causes rather than blaming the human error.	Members of investigation teams are trained to identify true root causes rather than blame human error. (Davies et al., 2001)
V34	There is a consistency regarding disciplinary measures for incidents or accidents.	There is a lack of consistency regarding disciplinary measures for incidents. (Gordon et al., 2007)
V35	Employees are willing to report incidents because they know that they are treated in fair manner.	People are willing to report incidents because they know they will be treated in a fair manner. (Gordon et al., 2007)
V36	Management practices a fair appraisal system.	Management practices a fair appraisal system*.
V37	I am satisfied with the follow-up measures taken after accidents, incidents or near misses.	I am very satisfied with the follow-up measures taken after accidents, incidents and near misses. (ABS, 2012)

Learning (D7)		
V38	The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.	Safety system (issues) is improved based on past experiences; news related the safety issue or recognized solution. (Jung, 2017)
V39	Lessons learned from incidents or accidents are published, such as in company's notice or newsletter.	Lessons learned from incidents are published in a de-identified manner in a newsletter or similar. (Gordon et al., 2007)
V40	The issue of safety is shared by employees as a best practice through review and analysis.	The issue of safety is shared by all crew members as a best practice through review and analysis. (Jung, 2017)
V41	Employees are encouraged to report unsafe conditions.	I am strongly encouraged to report unsafe conditions. (HSE, 2019)
V42	Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident.	I get feedback on the status and results of the investigation when I report an incident. (Gordon et al., 2007)
Teamwork (D8)		
V43	Management rewards individual performance, and rewards other team members based on team performance.	Management rewards individual performance, and rewards other team members based on team performance*.
V44	Employees who work in my team are fully committed to safety.	All the people who work in my team are fully committed to health and safety. (Khan, 2017)
V45	Co-workers give advice to each other on how to work safely.	Co-workers often give tips to each other on how to work safely. (HSE, 2019)
V46	Employees can seek help from others, when things get busy.	When things get busy, we can get the help of others to deal with the situation. (Gordon et al., 2007)
V47	I must work safely if I want to keep the respect of others in my team.	It is important for me to work safely if I want to keep the respect of others in my team. (Khan, 2017)
Reward System (D9)		
V48	Employees' performance relating to safety is evaluated according to the standards.	Safe crew members' performance is evaluated using clear standards. (Jung, 2017)
V49	Employees understand 'acceptable and unacceptable safety behaviors at workplace.	Management rewards individual performance, and rewards other team members based on team performance*.
V50	Employees who cause an accident or incident are held sufficiently accountable for their actions.	Crew members who cause accidents or incidents are not held sufficiently accountable for their actions. (Jung, 2017)
V51	Consistent actions are taken & applied to any employees who violate safety procedure or rule.	Action is consistently taken against crew members who violate safety procedures or rules. (Jung, 2017)
V52	Employees with good safety performance are recognized and rewarded by management.	Employees with good safety performance are recognized and rewarded by management*.
Training (D10)		
V53	Training covers all the safety risks associated with the work for which employees are responsible.	The training has covered all the health and safety risks associated with the work for which I am responsible. (Davies et al., 2001)
V54	Adequate safety training is given by management to perform the job safely.	Adequate health and safety training is given by the company to perform the job safely. (Khan, 2017)
V55	Employees are consulted to establish their training needs.	People here are consulted to establish their training needs. (Davies et al., 2001)
V56	Management places a high priority on safety training.	Ship management places a high priority on safety training. (ABS, 2012)

V57	I am satisfied with competency of training, such as the ways of training.	How satisfied do you feel with regard to competence of training? (Davies et al., 2001)
V58	All the safety rules or procedures are strictly followed here.	Not all the health and safety rules or procedures are strictly followed here. (Khan, 2017)
Y1	The risk of accidents has kept to a minimum.	The frequency of accident risk is reducing. (Shang et al., 2011)
Y2	The frequency of equipment failure is reducing.	The frequency of equipment failure is reducing. (Shang et al., 2011)
Y3	The current state of the organization's SMS continuous improvement has been effective.	The current state of the organization's SMS continuous improvement has been effective*.
Y4	The current state of the management's safety performance has been good.	The current state of the management's safety performance has been good*.

5.1.3.1 Management Commitment

There were ten items in this factor of safety culture, out of which four items were adapted from Jung (2017) and slightly reworded to match the research context. Other three items from Khan (2017) were adapted and slightly changed with the contents to reflect the subjects and the context of study. Respectively, an item from the ABS (2012)'s, the HSE (2019)'s, and the Davies et al. (2001)'s was adapted and slightly reworded to describe the subjects of study.

5.1.3.2 Employee Involvement

There were five items in this factor of safety culture. Of the items, four from the Davies et al. (2001) were adapted but slightly reworded to describe the subjects and the context of study. Then, one further item was adapted from the Khan (2017) and reworded to fit the survey purpose.

5.1.3.3 Employee Empowerment

Out of the five items in this factor of safety culture, three items were adapted from the ABS (2012) but edited to reflect the subjects and the context of study. Respectively, an item was adapted from the Jung (2017) but slightly reworded to reflect the context of study, while the self-created item V19 was incorporated to measure this specific factor, with a view of ensuring that the HSC Officers are genuinely empowered to have a good control over the safety outcomes of their jobs**.**

5.1.3.4 Communication

Amongst the seven items in this factor of safety culture, three items were adapted from the Davies et al. (2001) but slightly edited to reflect the subjects and the context of study, and

the other two items were adapted from the Gordon et al. (2007) but slightly reworded to describe the subjects and the context of study. Respectively, an item from the Jung (2017) and the HSE (2019) was adapted and reworded slightly to reflect the subjects and the context of study.

5.1.3.5 Reporting

Five items were adapted from the Jung (2017). They were edited to better reflect the subjects and the context of study. To improve respondent's interpretation for the accuracy of responses, two V31 and V32 of the items in this factor were provided with examples to help explain the item statements.

5.1.3.6 Fairness

There were five items in this factor of safety culture, out of which two were adapted from the Gordon et al. (2007) with the contents slightly modified to reflect the subjects. An item each from the Davies et al. (2001) and the ABS (2012) was respectively adapted and slightly reworded to reflect the subjects, while the last item was self-created '*V36*', customized by the author to better measure this specific factor.

5.1.3.7 Learning

There were five items in this factor of safety culture. Two items were respectively adapted from the Jung (2017) and the Gordon et al. (2007) but slightly edited to reflect the subjects and the context of study. The last one was adapted from the HSE (2019) but slightly reworded to reflect the subject.

5.1.3.8 Teamwork

Amongst five items in this factor of safety culture, two items were adapted from the Khan (2017) with the subjects changed. An item adapted from the Gordon et al. (2007) and another from the HSE (2019) was slightly reworded to reflect the subjects and the context of study. Additionally, one self-created item V43 was customized by the author to measure further this specific factor.

5.1.3.9 Reward System

There were five items in this factor of safety culture, out of which three were adapted from the Jung (2017) but edited to reflect the subjects and the context of study. Additionally, two self-created items V49 and V52 were customized by the author and added to measure this

specific factor.

5.1.3.10 Training

There are six items in this factor of safety culture. Firstly, three items were adapted from the Davies et al. (2001), out of which two items were slightly reworded to reflect the subjects and the context of study, and the other one V57 was rewritten from question to statement. Secondly, the other two items were adapted from the Khan (2017). One of them was slightly reworded to reflect the context of study, and the other one V58 was transformed from a negative statement to positive format. In addition, the last item was adapted from the ABS (2012) and fine-tuned to reflect the context of study.

Concerning the dependent variable, there were four items regarding "Safety Performance". Two of them were adapted from the Shang et al. (2011) with contents reworded to reflect the study objectives, and the other two items were self-created Y3 & Y4, customized by the author for measuring further this specific variable.

In summary, subsequent to screening the source questionnaires, modifications in the original items were imposed, such as re-wording the items, providing examples to enable respondents to reply promptly with no uncertainty. Besides, several of the items were subjected to change from questions into statements and from negative to positive signs. Additionally, seven self-created items including V19, V36, V43, V49, V52, Y3 and Y4 were incorporated into the respective factors of the questionnaire before piloting.

5.1.4 Structure of the Survey Questionnaire

The survey questionnaire had two parts. Each part had its own set of questions or items with different objectives to accomplish.

In Part I of the questionnaire, it had eight close-ended questions. Questions were designed to capture the backgrounds of the participating HSC Officers on a nominal scale of measurement, from which demographic characteristics of respondents, including their job positions, qualifications, work experiences, employers, age ranges and genders were sought.

In Part II, a set of 58 questionnaire items founded the main body of the survey questionnaire. All items excepting those in Part I were scored on a 5-point Likert scale.

They intended to measure the HSC Officer's opinions on the ten factors of safety culture, including management commitment, employee involvement, employee empowerment, communication, reporting, fairness, learning, teamwork, reward system, and training were assessed.

In this questionnaire-based survey research, the respondents were asked to indicate their thoughts or opinions. All items except the demographics were scored on a 5-point Likert scale. According to Berenson et al. (2012), more or less than five choices in the scale could likely confuse respondents when answering a questionnaire. Hence, the response scale for this study was rated from 1= 'Strongly disagree' to 5= "Strongly agree" to tell how strongly the participating HSC Officers would agree or disagree with each item, in which a higher value on the scale would indicate a more effective safety culture in the workplace.

5.2 Process and Results of the Pilot Study

A pilot test was carried out with a small group of the HSC practitioners to examine the feasibility of an approach that was intended for the survey research.

To process the pilot study, the author firstly tested the appropriateness of the survey instrument, secondly evaluated the feasibility of the subject recruitment, thirdly determined the feasibility of the study process, and lastly verified the methods of data entry and analysis.

To test the appropriateness of the survey instrument, the respondents after the research brief delivered by the author were left alone to complete the questionnaires themselves, in order to verify whether the questions and items in the survey questionnaire were well defined, comprehensible and appropriate.

In the data collection process, the author stayed away from the subjects studied but keeping an eye on them, should the respondents require facilitation. Without influencing the respondents, the author observed that the respondents were able to comprehend the terms of participation consent in the cover letter, understand the instructions in each part of the questionnaire, and the terms used in the questions and items. In addition, they could read and find no difficulties in the font size and layout, and eventually complete the questionnaire without giving any negative feedback.

To evaluate the feasibility of the subject recruitment**,** an "Invitation Document" in which a

cover letter and the questionnaire were enclosed, was handed to each respondent from the author at the Institute. In the cover letter, the objectives of the survey research and the conditions of participation consent were declared. Participants could consider whether they would wish to participate, and participants would demonstrate their consent to participate by returning their completed questionnaires to the author at the Institute.

In December 2019, sixty questionnaires were distributed to the potential participants at the Institute out of which 51 questionnaires were returned to the author at the Institute with a return rate of 85.0%. As indicated in Table: 5.2 **-** *Number of Questionnaires returned from Survey Location*, a high response rate of 83.3% or 50 qualified questionnaires implied that participants felt satisfied with the recruitment process. Most of them filled in the survey questionnaires during their class breaks and returned the completed questionnaires after their class at the Institute.

Table: 5.2 - Number of Questionnaires returned from Survey Location (Pilot Study)

Locations for Delivery and Return of Questionnaires	Questionnaires		Return Rate	Qualified Questionnaires	Response Rate
	Sent	Returned			
The Institute	60	51	85.0%	50	83.3%

To determine the feasibility of the study process**,** the author, who himself conducted a pilot study at the Institute, strictly followed the study process from subject recruitment to data analysis.

The result of the pilot study revealed that the study process was feasible. Firstly, the time for the author to complete a research brief and obtain consent from each participant was less than two minutes. Secondly, the respondents when filling in the survey questionnaires encountered no difficulties. They attempted all questions in Part I without missing any items in Part II. On average, they took less than 30 minutes to complete and submit the questionnaires. Upon returning the completed questionnaire, no queries were raised from the respondents. Hence, the appropriateness of the survey instrument was assumed.

To verify the methods of data entry and analysis**,** the author himself entered the data for the 50 subjects into the SPSS program, with specific codes assigned to each participant and questionnaire items. For analyzing internal consistency, the SPSS was used as an analytical tool to analyze the collated data (Leon, Davis & Kraemer, 2011).

The results of the pilot study indicated that the methods of data entry and analysis were appropriate. During the data entry process, all participants were found meeting the participation criteria of having at least one-year experience as the HSC Officer in the HSC industry of Hong Kong, except one HCS Officer Cadet employed for less than one year. In addition, codes for some items in the questionnaire were incorrectly ordered, but rectified afterwards.

The author performed the Cronbach's alpha reliability test for each factor in terms of Cronbach's alpha value as an indicator for an acceptable level of internal consistency. In the result, the averaged Cronbach's alpha value for each factor of safety culture was well above the suggested threshold alpha level (α) of 0.70 ($\geq$ 0.7) by Nunnally (1978) and George & Mallery (2003), hence the scale was acceptable.

To conclude, the pilot study proved to be a guide to implement the survey research with larger samples. It was possible to recruit large number of participants from the Institute as the survey location, based on the inclusion criteria of the study. Furthermore, the survey questionnaire was comprehensible and applicable to the survey research. Subsequent to the corrections to the typographical errors and coding mistakes, no further technical issues were expected from data entry to data analysis. Hence, there would be unlikely any unforeseen difficulties when embarking on the survey research in the next stage.

5.2.1 Descriptive Analysis of Questionnaire Items (58 Items)

This section presents a descriptive analysis of the pilot survey about the 50 respondents' perceptions of the safety performance of organizations, based on the respondents' answers to the survey questions in terms of their levels of agreement with the items related to the factors of safety culture.

In the pilot, the 58-item questionnaire was pilot-tested (See Appendix C: *Questionnaire Survey*), and a sample of 50 HSC Officers from the study population were involved, and asked to tell how strongly they agreed or disagreed with the items on a five-point Likert scale. A high mean score for a factor indicates a strong agreement of the respondents with the questionnaire items. Conversely, a low mean score denotes a low value is placed on the respective item of safety culture.

As revealed in Table: 5.2.1 - Breakdown of Means, Mean Scores and Standard Deviations, 'V1: Management really cares about the safety of employees who work here (3.580)' with its mean rated at 3.580, was strongly agreed by the respondents about the safety performance of organizations. In contrast, the low means of 'V12: Employees feel involved when safety procedures / instructions / rules are developed or reviewed (3.100)' and 'V26: Employees are willing to report near misses (3.100)' exhibited the weak agreements and low values on the items.

To conclude, V1 was the most important item of safety culture to influence the HSC Officer's perceptions. Its high mean implied that organizations strongly embraced the workplace safety. Conversely, its low mean suggested the need for further improvement. For example, the HSC organizations should encourage the HSC Officers to attend more safety meetings or safety campaigns.

Table: 5.2.1 - Breakdown of Means, Mean Scores and Standard Deviations
Extracts from: the SPSS worksheets

58 Items		Mean	S.D.
Factor 1	**Items relating to Management Commitment**		
V1	Management really cares about the safety of employees who work here.	3.5800	.49857
V2	Management motivates and praises employees for working safely.	3.4200	.57463
V3	Management is willing to invest money and effort to improve safety.	3.3600	.48487
V4	Management shows concern if safety procedures are not followed.	3.4600	.57888
V5	Management does all it can to prevent accident or incident from happening.	3.4400	.57711
V6	There are enough employees available to get the job done according to the safety procedures.	3.5000	.50508
V7	Employees can get the equipment that they need to work according to the safety procedures.	3.4800	.50467
V8	Management has excellent safety maintenance standards.	3.5400	.50346
V9	Management involvement in safety issues has a high priority in the organization.	3.5000	.50508
V10	Management gets personally involved in safety activities or events.	3.4800	.57994
Factor 2	**Items relating to Employee Involvement**		
V11	Employees are involved in informing management of important safety issues.	3.1200	.77301
V12	Employees feel involved when safety procedures / instructions / rules are developed or reviewed.	3.1000	.70711
V13	Employees have an opportunity of influencing the decisions to be made by management.	3.1600	.65027
V14	Employees clearly understand their responsibilities for safety.	3.2000	.57143
V15	I am satisfied with employee involvement in safety at work.	3.1800	.66055

Factor 3	Items relating Employee Empowerment		
V16	Employees are consulted on matters that affect how they do their job.	3.1600	.73845
V17	Employees are actively encouraged to improve safety.	3.1000	.76265
V18	Employees have good control over the safety outcomes of their job.	3.1400	.70015
V19	Employees can make decisions on safety issues, even if the decisions may lower the productivity.	3.1200	.74615
V20	Management ensures that employees are responsible and accountable for safe operations.	3.4200	.57463
Factor 4	**Items relating to Communication**		
V21	Employees are informed of the meeting outcomes that address safety.	3.3400	.65807
V22	Safety information is brought to employees' attention by management.	3.4400	.61146
V23	I am satisfied with the way I am kept informed of safety at work.	3.3200	.65278
V24	There is mutual trust between management and employees based on honesty and truthfulness.	3.2200	.67883
V25	Employees trust the confidentiality of the reporting or investigation process.	3.2600	.66425
V26	Employees are willing to report near misses.	3.1000	.61445
V27	Employees trust the systems that they need to use and follow in their job.	3.1600	.58414
Factor 5	**Items relating to Reporting**		
V28	Employees are familiar with the systems for formally reporting safety issues.	3.3800	.60238
V29	When an employee reports a safety problem, management acts quickly to correct the safety issues.	3.3600	.63116
V30	Safety issues raised by employees are communicated regularly to all employees.	3.4000	.60609
V31	Employees do not hesitate to report minor injuries or incidents.	3.4800	.61412
V32	I am satisfied with the way management deals with the safety reports.	3.2600	.72309
Factor 6	**Items relating to Fairness**		
V33	Investigation team members are trained to identify the root causes rather than blaming the human error.	3.2200	.58169
V34	There is a consistency regarding disciplinary measures for incidents or accidents.	3.1600	.61809
V35	I feel that employees are willing to report incidents because they know that they are treated in a fair manner.	3.2800	.64015
V36	Management practices a fair appraisal system.	3.1800	.62890
V37	I am satisfied with the follow-up measures taken after accidents, incidents or near misses.	3.2800	.70102
Factor 7	**Items relating to Learning**		
V38	The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.	3.6000	.53452
V39	Lessons learned from incidents or accidents are published, such as in company's notice or newsletter.	3.4400	.61146
V40	The issue of safety is shared by employees as a best practice through review and analysis.	3.5600	.64397
V41	Employees are encouraged to report unsafe conditions.	3.2400	.71600
V42	Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident	3.3200	.71257

Factor 8	Items relating to Teamwork		
V43	Management rewards individual performance, and rewards other team members based on team performance	3.1400	.72871
V44	Employees who work in my team are fully committed to safety.	3.4600	.67643
V45	Co-workers give advice to each other on how to work safely.	3.5000	.67763
V46	When things get busy, employees can seek help from others.	3.5000	.67763
V47	I must work safely if I want to keep the respect of others in my team.	3.4400	.54060
Factor 9	**Items relating to Reward System**		
V48	Employees' performance relating to safety is evaluated according to the standards.	3.1400	.72871
V49	Employees understand 'acceptable and unacceptable safety behaviours' at workplace.	3.3800	.63535
V50	Employees who cause an accident or incident are held sufficiently accountable for their actions.	3.3400	.62629
V51	Employees with good safety performance are recognized and rewarded by management.	3.2000	.69985
V52	Employees with good safety performance are recognized and rewarded by management.	3.2400	.62466
Factor 10	**Items relating to Training**		
V53	Training covers all the safety risks associated with the work for which employees are responsible.	3.5600	.50143
V54	Adequate safety training is given by management to perform the job safely.	3.5400	.54248
V55	Employees are consulted to establish their training needs.	3.5400	.57888
V56	Management places a high priority on safety training.	3.4800	.61412
V57	I am satisfied with competency of training, such as the ways of training.	3.4400	.54060
V58	All the safety rules or procedures are strictly followed here.	3.4800	.64650

5.2.2 Results of the Cronbach's alpha Reliability Test for the Measurement Scale

The author ran reliability tests to compute the Cronbach's alpha values for each of the ten factors of safety culture in the questionnaire. The results of the pilot were shown in Table: 5.2.2 - *Cronbach's alpha Value for Safety Culture Measurement Scale*, where the lowest Cronbach's alpha value was 0.723 well above the threshold alpha level of ≥ 0.7. To conclude, the high Cronbach's alpha values indicated that the measurement scale was reliable in terms of good internal consistency of the items in the scale.

Table: 5.2.2 – Cronbach's alpha Value for Safety Culture Measurement Scale (N=50)
Extracts from: the SPSS worksheets

Factors of Safety Culture	Cronbach's alpha Value
D1 - Management Commitment to Safety	0.916
D2 - Employee Involvement	0.885
D3 - Employee Empowerment	0.932
D4 - Communication	0.914
D5 - Reporting	0.826
D6 - Fairness	0.766
D7 - Learning	0.873
D8 - Teamwork	0.821
D9 - Reward System	0.723
D10 - Training	0.906
Y - Safety Management of Organizations	0.982

5.3 Chapter Summary

The author, having edited the selected items of the source questionnaires after the expert reviews, designed a self-administered questionnaire for this survey research. In addition, the author by doing a pilot study confirmed the appropriateness of this measurement tool as survey research instrument, the feasibility of subject recruitment, the feasibility of study process, and the methods of data entry and analysis. Furthermore, the reliability of the measurement scale was verified by the results of the Cronbach's alpha reliability tests for the internal consistency of the items in the scale before conducting the larger-scale survey research.

In the next chapter, the author describes the data reduction technique by factor analysis to explore a simpler structure of the data set, and reports the findings and analyses of the survey research, based on the descriptive and inferential statistics in the field of statistics.

Chapter VI: FINDINGS AND ANALYSES

6.0 Introduction

This chapter consists of two parts. In the first part, the author illustrates the development of a new measurement scale through factor analysis. The author by using factor analysis intends to reduce the items to fewer sets of related factors, explore the correlations among a group of items, and eventually transform the variables into a simpler data structure for a measurement scale. Then, the author confirms the internal consistency reliability of the new measurement scale by using the Cronbach's alpha reliability coefficients.

In the second part, the author presents the analyses of the responses, the general characteristics of the respondents along with their demographics, as well as the findings and analyses of the survey research, including the outputs of descriptive and inferential statistics, and also examines the relationships between variables for answering the research questions through hypothesis testing.

6.1 Factor Analysis

"Factor analysis (FA)", which is a data reduction technique, statistically aggregates a large amount of items into fewer sets of factors, based on their underlying correlation patterns (Gorsuch, 1983).

According to Gorsuch (1983), there are several ways to conduct the FA. Fabringer et al. (1999) suggest that if the goal is to uncover un-observed items and arrive at a more parsimonious solution for a set of items, "Exploratory factor analysis" (EFA) is more appropriate than other analytic techniques. In contrast, "Confirmatory factor analysis" is used for a priori fixed number of factors (Fabringer et al., 1999; Kline, 2002).

For this study, the author chose the EFA, as he expected to know the underlying structure of the data set for developing a measurement scale. In the EFA approach, a large number of the questionnaire items were reduced into a fewer number of factors for the independent variables of the study.

6.1.1 Exploratory Factor Analysis

The EFA was conducted on the 58 questionnaire items about employee's perceptions with the full data, to establish a simpler data structure for confirming the number of factors to the items. To make valid predictions from the analyses of data, collated data was checked for applicability of factor analysis and regression analyses.

6.1.1.1 Data Suitability

To confirm data suitability, the author before analyzing the data set verified the data assumptions (Norusis, 2006; Yin, 2009), including missing values, multicollinearity, the diagonalization assumption for the appropriateness of the data set, and the normality of residuals and outliers.

6.1.1.1.1 Missing Values

In the EFA output, seven missing values indicated as missing data in the SPSS. In statistics, missing values refer either to system or user missing values. System missing values are the values that are absent from the data, while user missing values are values that are not visible when analyzing or editing the data. Missing values, which should exclude from the output, may influence the conclusions drawn from the data.

The author checked the missing values in the Table of descriptive statistics where seven missing values were identified from the 221 cases (7/221=3.17% missing data). To look for the causes, the author inspected "the Data and the Variable view sheets" of the SPSS to find if there were any typo mistakes, any values falling outside the expected range for each item, or any missing data entry per item.

To eliminate the effect of either system or user missing values, the author selected the option of "List-wise exclusion analysis" as a function in the SPSS, with which only data without missing values were analyzed. Hence, the seven missing values were only indications and recorded as missing data without influencing the analysis of the data set. The final sample size of 214 was adequate for statistical analysis.

6.1.1.1.2 Multicollinearity

Researchers should fulfill the assumption of normality with no multi-collinearity in the data, and absence of singularity in the data. Multi-collinearity refers to high

inter-correlations between two or more independent variables. According to Kutner et. al. (2004), a very high correlation may cause a variable insignificant even though it supposes to be significant. When the independent variables are too correlated with each other, it may become difficult to determine the unique contribution of the variables. Tabachnick (2010) suggests that the degree of the correlation coefficients should be less than 0.8, otherwise it is a cause of concern. The extreme case of multicollinearity is termed singularity, which means that the correlation between two independent variables is perfectly correlated. Therefore, the degree of the correlation coefficients is equivalent to 1.0.

The author examined the effects in several ways. First, findings in the Pearson's correlation matrix indicated that none of the correlation coefficients between pairs of variables exceeded 0.9. Hence, no problem of singularity was present in the data, while the determinant of the correlation matrix indicated 3.833E-25 equivalent to 0.0003833 above the threshold of 0.00001, hence there was no problem of multi-collinearity in the data.

Second, values of the "Variance Inflation Factors" (VIF) and "Collinearity Tolerance" (TOL) for each regression coefficient were checked for the effect of multicollinearity. The VIF refers to the extent to which the variables are explained by other causal variables, while the TOL is about the amount of variability of the selected variables to be explained by the other causal variables (Kutner et. al., 2004). According to Belsley et al. (2004), a high VIF gives an indication of multicollinearity problem due to very strong correlation among independent variable. Hence, the VIF should be less than ten (Belsley et. al., 2004). Kutner et al. (2004) also warn that the VIF if exceeding 2.5 becomes a cause of concern (Kutner et al., 2004). Nevertheless, some scholars suggested that a combination of low VIF and high TOL should give no multi-collinearity, as the VIF is the reciprocal of the TOL (Belsley et al., 2004; Kutner et al., 2004).

As revealed in Table: 6.1.1.1.2 - *Coefficients for Collinearity Assessment*, values of the VIF for all variables were below 2.5, while the TOL was well above 0.5 for all coefficients. All variables were reasonably correlated, neither very highly correlated (e.g. R>0.9) nor perfectly correlated, with no problems in multicollinearity or even singularity in the data, hence the data set held good for further analyses.

Table: 6.1.1.1.2 – Coefficients for Collinearity Assessment
Extracts from: the SPSS worksheets

Model		Collinearity Statistics	
		Collinearity Tolerance (TOL)	**Variance Inflation Factors (VIF)**
1	**(Constant)**		
	F1 - Management Commitment	.617	1.620
	F2 - Employee Empowerment	.525	1.904
	F3 - Communication	.518	1.929
	F4 - Learning	.607	1.648
	F5 - Reporting	.588	1.702
	F6 - Training	.701	1.427
	F7 - Teamwork	.867	1.154
	F8 - Fairness	.753	1.328
a. Dependent Variable: Y - Safety Management of Organizations			

6.1.1.1.3 Diagonalization

To check the diagonalization assumption of factor analysis for the appropriateness of the data set, both the "Kaiser-Meyer-Olkin measure" (KMO) and the "Bartlett's test of Sphericity" were used.

The KMO test measures the sampling adequacy that there are sufficient items for each factor. Its values range from zero to one (Deviant, 2017). Value at 0.00 indicates unacceptable, while the value of 0.90 or above is described as marvelous (Hutcheson & Sofroniou, 1999). It is however suggested that the KMO value should be 0.7 or above for satisfactorily performing factor analysis (Kaiser, 1974).

In the EFA results, the KMO value was 0.817 classed as meritorious for the independent variables of safety culture, and 0.789 as middling for the dependent variables known as the perceived safety performance of organizations (Hair et al., 1998). Both values demonstrated high levels of sampling adequacy (See *Tables: 6.1.1.1.3a - Values of KMO and Bartlett's Test for the Safety Culture Measurement Scale & 6.1.1.1.3b - Values of KMO and Bartlett's Test for the Safety Performance Measurement Scale).* Apparently, items were sufficient and could be predicted by each factor. Hence, the data set was appropriate to work with the EFA.

The Bartlett's test of Sphericity is another measure of sampling adequacy for the strength of correlations between items. As indicated in the above-mentioned Tables: 6.1.1.1.3a and 6.1.1.1.3b, the overall significance of correlations amongst all items was 0.000 (p<0.05

threshold), proving that the correlation matrix was significantly different from an identity matrix (Shi et al., 2014). Hence, the items were sufficiently correlated, forming the reasonable bases for a satisfactory factor analysis to proceed (Field, 2013).

Table: 6.1.1.1.3a – Values of KMO and Bartlett's Test for the Safety Culture Measurement Scale (Independent Variables)
Sourced from: the SPSS worksheets

Kaiser-Meyer-Olkin (KMO)	Measure of Sampling Adequacy	0.817
Bartlett's Test of Sphericity	Approx. Chi-Square	11028.667
	df	1128
	Level of Significance	0.000

Table: 6.1.1.1.3b – Values of KMO and Bartlett's Test for the Safety Performance Measurement Scale (Dependent Variable)
Sourced from: the SPSS worksheets

Kaiser-Meyer-Olkin (KMO)	Measure of Sampling Adequacy	0.789
Bartlett's Test of Sphericity	Approx. Chi-Square	1351.374
	df	6
	Level of Significance	0.000

To conclude, the high levels of the KMO's sampling adequacy for the measurement scales, the significance values of 0.000 for the Bartlett's tests of Sphericity, and the highly correlated coefficients between items suggested that none of the items should be removed for conducting factor analysis. Hence, the appropriateness of the data set for factorability was proved.

6.1.1.1.4 Normality of Residuals and Outliers

To determine if the residuals of regression follow the assumption of normality for regression, a normal "Predicted Probability Plot of Regression" (P-P Plot of Regression) may be used.

As indicated in the scatter plot (See Figure: 6.1.1.1.4 of Appendix: D – *Normal P-P Plot of Regression*), the vertical distance between the data-points and the diagonal regression line is the residual between the actual value of the dependent variable and the predicted value of the regression model. Any departure from the diagonal regression line running from the bottom left to the top right indicates deviation from normality (Aczel, 2002).

Furthermore, the presence of outliers may weaken the predictive power of the regression model as the line of best fit, thus affecting the assumption of normality for the data set

(Aczel, 2002).

As revealed in the plot of residual output, the data-points of observed responses fell close to the fitted regression line forming approximately a linear pattern without much scattered responses or any outliers lying outside the overall pattern in the distribution. Hence, the model fit the data well and the residuals were approximately normally distributed.

6.1.1.2 Methods of Factor Extraction, Factor Retention and Factor Rotation

For the EFA, the methodological decisions on the extraction, retention and rotation of factors, and the communalities for the items are described

6.1.1.2.1 Factor Extraction

In factor analysis, there are several ways to extract factors from the data set. "Principal components analysis" (PCA) is commonly used to extract principal components or factors from a data set for analysis. It is a factor extraction technique used in the SPSS with eigenvalues over 1.0 to be extracted (Burns & Burns, 2008). By the PCA, items which are correlated with one another but largely independent of other sets of items are combined into a component or factor. The objective is to account for as much of the total variance in the items as possible (Burns & Burns, 2008). Hence, the author employed the PCA as an appropriate extraction method to yield an initial factor solution.

6.1.1.2.2 Factor Retention

In determining the amount of factors to retain in factor analysis, both the Kaiser's Normalization Criterion and the Scree test are the common methods (Hair et al., 1998; Kaiser, 1974). According to the Kaiser's Normalization Criterion, the default eigenvalue exceeding one is used as the cut-off value for extraction (Yong & Pearce, 2013). For example, factors with eigenvalues>1 are retained as extracted factors (Hair et al., 1998).

Hence, the Kaiser's Normalization Criterion was used to determine an initial set of factors, while the Scree plot served as an alternative measure for the author to indicate the number of factors to retain, as it was not easy to identify the break point where the curve should start to flatten.

6.1.1.2.3 Factor Rotation

After deciding upon the number of factors to extract and retain, the author interpreted the

factor loadings in order to identify the meaningful factors.

Factor rotation helps reduce the complexity of factor loadings. For example, rotation maximizes the loadings of each item on one of the extracted factors, while minimizing the loadings on all other factors. Regrouping the number of items, all items will have high factor loadings on one factor only, thus making the factor structure simpler to interpret (Hair et al., 1998).

There are two modes of rotation, the orthogonal and oblique rotations. The orthogonal rotation assumes that the factors after rotation are independent, uncorrelated with each other. In contrast, the oblique rotation considers factors are not independent but correlated (Gorsuch, 1983).

Thompson and Daniel (1996) suggest that employing a mode of rotation, either an orthogonal or oblique rotation largely relies on the purpose of analysis. If the purpose is to produce a result that best fits the data, an oblique rotation seems to be the choice. Conversely, if the purpose is to replicate the factor analytic results, then an orthogonal rotation is preferable (Thompson & Daniel, 1996).

For this study, several advantages of adopting an orthogonal rotation could be achieved. Firstly, the factors could remain perfectly un-correlated with one another. Secondly, the orthogonal rotation could improve interpretability of the factor solution. By rotating the factor matrix to a simple structure, researchers could know how well a set of items would be loaded on each factor (Kline, 2002; Pedhazur & Schmelkin, 1991). Hence, the factor solution could be more parsimonious, and in theory it could be more replicable (Gorsuch, 1983; Pedhazur & Schmelkin, 1991).

There are four orthogonal rotations, including equamax, orthomax, quartimax, and varimax (Gorsuch, 1983). Amongst the methods of factor rotation, the advantages of the orthogonal rotation by varimax method are in two folds.

In reality, factor loadings are simple correlations of items with factors, while the uncorrelated factors are easier to interpret, and the rotated solution is used to estimate the unique contribution of each factor.

In theory, results of the orthogonal rotation are likely to be replicated in future studies. There should be less sampling errors in the orthogonal rotation according to Kaiser (1974). Furthermore, Kim and Mueller (1978) add that Varimax method is the most common orthogonal rotation, and their views are agreed by Tabachnick and Fiddell (2010) that varimax method of orthogonal rotation fits well when an orthogonal rotation is applied.

To conclude, the three methods can meet the statistical assumptions, namely the PCA, Factors with eigenvalues greater than 1.0, and the varimax method, for the factor extraction, retention and rotation criteria of this survey research.

The PCA was used for factor extraction to reduce the 58 items into a fewer set of factors (Fabrigar et. al., 1999), while the criteria to retain all the factors with the default eigenvalues greater than 1.0 (Kaiser Criterion) in the SPSS was adopted as the cutoff value for determining an initial set of factors. Regarding factor rotation, the factor structure was rotated using the orthogonal rotation by varimax method without changing the basic aspects of the analysis, such as factor loadings or variance explained (Hair et. al., 1998) but the factors were kept perfectly uncorrelated to meet the statistical assumptions of multiple regression analyses (Osborne & Costello, 2009).

6.1.1.2.4 Communalities

'Communalities' are estimates of the variance in each item (Crocker & Algina, 1986). In Table: 6.1.1.2.4 of Appendix: D – *Communalities before and after Extraction for the Items of Safety Culture*, the initial communalities are accounted for by all factors, while the extracted communalities indicate the amount of variance in each item explained by the retained factors (Crocker & Algina, 1986). Communalities range from zero with no correlation to 1.0 with perfect correlation (Crocker & Algina, 1986). To be acceptable, the communality value for each item after extraction should be above 0.4 (Osborne & Costello, 2009; Yong & Pearce, 2013). Items with the value of extracted communality below the threshold may not fit well with the factor solution, and hence are removed from the analyses.

As revealed in Table: 6.1.1.2.4 of Appendix: D – *Communalities before and after Extraction for the Items of Safety Culture*, the communalities after extraction for the items ranged between 0.414 and 0.87 had the least variance of 0.414. When averaging all the extracted communalities, the communalities were 0.725, accounted for 72.5% of the

variance explained. Hence, the extracted communality values for the items were acceptable, as high as above 0.7 on average, thus proving that the items fit well with the factor solution.

6.2 Results of Empirical Analyses

This section describes the development of a new measurement scale through factor analysis in the early stage of the empirical analyses. Then, it presents the outputs of the descriptive and inferential statistics, and the results of hypothesis testing.

6.2.1 Exploratory Factor Analysis

Exploratory factor analysis (EFA) was conducted to build and evaluate the measurement scales. With varimax method of orthogonal rotation, EFA reduced the 58 items of safety culture into a fewer and manageable set of underlying factors.

6.2.1.1 Process of Factor Extraction, Retention & Rotation (Between First & Fourth EFA Runs)

A cut-off value of 0.5 was used to be the significant level for setting the factor loadings (Field, 2013; Hair et al., 1998; Tabachnick & Fidell, 2010). Sometimes, there could be too few items left for interpretability when setting to this level. According to Tabachnick & Fidell (2010), 0.4 can be an optimal level for the significance of factor loadings to retain items after rotation, and to explain the amount of variability in a data set. Hence, the author set the factor extraction criterion for the significance of factor loadings to 0.4 cut-off level, which was neither too liberal nor too conservative to retain the items (Hair et al., 1998; Tabachnick & Fidell, 2010). In this setting, a reasonable amount of items was left for interpretability with factor loadings of less than 0.4 not extracted and displayed in the matrix.

To identify the amount of final factors of safety culture to retain in the analysis, the author performed a series of factor analyses on the initial 58 items. On one hand, the Table: 6.2.1.1a - *Total Variance Explained (First EFA Run for the Initial 58 Items)* indicates 'the factors before and after extraction, and after rotation alongside with their eigenvalues, the percentage of variance attributable to each factor, and the cumulative variance of the factors'. To identify the factors, the Principal Component Analysis (PCA) is the default extraction method in the SPSS (Yong & Pearce, 2013).

On the other hand, the Rotated Component Matrix (See Table: 6.2.1.4.a - *Eight-Factor Structure of Safety Culture*) shows a matrix of factor loadings for each item to each factor. The values of factor loadings indicate the correlations between the items and the corresponding factors. The higher the factor loadings of the items, the more the items contribute to a factor (Gorsuch, 1983).

The first EFA run extracted 11 factors based on the initial 58 items. As revealed in Table: 6.2.1.1a - *Total Variance Explained*, an analysis of the 58 items yielded an 11-factor solution. These 11 factors with eigenvalues greater than 1.0 explained 77.518% of the total variance after rotation. In this structure, the total variance was 74.841% by 10 factors, 71.138% by 9 factors, 66.936% by 8 factors, 61.073% by 7 factors, and 54.597% (which was below 60%) by six factors, respectively. Zikmund et al. (2010) suggested that a factor solution accounted for more than 60% of the variance was acceptable in social sciences. Hence, the author opted for a maximum variance above 60% in the final factor solution.

Table: 6.2.1.1a – Total Variance Explained (First EFA Run for the Initial 58 Items)
Extracts from: the SPSS worksheets

Component	Initial Eigenvalues			Total Variance Explained			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.616	30.373	30.373	17.616	30.373	30.373	6.639	11.446	11.446
2	5.328	9.186	39.559	5.328	9.186	39.559	6.554	11.300	22.746
3	4.097	7.063	46.622	4.097	7.063	46.622	5.634	9.714	32.460
4	3.317	5.719	52.341	3.317	5.719	52.341	4.960	8.551	41.011
5	3.155	5.439	57.780	3.155	5.439	57.780	4.102	7.073	48.083
6	2.833	4.884	62.664	2.833	4.884	62.664	3.778	6.514	54.597
7	2.379	4.102	66.767	2.379	4.102	66.767	3.756	6.476	61.073
8	1.991	3.433	70.200	1.991	3.433	70.200	3.400	5.863	66.936
9	1.724	2.973	73.173	1.724	2.973	73.173	2.437	4.202	71.138
10	1.318	2.273	75.446	1.318	2.273	75.446	2.148	3.703	74.841
11	1.202	2.072	77.518	1.202	2.072	77.518	1.553	2.677	77.518
Extraction Method: Principal Component Analysis									

For each extracted factor, the author tried labelling first based on their specific theme with due regard to the factor loadings. For example, amongst the 11 items loaded on the Factor 1, five of the items were highly related to management commitment to safety, three were concerned about the perceived resources for safety, the other two were associated with management involvement in safety, and the remaining one dealt with reporting. Taking

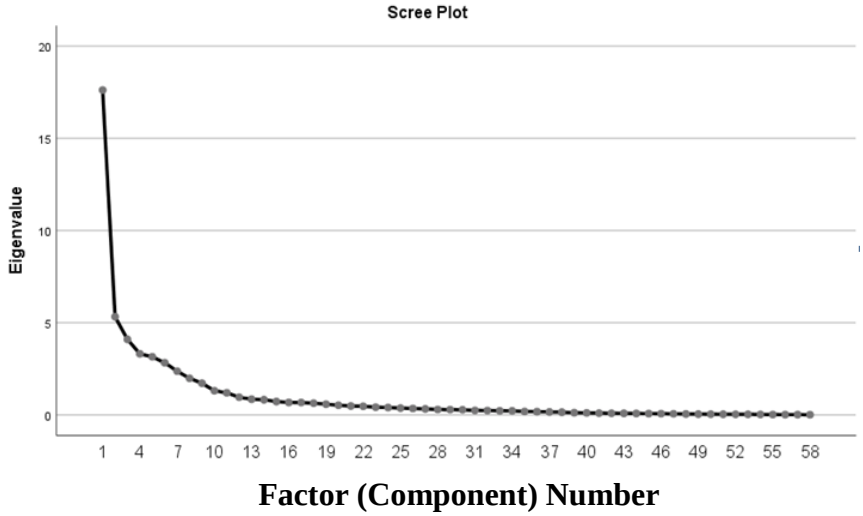
into consideration of their factor loadings and themes in similarity, the author named it as 'Management Commitment' after the first EFA run.

In the first few EFA runs, the author encountered a number of cross-loaded items. An example as revealed in Table: 6.2.1.1c – *Total Variance Explained*, eight out of the 58 items in the 11-factor structure had the interpretability issue of cross-loaded items with 'One item loaded on more than one factor'. If they were deleted accordingly, there would not be any item left at the Factor 11, and only two items would be retainable at the Factor 9 and the Factor 10 respectively.

Therefore, the author shifted from eigenvalue requirement to a fixed number of factors as an option in the SPSS, to find whether more items would join the Factor 9 and the Factor 10, or even the Factor 8 in the second EFA run.

Apparently, it was indicated in Figure: 6.2.1.1b – *Scree Plot* that two elbows were located in the Scree plot, one was positioned at the Factor 4 and the other was at the Factor 10. Though the scree plot did not accurately indicate the break point where the curve should start to scree, it helped the author to determine with which the number of factors (e.g. the Factor 10) to start in the next EFA run.

Figure: 6.2.1.1b – Scree Plot
Sourced from: the SPSS worksheets



In the second EFA run, the author started fixing the number of factors at the Factor 10. The result retracted ten factors in a slightly different factor structure that explained 75.446% of the total variance after rotation, and followed by the total variance of 72.140% by 9 factors,

67.978% by 8 factors, and 62.011% by 7 factors above the 60% threshold.

If all of the multi-factor loadings were deleted, none of items would retain at the Factor 10, and merely two items would be retainable at the Factor 9. To attain an interpretable factor solution, the author tried reducing the number of factors from ten to nine in the third EFA run, without deleting any items from the analysis, in order to check what the factor structure would present.

Then, the author ran the third EFA trial with the factors fixed at nine. The 9-factor structure explained 73.173% of the total variance, while 69.048% by 8 factors and 62.962% by 7 factors respectively. Again, Factor 9 would consist of only one single item, and 3 items loaded on Factor 8 alone, if deleting all cross loadings.

In the fourth EFA run, the author fixed the number of factors at 8 without taking away any items from the analysis, the output yielded an eight-factor solution based on 58 items with the total variance of 70.200% explained, while 64.260% accounted for by 7 factors (See Table: 6.2.1.1c - *Total Variance Explained*).

Table: 6.2.1.1c – Total Variance Explained (Fourth EFA Run for 58 Items in Safety Culture)

Extracts from: the SPSS worksheets

Component	Initial Eigenvalues			Total Variance Explained			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.616	30.373	30.373	17.616	30.373	30.373	7.127	12.287	12.287
2	5.328	9.186	39.559	5.328	9.186	39.559	6.680	11.517	23.804
3	4.097	7.063	46.622	4.097	7.063	46.622	5.630	9.707	33.511
4	3.317	5.719	52.341	3.317	5.719	52.341	5.071	8.743	42.254
5	3.155	5.439	57.780	3.155	5.439	57.780	4.725	8.146	50.400
6	2.833	4.884	62.664	2.833	4.884	62.664	4.108	7.083	57.483
7	2.379	4.102	66.767	2.379	4.102	66.767	3.930	6.777	64.260
8	1.991	3.433	70.200	1.991	3.433	70.200	3.445	5.940	70.200
9	1.724	2.973	73.173						
10	1.318	2.273	75.446						
11	1.202	2.072	77.518						
Extraction Method: Principal Component Analysis									

6.2.1.2 Process of Factor Extraction, Retention, and Rotation (Between Fifth and Seventh EFA Runs)

The factor extraction process repeated with the number of items held constant while reducing the number of factors of safety culture until the fifth EFA run. With factors fixed at eight, the author started deleting the number of cross-loaded items.

Before conducting the fifth EFA run, the first four items loaded on two different factors were deleted. These 4 cross-loaded items included 'V12: Employees feel involved when safety procedures / instructions / rules are developed or reviewed', 'V13: Employees have an opportunity of influencing the decisions to be made by management', and 'V14: Employees clearly understand their responsibilities for safety', and 'V15: I am satisfied with employee involvement in safety at work'. The fifth EFA's factor structure retained 8 factors with 70.563% total variance explained, while 64.326% accounted for by 7 factors.

Before conducting the sixth EFA run, the author deleted four more cross-loaded items. The 4 items, including 'V26: Employees are willing to report near misses', 'V31: Employees do not hesitate to report minor injuries or incidents', 'V48: Employees' performance relating to safety is evaluated according to the standards', and 'V51: Employees with good safety performance are recognized and rewarded by management' were removed from the analysis. While, 'V47: I must work safely if I want to keep the respect of others in my team' itself had a factor loading of less than 0.4, and hence were not extracted or displayed in the matrix due to practical insignificance.

The sixth EFA result with eight factors explained 72.144% of total variance, while 65.819% accounted for by seven factors. The factor structure left one single item with cross-loadings only. Before conducting the seventh EFA, the author deleted the last problematic item 'V33: Investigation team members are trained to identify the root causes rather than blaming the human error'.

After the seventh run, the final 8-factor structure got no more cross-loadings. The 48 items clustered into 8 factors explained 72.504% of the total variance, and 66.438% accounted for by seven factors (See Table: 6.2.1.2a - *Total Variance Explained*).

Table: 6.2.1.2a – Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)

Adapted from: the SPSS worksheets

Component	Initial Eigenvalues			Total Variance Explained			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.533	30.278	30.278	14.533	30.278	30.278	6.178	12.870	12.870
2	4.489	9.352	39.630	4.489	9.352	39.630	5.122	10.671	23.541
3	3.900	8.126	47.755	3.900	8.126	47.755	4.562	9.505	33.045
4	3.177	6.620	54.375	3.177	6.620	54.375	4.366	9.096	42.141
5	2.528	5.267	59.642	2.528	5.267	59.642	4.083	8.505	50.646
6	2.371	4.939	64.582	2.371	4.939	64.582	3.839	7.998	58.645
7	1.939	4.041	68.622	1.939	4.041	68.622	3.741	7.794	66.438
8	1.863	3.882	72.504	1.863	3.882	72.504	2.912	6.066	72.504
9	1.502	3.128	75.632						
10	1.193	2.486	78.118						
11	.920	1.916	80.034						
Extraction Method: Principal Component Analysis									

In essence, the final factor structure, which was based on 48 items, yielded an 8-factor solution. The percentage of 'Total Variance Explained at 8-factor Solution' indicated that the author was able to explain the maximum variability of 72.504% in the dependent variable, with a fewer number of interpretable factors after the seventh EFA run (See Table: 6.2.1.2a - *Total Variance Explained*).

Compared to the same number of factor solution after the first EFA run, there was an increase of 5.568% in the Total Variance Explained (See Table: 6.2.1.2b - *Increase in Percentage of Total Variance Explained at different Factor Solutions*), with all conditions held constant (e.g. 0.4 as cut-off level for factor loadings to retain items after extraction and eigenvalues greater than 1.0 were adopted).

Table: 6.2.1.2b – Increase in Percentage of Total Variance Explained at different Factor Solutions

EFA Run / Factor Solution	Phases	% of Total Variance Explained at 8-factor Solution	Increased % of Total Variance Explained since the 1st EFA Run
1st EFA / 11-factor Solution	Keeping same items but reducing factors	66.9%	0%
4th EFA / 8-factor Solution	Keeping same factors but starting to reduce items	70.2%	+3.264% (Increase)
7th EFA / 8-factor Solution	Achieving the least 8-factor structure with the highest % of Total Variance Explained	72.5%	+5.568% (Increase)

6.2.1.3 Process of Factor Extraction, Retention, and Rotation (Safety Performance of Organizations)

Eigenvalues in respect to each factor or component produced a percentage of variance explained by the four items for the safety performance of organizations before extraction, as indicated in Table: 6.2.1.3 - *Total Variance Explained*. The Initial Eigenvalues revealed that the Component or Factor 1 explained a relatively high percentage of variance (92.292%) with eigenvalue greater one. The subsequent factors, including the Factor 2 (5.386%), the Factor 3 (1.394%) and the Factor 4 (0.927%) expressed eigenvalues less than one.

In the result, only the Factor 1 retained after factor extraction, and explained 92.292% of the total variance, while the subsequent factors were not significant with their values, hence they were not extracted or displayed in the matrix.

Table: 6.2.1.3 – Total Variance Explained (Safety Performance of Organizations)
Extracts from: the SPSS worksheets

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.692	92.292	92.292	3.692	92.292	92.292
2	0.215	5.386	97.678			
3	0.056	1.394	99.073			
4	0.037	0.927	100			
Extraction Method: Principal Component Analysis						

6.2.1.4 Label the Factors

After a series of EFA runs, 10 items was deleted. The final factor solution extracted 8 factors accounting for 72.504% of the total variance in the dependent variable (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture*).

Each of the factors in the final factor structure was named according to the common theme of the items loaded on the factor with the highest loading item to be the key theme, and their names were referred to the factors of safety culture as identified in the literature.
In addition, the percentage of the variance due to each factor according to the results of the final EFA run was given (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture*).

Factor 1, which was labelled as 'Management commitment', comprised of ten items. Of the ten items, five were highly related to management commitment to safety, three were concerned about the perceived resources for safety, and two others were associated with management involvement in safety.

These items were highly related to the functions of management commitment, and being parts of the factor. For examples, management should be clear about their responsibilities for safety to demonstrate safety commitment with a positive attitude toward safety, such as making safety resources available adequately for supporting the safety management and operation of ships, and getting personally involved in the daily safety activities, like on-site observation during passenger embarkation. The items exhibited the general characteristics of management commitment to safety, though they showed differences in the description of items. Hence, the author integrated their similarities in characteristics into a single theme as management commitment.

Factor loadings of the items ranged between 0.503 and 0.853. Taking into account the factor loadings, Item 'V2: Management motivates and praises employees for working safely' was found to have the highest factor loading amongst others in this factor, while Item 'V9: Management involvement in safety issues has a high priority in the organization' was loaded with the least factor loading (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, the Factor 1 had an eigenvalue of 6.178 accounting for 12.870% of the total variance in the dependent variable after rotation (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture))*.

Factor 2, which was labelled as 'Employee empowerment', consisted of six items. Five out of the six items were highly related to employee empowerment, while the other item was concerned about employee involvement. Having carefully studied the characteristics of all items, the author interpreted them as the functions of empowered employees.

The items had factor loadings ranging from 0.624 to 0.837. Item 'V17: Employees are actively encouraged to improve safety' had the highest factor loading of 0.837, while item 'V20: Management ensures that employees are responsible and accountable for safe operations' had the least factor loading of 0.624 (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, this factor had an eigenvalue of 5.122, accounting for 10.671% of the total variance after factor rotation (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)).*

Factor 3, which was labelled as 'Communication', comprised of six items. These six items were closely related to communication to safety, founded on trust. For example, management could build a climate of trust between management and employees based on an effective communication channel in place, or management could make employees trust the systems that it was safe to report by ensuring the confidentiality of the reporting and investigation processes (Gordon et al., 2007). Hence, communication and trust were inter-related, and interpreted as communication.

These six items had factor loadings of between 0.609 and 0.868 (See Table: 4.3.2.2a). Item 'V23: I am satisfied with the way I am kept informed of safety at work' had the highest factor loading, while item 'V27: Employees trust the systems that they need to use and follow in their job' was the lowest one (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, this factor had an eigenvalue of 4.562, and accounted for 9.505% of the total variance subsequent to factor rotation (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture*)).

Factor 4, which was labelled as 'Learning', included five items. In this factor, 3 items were concerned with learning and the other two were about reward system. These 5 items were closely related to learning with factor loadings ranged between 0.513 and 0.834 (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). Item 'V50: Employees who cause an accident or incident are held sufficiently accountable for their actions' attained the highest

factor loading, while item 'V40: The issue of safety is shared by employees as a best practice through review and analysis' was the lowest one (See Table: 6.2.1.4a). Furthermore, this factor had an eigenvalue of 4.366, accounting for 9.096% of the total variance (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)).*

Factor 5, which was labelled as 'Reporting', included seven items in it. All items were closely related to employee's attitude towards reporting activities.

The factor loadings ranged between 0.520 and 0.722. For examples, item 'V28: Employees are familiar with the systems for formally reporting safety issues' had the highest loading, and item 'V32: I am satisfied with the way management deals with the safety reports' had the lowest factor loading (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, this Factor had an eigenvalue of 4.083, accounting for 8.505% of the total variance (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)*).

Factor 6, which was labelled as 'Training', comprised of six items. These six items were associated with the issues of training. In this factor, the characteristics of training and regulatory effectiveness were present. For example, training could enhance the safety knowledge, skills and attitudes of employees for performing a specific job to meet the requirements of the governing rules and regulations, thus eventually increasing the level of regulatory effectiveness through training, such as item 'V58: All the safety rules or procedures are strictly followed here'. Hence, training and regulatory effectiveness were inter-related, and interpreted as Training factor.

The factor loadings ranged between 0.565 and 0.821. Item 'V54: Adequate safety training is given by management to perform the job safely' had the highest factor loading, while 'V57: I am satisfied with competency of training, such as the ways of training' had its lowest factor loading (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, the Factor 6 had an eigenvalue of 3.839, which explained 7.998% of the total variance (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)*).

Factor 7, which was labelled as 'Teamwork', consisted of five items. These items were highly related to teamwork for safety. The factor loadings ranged between 0.444 and 0.891. Item 'V44: Employees who work in my team are fully committed to safety' had the highest factor loading on this factor, while item 'V49: Employees understand 'acceptable and unacceptable safety behaviours" at workplace' was the lowest one (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, this factor had an eigenvalue of 3.741, accounting for 7.794% of the total variance (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture*)).

Factor 8, which was labelled as 'Fairness', had three items. These items were close to the matters relating to fairness. The factor loadings ranged between 0.683 and 0.871. Taking into account factor loadings, item 'V36: Management practices a fair appraisal system' turned out as the highest factor loading, while the lowest was item 'V35: I feel that employees are willing to report incidents because they know that they are treated in a fair manner' (See Table: 6.2.1.4a – *Eight-Factor Structure of Safety Culture*). In addition, this factor had an eigenvalue of 2.912, accounting for 6.066% of the total variance (See Table: 6.2.1.2a - *Total Variance Explained (Seventh EFA Run reduced 58 to 48 Items in Safety Culture)).*

In essence, the number of factors was reduced from the first beginning of 10 to 8 in the final factor solution, with the cross-loaded items deleted after each EFA re-run.

In naming, each factor was named according to the common theme of the items loaded on the factor, but the item having the highest factor loading would be the key theme.

Based on the percentage of the variance explained by each factor, the maximum variance from the first factor (e.g. the Factor 1) to the least factor variance in the last factor (e.g. the Factor 8) were arranged in the descending order of their significance. Hence, the most important one stood at the top of the list.

Table: 6.2.1.4a – Eight-Factor Structure of Safety Culture (Rotated Component Matrix)

Extracts from: the SPSS worksheets

Items	F1 Management Commitment (10 Items)	F2 Employee Empowerment (6 Items)	F3 Communication (6 Items)	F4 Learning (5 Items)	F5 Reporting (7 Items)	F6 Training (6 Items)	F7 Teamwork (5 Items)	F8 Fairness (3 Items)
V1	.743							
V2	.853							
V3	.766							
V4	.806							
V5	.788							
V6	.661							
V7	.677							
V8	.763							
V9	.503							
V10	.570							
V11		.776						
V16		.819						
V17		.837						
V18		.817						
V19		.832						
V20		.624						
V21			.809					
V22			.686					
V23			.868					
V24			.694					
V25			.653					
V27			.609					
V28					.722			
V29					.650			
V30					.695			
V32					.520			
V34								.844
V35								.683
V36								.871
V37					.663			
V38				.678				
V39				.808				
V40				.513				
V41					.718			
V42					.715			
V43							.721	
V44							.891	
V45							.827	
V46							.865	
V49							.444	
V50				.834				

V52				.744				
V53						.747		
V54						.821		
V55						.819		
V56						.767		
V57						.565		
V58						.566		

Table: 6.2.1.4b – The Ten Deleted Items after Factor Analysis
Extracts from: the SPSS worksheets

Deleted Items	**Factor Loadings**							
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
V12	0.592		0.496					
V13	0.529		0.454					
V14	0.559		0.409					
V15	0.475		0.567					
V26	0.414		0.414		0.407			
V31		0.412	0.421		0.434			
V33				0.406				0.423
V48	0.518							0.437
V51	0.443			0.405				
V47						<0.400		

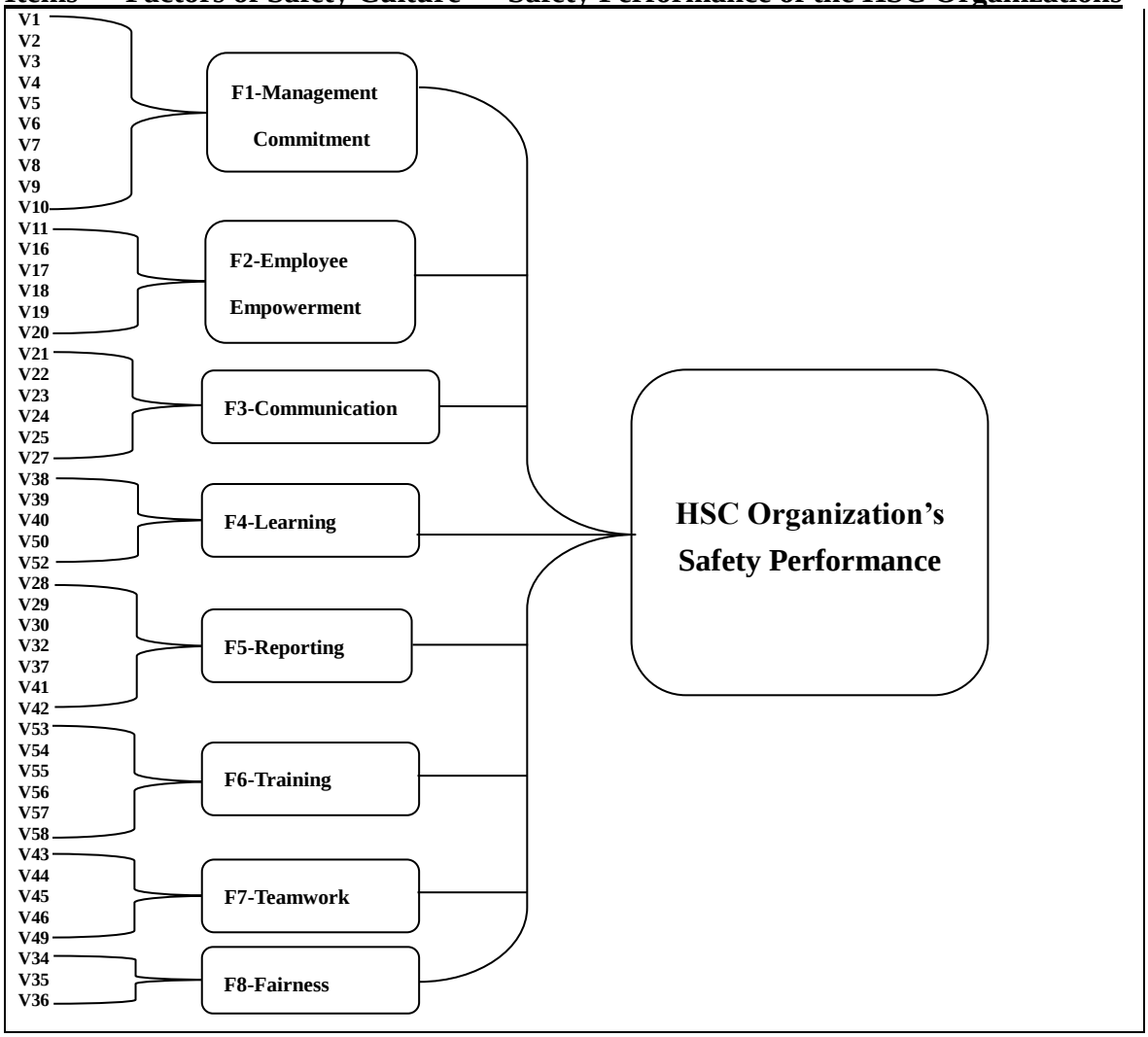
Remarks: Deleting items due to cross-loaded items or items with factor loadings below 0.4 cut-off level.

6.2.1.4.1 New Measurement Scale on Eight-factor Structure of Safety Culture

After factor analysis, a new measurement scale clustered the 48 items into eight factors of safety culture. They were 'F1 - Management Commitment (10 items)', 'F2 - Employee Empowerment (6 items)', 'F3 - Communication (6 items)', 'F4 - Learning (5 items)', 'F5 - Reporting (7 items), 'F6 - Training (6 items)', 'F7 - Teamwork (5 items)', and 'F8 - Fairness (3 items)'.

This new measurement scale was used for soliciting the HSC Officers' views on the safety performance of the HSC organizations in Hong Kong. As depicted in Figure: 6.2.1.4.1 – *Eight-factor Structure of Safety Culture for the Hong Kong Context*, the associations between the items and the factors, as well as the relationships between the eight factors of safety culture and the safety performance of organizations in this eight-factor structure are illustrated.

Figure: 6.2.1.4.1 - Eight-factor Structure of Safety Culture for the Hong Kong Context



6.2.1.4.2 Internal Consistency and Reliability of the New Measurement Scale

For this new set of items after factor analysis, the Cronbach's alpha reliability coefficient was used to measure the internal consistency and reliability of the measurement scale.

In the test results, the averaged Cronbach alpha value for each of the eight factors of safety culture was above the threshold alpha level (α) of 0.70, as suggested by a number of researchers (Nunnally, 1978). For examples, 'the Factor 2 – Employee Empowerment (0.943)' had the largest Cronbach's alpha value, while 'the Factor 7 - Teamwork (0.848)' was the lowest one (See Table: 6.2.1.4.2 - *Averaged Cronbach's alpha Values for the New Measurement Scale of Safety Culture*).

Compared to other factors, the Factor 8 (0.895) was loaded with the least number of three

items only, but adequately alpha tested for internal consistency. Evidently, it acquired a Cronbach's alpha value of 0.895 which was high above the suggested threshold alpha level. According to Tavakol and Dennick (2011), a factor structure is interpretable when there are as few as three items in a factor.

To conclude, the new measurement scale based on the final eight-factor structure of safety culture was reliable. A high level of internal consistency of the scale could be indicated.

Table: 6.2.1.4.2 – Averaged Cronbach's alpha Values for the New Measurement Scale of Safety Culture
Extracts from: the SPSS worksheets

Factors of Safety Culture (N=214)	Cronbach's alpha Value	Items / Factor
Factor 1 - Management Commitment	0.932	10
Factor 2 – Employee Empowerment	0.943	6
Factor 3 - Communication	0.912	6
Factor 4 - Learning	0.869	5
Factor 5 - Reporting	0.864	7
Factor 6 - Training	0.861	6
Factor 7 - Teamwork	0.848	5
Factor 8 - Fairness	0.895	3

6.2.2 Descriptive Statistics

This presents quantitative descriptions and summary of the survey data.

6.2.2.1 Response Rate

Between December 2019 and June 2020, an aggregate of 210 questionnaires were distributed at the Institute where 162 questionnaires were satisfactorily completed and returned to the author at the Institute. The response rate was 77.1%, equivalent to about one-third of the population of the HSC Officers, while the remaining 22.9% were completed at the Association Club with a response rate of 65.0%.

The response rate of the Institute was as high as 77.1%, compared to a relative low return of 65.0% from the Association Club. The difference was attributed to the fact that some of the questionnaires were not completed at the Association Club but taken away.

By the end of June 2020, an aggregate of 214 questionnaires were successfully completed and returned. Of the 450 HSC Officers in the population (See Table: 6.2.2.1 - *Number of Questionnaires returned from Survey Locations*), 290 questionnaires were sent with 214 duly completed and returned. The overall response rate was 73.8% that was accounted for

47.6 % of the population.

In essence, the author collected nearly half of the target population, which was equivalent to 214 responses to be representative of the population studied. Typically, 'the response rate to survey' in published peer-reviewed research was below 50% (Baruch & Holtom, 2008). Statistically, the high response rate of the samples at 73.8% on average should be able to generalize the results of this study to the population.

Table: 6.2.2.1 - Number of Questionnaires returned from Survey Locations

Locations for Delivery and Return of Questionnaires	Questionnaires		Return Rate	Qualified Questionnaires	Response Rate
	Sent	Returned			
The Institute	210	165	78.6%	162	77.1%
The Association Club	80	54	67.5%	52	65.0%
Total	**290**	**219**	**75.5%**	**214**	**73.8%**

6.2.2.2 Analyses of the Responses

This section presents a summary of the 214 respondents' perceptions of the safety performance of the HSC organizations after the questionnaire-based survey research conducted on the 48 items, including the outcomes of the respondents' levels of agreement with the items of each factor of safety culture.

Respondents were asked to express their degree of agreement on a five-point Likert scale ranging from 5= 'Strongly agree' to 1='Strongly disagree' to indicate how strongly they agreed or disagreed with the statements, where a higher value on the scale indicated a more effective safety culture.

6.2.2.2.1 Management Commitment (F1)

'Management commitment' was the first significant factor of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.1 - *Analysis of the Reponses (F1 - Management Commitment*), more than half of the participating HSC Officers felt that management cared for the safety of employees working at workplace (62.0%), with adequate number of employees deployed (55.2%) and the essential equipment needed to complete their work (56.1%) according to the safety procedures specified in the code of practice. Nearly half of the respondents believed that management was eager to invest money and effort to improve safety (46.2%). No wonder why more than half of the

respondents felt that management involvement in safety was a high priority in organizations (59.3%).

Concerning the safety activities or events, nearly half of the respondents perceived that management got personally involved (49.8%). More than half expressed that management had excellent safety maintenance standards (57.9%), and they believed that management tried all possible means to prevent accident or incident from happening (57.0%).

In addition, more than half of the respondents agreed that management motivated and praised employees for working safely (55.2%), and they asserted that management showed concern if safety procedures were not followed (54.8%). In general, more than half of the respondents positively agreed with the management commitment.

Nevertheless, 10% or less than 10% of the total respondents disagreed that management motivated and praised employees for working safely (10.0%). Due regard should be paid to the management involvement in safety activities or events (7.7%), safety concern about non-compliance with safety procedures (6.8%), and safety measures to prevent accident or incident from happening (5.4%).

Table: 6.2.2.2.1-Analysis of the Reponses (F1 - Management Commitment)

Extracts from: the SPSS worksheets

10 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 1	Management Commitment	%	%	%	%	%
V1	Management really cares about the safety of employees who work here.	0	4.5	30.3	62.0	.9
V8	Management has excellent safety maintenance standards.	0	.9	38.0	57.9	0
V7	Employees can get the equipment that they need to work according to the safety procedures.	0	0	40.7	56.1	0
V9	Management involvement in safety issues has a high priority in the organization.	0	3.6	33.9	59.3	0
V6	There are enough employees available to get the job done according to the safety procedures.	0	0	41.6	55.2	0
V5	Management does all it can to prevent accident or incident from happening.	0	5.4	34.4	57.0	0
V4	Management shows concern if safety procedures are not followed.	0	6.8	35.3	54.8	0
V2	Management motivates and praises employees for working safely.	0	10.0	30.8	55.2	.9
V3	Management is willing to invest money and effort to improve safety.	0	2.7	48.0	46.2	0
V10	Management gets personally involved in safety activities or events.	0	7.7	39.4	49.8	0

6.2.2.2.2 Employee Empowerment (F2)

'Employee empowerment' was the second significant factor of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.2 - *Analysis of the Reponses (F2 - Employee Empowerment*), nearly half of the participating HSC Officers believed that management enabled employees responsible and accountable for safe operations (49.8%). In addition, nearly half of respondents were in their belief that they were involved in informing management of important safety issues, and they were consulted on the matters relating to their job (48.4%). Almost half of the responses believed that they could make decisions on safety issues, even if the decisions might lower the productivity (45.7%), while less than half of the respondents believed that they had active control over the safety outcomes of their job (43.0%), and they were actively encouraged to improve safety (41.6%). In general, almost half of the respondents positively agreed with the empowerment given to employees.

However, roughly 10% of the respondents disagreed with that empowered employees were actively encouraged to improve safety (12.7%), consulted on matters relating to their job (12.7%), involved in informing management of important safety issues (9.1%). It seemed unlikely that they could make decisions on safety issues if the decisions might lower the productivity (9.9%), or were given control over the safety outcomes of their job (9.0%).

Table: 6.2.2.2.2 - Analysis of the Reponses (F2 - Employee Empowerment)
Extracts from: the SPSS worksheets

6 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 2	Employee Empowerment	%	%	%	%	%
V20	Management ensures that employees are responsible and accountable for safe operations.	0	3.2	43.9	49.8	0
V11	Employees are involved in informing management of important safety issues.	1.4	7.7	39.4	48.4	0
V16	Employees are consulted on matters that affect how they do their job.	1.4	**11.3**	35.7	48.4	0
V19	Employees can make decisions on safety issues, even if the decisions may lower the productivity.	.9	9.0	41.2	45.7	0
V18	Employees have good control over the safety outcomes of their job.	.9	8.1	44.8	43.0	0
V17	Employees are actively encouraged to improve safety.	.9	11.8	42.5	41.6	0

6.2.2.2.3 Communication (F3)

'Communication' was the third significant influence of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.3 - *Analysis of the Reponses (F3 - Communication*), the majority of the responses agreed that safety information were brought to employees' attention by management (60.6%), while more than half of the responses believed that they were informed of the safety outcomes of meeting (54.7%), and they felt satisfied with the way they were kept informed of safety at work (53.8%).

Nearly half of the responses trusted the confidentiality of the reporting and investigation process (47.5%). In their belief, there was mutual trust between management and employees based on honesty and truthfulness (47.1%). In general, nearly half of the respondents agreed with communication at workplace.

Nevertheless, one-third of the respondents trusted the systems they used to follow in their job (38.9%), while more than half of the respondents expressed their views in neutral

position (52.5%). All in all, less than 10% but more than 5% of the responses felt dissatisfied with this factor of safety culture in respect to the organization's safety performance.

Table: 6.2.2.2.3 - Analysis of the Reponses (F3 - Communication)
Extracts from: the SPSS worksheets

6 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 3	Communication	%	%	%	%	%
V22	Safety information is brought to employees' attention by management.	0	6.3	29.9	59.7	.9
V21	Employees are informed of the meeting outcomes that address safety.	.5	5.0	36.7	53.8	.9
V23	I am satisfied with the way I am kept informed of safety at work.	.5	5.0	37.6	52.9	.9
V25	Employees trust the confidentiality of the reporting or investigation process.	.9	4.5	43.9	47.5	0
V24	There is mutual trust between management and employees based on honesty and truthfulness.	0	7.2	42.5	46.2	.9
V27	Employees trust the systems that they need to use and follow in their job.	.9	4.5	52.5	38.9	0

6.2.2.2.4 Learning (F4)

'Learning' was the fourth significant factor of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong. Refer to Table: 6.2.2.2.4 - *Analysis of the Reponses (F4 - Learning),* more than two-thirds (68.8%) of the respondents agreed that the safety system could be improved based on experience, safety news, and the recognized solutions. More than half of the respondents opined that management supported learning with incidents or accidents published, such as in company's notice or newsletter (58.4%). They also agreed with the learning approach of management to have the safety issues shared amongst employees through reviews and analyses (59.3%).

Nearly half of the respondents believed that employees involved in an accident or incident were held sufficiently accountable for their actions (47.1%). In general, nearly half of the respondents agreed with the learning approach of management.

However, less than half (43.0%) of the respondents felt that employees with good safety performance were recognized and rewarded by management, while more than half of the

responses adopted a neutral stance (51.1%). In overall, less than 5% of the respondents felt dissatisfied with this factor of safety culture in respect to the organization's safety performance.

Table: 6.2.2.2.4 - Analysis of the Reponses (F4 - Learning)
Extracts from: the SPSS worksheets

5 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 4	Learning	%	%	%	%	%
V38	The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.	0	.9	27.1	67.9	.9
V39	Lessons learned from incidents or accidents are published, such as in company's notice or newsletter.	.9	1.8	35.7	57.5	.9
V40	The issue of safety is shared by employees as a best practice through review and analysis.	0	4.5	33.0	59.3	0
V50	Employees who cause an accident or incident are held sufficiently accountable for their actions.	1.8	.9	47.1	46.2	.9
V52	Employees with good safety performance are recognized and rewarded by management.	1.4	1.4	51.1	43.0	0

6.2.2.2.5 Reporting (F5)

"Reporting" was the fifth significant factor of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.5 - *Analysis of the Reponses (F5 - Reporting)*, nearly half of the participating HSC Officers believed that management reacted quickly to the reported safety issues (49.8%) and communicated regularly about the safety issues employees raised (47.1%). In addition, employees were familiar with the formal safety reporting systems (48.0%). In general, nearly half of the respondents positively agreed with the reporting practice.

Nevertheless, less than half of the responses felt satisfied with the way in which management dealt with the safety reports (43.4%), or agreed with that employees received feedback on the results of incident or accident investigation (43.0%). Only one-third of the respondents felt satisfied with the follow-up measures taken after accidents, incidents or near misses (38.9%), and felt encouraged to report unsafe conditions (34.4%). However, more or less than half of the respondents expressed their view in the neutral position. As a whole, less than 10% of the responses felt dissatisfied with the current reporting practice of organizations.

Table: 6.2.2.2.5 - Analysis of the Reponses (F5 - Reporting)
Extracts from: the SPSS worksheets

7 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 5	Reporting	%	%	%	%	%
V29	When an employee reports a safety problem, management acts quickly to correct the safety issues.	0	4.5	42.5	49.8	0
V28	Employees are familiar with the systems for formally reporting safety issues.	0	6.3	42.5	48.0	0
V30	Safety issues raised by employees are communicated regularly to all employees.	0	6.3	43.4	47.1	0
V32	I am satisfied with the way management deals with the safety reports.	2.3	5.9	45.2	43.4	0
V42	Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident	1.8	8.1	43.9	43.0	0
V37	I am satisfied with the follow-up measures taken after accidents, incidents or near misses.	.9	3.6	57.5	34.8	0
V41	Employees are encouraged to report unsafe conditions.	0	12.7	49.8	32.6	1.8

6.2.2.2.6 Training (F6)

'Training' was the sixth significant influence of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.6 - *Analysis of the Reponses (F6 - Training)*, more than half of the participating HSC Officers felt that management placed a high priority on safety training (55.2%), provided adequate safety training to employees (50.7%), and the training allowed them to handle all possible risks at work (52.5%). In addition, more than half of the responses felt satisfied with the competency of training, such as the ways of training (51.6%) and their training needs were consulted (50.7%). In their belief, employees strictly followed all the safety rules or procedures at work place (59.7%).

In general, more than half of the respondents positively agreed with the training given. Nevertheless, less than 5% of the total respondents disagreed with the training of organizations.

Table: 6.2.2.2.6 - Analysis of the Reponses (F6 - Training)
Extracts from: the SPSS worksheets

6 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 6	Training	%	%	%	%	%
V58	All the safety rules or procedures are strictly followed here.	0	4.1	33.0	59.7	0
V53	Training covers all the safety risks associated with the work for which employees are responsible.	0	0	44.3	52.5	0
V56	Management places a high priority on safety training.	0	3.2	38.5	55.2	0
V54	Adequate safety training is given by management to perform the job safely.	0	.9	45.2	50.7	0
V57	I am satisfied with competency of training, such as the ways of training.	0	2.3	43.0	51.6	0
V55	Employees are consulted to establish their training needs.	0	2.7	43.4	50.7	0

6.2.2.2.7 Teamwork (F7)

'Teamwork' was another significant influence of safety culture affecting the safety performance of organizations. Refer to Table: 6.2.2.2.7 - *Analysis of the Reponses (F7 - Teamwork)*, more than half of the responses agreed that employees gave advice to the team on how to work safely (56.1%). Employees were able to seek help from other team members when in need (54.3%). Nearly half of the respondents trusted that teamwork was committed to safety (48.9%), and almost half of the respondents agreed that employees were clearly aware of the expected safety behaviours at workplace (45.7%). In general, nearly half of the respondents experienced teamwork in the workplace.

Though one-third of the respondents trusted that management would reward performance of individuals and the other team members (30.8%), more than half of the respondents expressed their views in neutral position (50.7%). About 10% of the responses felt dissatisfied with the teamwork efforts of the organizations.

Table: 6.2.2.2.7 - Analysis of the Reponses (F7 - Teamwork)
Extracts from: the SPSS worksheets

5 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 7	Teamwork	%	%	%	%	%
V45	Co-workers give advice to each other on how to work safely.	.9	3.6	36.2	56.1	0
V46	When things get busy, employees can seek help from others.	.9	4.5	37.1	54.3	0
V44	Employees who work in my team are fully committed to safety.	.9	3.6	43.4	48.9	0
V49	Employees understand 'acceptable and unacceptable safety behaviours' at workplace.	0	6.3	44.8	45.7	0
V43	Management rewards individual performance, and rewards other team members based on team performance.	1.8	13.6	50.7	30.8	0

6.2.2.2.8 Fairness (F8)

'Fairness' was the last significant factor of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong. Refer to Table: 6.2.2.2.8 - *Analysis of the Reponses (F8 - Fairness)*, nearly half of the participating HSC Officers indicated that they were eager to report incidents (47.1%).

About one-third of the respondents believed that management adopted a fair appraisal system (36.2%), and disciplinary measures applied to incidents and accidents were consistent (36.2%). Nevertheless, more than half of the responses adopted a neutral stance in these two issues (51.1%).

In conclusion, less than half of the respondents agreed with the status of fairness in the organizations. However, more than 5% but less than 10% of the respondents felt dissatisfied with the performance of organizations about this factor.

Table: 6.2.2.2.8 - Analysis of the Reponses (F8 - Fairness)
Extracts from: the SPSS worksheets

3 Items	Factor of Safety Culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 8	Fairness	%	%	%	%	%
V35	I feel that employees are willing to report incidents because they know that they are treated in a fair manner.	0	5.4	44.3	47.1	0
V34	There is a consistency regarding disciplinary measures for incidents or accidents.	0	9.0	51.6	36.2	0
V36	Management practices a fair appraisal system.	0	9.0	51.6	36.2	0
Means						

6.2.2.2.9 Safety Performance of Organizations (Y)

As revealed in Table: 6.2.2.2.9 - *Analysis of the Reponses (Y - Safety Performance of Organizations),* more than half of the respondents felt satisfied with the managerial approach to the accident prevention (56.1%) and the equipment maintenance (53.4%), and the current state of the safety performance (51.6%), as well as the SMS continuous improvement (48.9%) of the organizations.

Table: 6.2.2.2.9 - Analysis of the Reponses (Y - Safety Performance of Organizations)
Extracts from: the SPSS worksheets

4 Items	Safety Performance of Organizations	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		%	%	%	%	%
Y1	The risk of accidents has kept to a minimum	0	0	40.7	56.1	0
Y2	The frequency of equipment failure is reducing.	0	0	43.4	53.4	0
Y3	The current state of the organization's SMS continuous improvement has been effective.	0	0	48.0	48.9	0
Y4	The current state of the management's safety performance has been good.	0	0	45.2	51.6	0

6.2.2.3 Demographic Profile of the Respondents

This section describes the various characteristics of the respondents' demographics, including their 'Job positions', 'Trade qualifications', 'Total sea experience', 'Years of service in the HSC industry', and 'Years of employment in current employer', 'Age groups', 'Employing companies', and 'Genders' of the 214 respondents.

Table: 6.2.2.3 - Demographic Profile of the Respondents
Extracts from: the SPSS worksheets

Characteristics	Respondents (N=214)	Frequency (No. of Respondents)	Percent (%)
Job Positions	Master	96	44.9
	Chief Officer	62	29.0
	Night Vision Officer	24	11.2
	Chief Engineer	32	15.0
	Total	**214**	**100.0**
Trade Qualifications	Master Certificate of Competency	106	49.5
	Chief Officer Certificate of Competency	18	8.4
	Second Officer Certificate of Competency	58	27.1
	Marine Engineer Certificate of Competency	32	15.0
	Total	214	100.0
Total Sea Experience	1 – 3 years	14	6.5
	Above 3 – 6 years	28	13.1
	Above 6 – 9 years	20	9.3
	Above 9 years	152	71.0
	Total	**214**	**100.0**
Years of Service in the HSC Industry	1 – 3 years	14	6.5
	Above 3 – 6 years	32	15.0
	Above 6 – 9 years	22	10.3
	Above 9 years	146	68.2
	Total	**214**	**100.0**
Years of Employment in Current Employer	1 – 3 years	24	11.2
	Above 3 – 6 years	46	21.5
	Above 6 – 9 years	64	29.9
	Above 9 years	80	37.4
	Total	**214**	**100.0**
Age Groups	20 to 30	16	7.5
	31 to 40	32	15.0
	41 to 50	48	22.4
	51 to 60	62	29.0
	Above 60 Years old	56	26.2
	Total	**214**	**100.0**
Employing Companies	TurboJet	154	72.0
	CotaiJet	60	28.0
	Total	214	100.0
Genders	Male	212	99.1
	Female	2	0.9
	Total	**214**	**100.0**

6.2.2.3.1 Job Positions

Amongst the 214 respondents, 44.9% (96) ranked Masters, while 29.0% (62) were Chief Officers and 11.1 % (24) Night Vision Officers. The remaining 15.0% (32) was the Chief Engineers (See Table: 6.2.2.3 - *Demographic Profile of the Respondents*).

As indicated in Table: 6.2.2.3.1 - *Population of the HSC Officers*, 27.3% was the proportion of Masters' in the population, and the 44.9% was the proportion of Masters in the survey. While 28.2% was the proportion of Marine Engineers in the population, but only 15.0% was

the proportion of Marine Engineers in the survey.

In contrast, there was a large difference in the percentage of 'respondents in the survey' and 'samples in the population' in the cases of Masters and Marine Engineers.

At workplace, Masters serving onboard the HSC play the key role in a team as the leader, known as the commander-in-charge. Obviously, Masters constitute a stronger impact on safety onboard than any other job positions in the HSC. Hence, a larger volume of the survey data from Masters than Marine Engineers should not affect the appropriateness of the data set to represent the whole HSC population.

Table: 6.2.2.3.1 - Population of the HSC Officers (Updated to June 2019)
Extracts from: the SPSS worksheets

Ranks in HSC Organizations	Masters	Chief Officer	Marine Engineer	Night Vision Officer	Total
Turbojet	89	91	92	54	**326**
CotaiJet	34	37	35	18	**124**
Total	123	128	127	72	**450**
Samples in %	27.3%	28.5%	28.2%	16.0%	**Population**
Responses in %	44.9%	29.0%	15.0%	11.1%	**Survey**

6.2.2.3.2 Trade Qualifications

Regarding the grades of the trade Certificate of Competency, 49.5% (106) of the respondents were holders of "Master Certificate of Competency", 8.4% (18) and 27.1% (58) of them were holders of "Chief Officer Certificate of Competency" and "Second Officer Certificate of Competency" respectively. The latter two groups jointly accounted for one-third (8.4%+27.1%=35.5%) of the sample size. Lastly, Marine Engineers took up the remaining 15.0% (32) (See Table: 6.2.2.3 - *Demographic Profile of the Respondents*).

As indicated in Table: 6.2.2.3 - *Demographic Profile of the Respondents*, there were differences in the qualifications of Chief Officers. For examples, 54.8% (34) of the 62 Chief Officers held "Second Officer Certificate of Competency", whilst 29.0% (18) were holders of "Chief Officer Certificate of Competency". The remaining 16.2% (10) were holders of "Master Certificate of Competency" in the rank of Chief Officer who had a higher qualification than the basic certification requirements of the job position in the HSC. Hence, a higher safety level of shipboard operation and management while on a sea passage could be likely achievable.

6.2.2.3.3 Total Sea Experience and Years of Service in the HSC Industry

71.0% (152) of the 214 respondents had "Above 9 years" of sea experience, while 6.5% (14) with not more than three years of sea experience. In contrast with their HSC experience, 68.2% (146) of the 214 respondents had "Above 9 years" of HSC experience, while 6.5% (14) having not more than three years in the HSC industry.

As revealed in Table: 6.2.2.3 - *Demographic Profile of the Respondents*, 90.0% of the respondents had more than 3 years of service in the HSC industry. Hence, they would respond properly to the questionnaire survey, and the received data set should fit for the purpose of the survey research.

6.2.2.3.4 Years of Employment in Current Employer

Of the 214 respondents, 37.4% (80) were employed for "Above 9 years". There was only 11.2% (24) with 3 years of service or less. Hence, more than two-thirds of the 214 samples had a considerable length of service over 3 years with their present employers. Their feedbacks should be valuable, and able to represent the views of the population.

6.2.2.3.5 Age Groups

Amongst others, the age group of "51 to 60 years old" was the largest percentage representing 29.0% (62), whilst the lowest percentage of the respondents, equivalent to 7.5% (16), fell in the age group of "20 to 30 years-old". Between these two extremes, there were 15.0% (32) of the respondents "between 31 and 40 years old" and 22.4% (48) "between 41 and 50 years old". In addition, another 26.2% (56) of the HSC Officers were aged above 60 years old.

As revealed in Table: 6.2.2.3 - *Demographic Profile of the Respondents*, more than half (55.2%=29.0%+26.2%) of the respondents were aged over 50. It implied that less young people joined the seafaring profession as career. Therefore, the HSC workforce has been aging and forming a larger group of older employees than the younger age groups in the industry.

It was revealed in the manpower survey conducted by MSTB (2016) that over 65.0% of the seafarers were aged above 50. Such a high percentage of aging seafarers has posed an acute shortage of seafarers in the maritime industry. It is no wonder why the HSC Officers aged over 50 remain the main human resource in the HSC sector.

6.2.2.3.6 Employing Companies

As revealed in Table: 6.2.2.3 - *Demographic Profile of the Respondents*, 72.0% (154) of the respondents were employed by the TurboJet, and 28.0% (60) employed by the CotaiJet. Compared to the employee's distribution in the population, 72.4% (326 HSC Officers) worked for the TurboJet, and 27.6% (124 HSC Officers) were employees of the CotaiJet (See Table: 6.2.2.3.1 - *Population of the HSC Officers*).

In essence, the number of respondents in survey was close to the employee's distribution in the population. Hence, the returned responses were in fair distribution between the employing companies.

6.2.2.3.7 Genders

As revealed in Table: 6.2.2.3 - *Demographic Profile of the Respondents*, only 0.9% (2) of the respondents was female, the remaining 99.1% (212) were male. This should not be surprising, as seafaring jobs in the merchant navy were still male-dominated, with no exception to the HSC industry.

In the survey, less than 1.0% of the respondents were female. The gender difference was significantly large, mainly attributed to the ratio of male-to-female HSC Officers working in the HSC industry where over 95% of the seafaring staff was male.

6.2.2.4 Descriptive Analysis of Questionnaire Items (48 Items)

This section presents a summary of the 214 respondents' perceptions of the organization's safety performance after the questionnaire-based survey research.

As revealed in Table: 6.2.2.4 of Appendix: D - *Breakdown of Means, Mean Scores and Standard Deviations*, 'V38' was the one having the highest mean of 3.7103, while 'V43' had the lowest mean of 3.1402 amongst all items. On the other hand, 'Learning' had the highest mean score of 3.5402, while 'Fairness' had the lowest mean score of 3.3302 amongst the factors of safety culture.

A higher mean score for a factor indicates a stronger agreement of the respondents on it. Conversely, a lower mean score indicates a lower value is placed on the respective factor of safety culture.

Hence, the high mean score of Learning suggested that the respondents felt positive about the learning approach adopted by the organizations, while the low mean score of Fairness implied that the respondents expected a higher level of fairness.

To conclude, the outputs indicated that Learning should be the most important factor to influence the HSC Officer's perceptions. Its high mean score implied that organizations strongly embraced Learning, while the impact of Fairness had the lowest mean score to influence the HSC Officer's perceptions of the organization's safety performance. Hence, the HSC organizations should improve safety culture by keeping to the learning approach with more equitable measures applicable to employees.

6.2.3 Inferential Statistics

6.2.3.1 Multiple Regression Analysis

In the final EFA result, eight factors of safety culture were extracted, including management commitment, employee empowerment, communication, learning, reporting, fairness, teamwork, and training. The author, having calculated the mean of the multiple items for each factor, entered the summated scales into the Multiple Regression Analysis as independent variables, and the summated scale for the organizations' safety performance as dependent variable to report the following results.

6.2.3.1.1 Regression Statistics

To determine how well the regression model fit the data set, the author used the values of R, R^2 and Adjusted R^2. As indicated in Table: 6.2.3.1.1 - *Model Summary*, R is the correlation coefficient that is used to determine how strong the predictor variables are related to the response variable for a data set. The larger the R value, the stronger the relationship can be. While R^2 is the determination coefficient that serves as the predictive success criteria for measuring how close the data is to the fitted regression line of the regression model. The value of R^2 varies between zero and 1.0, where zero means that the response variable or outcome cannot be predicted or explained by any predictor variables, while 1.0 is the outcome that can be predicted from the independent variables (McClave, 2001). In other words, R^2 represents how much of the variance in the dependent variable can be explained by the independent variables, so as to indicate how well the regression model can fit the data set (Stockburger, 1998).

As revealed in Table: 6.2.3.1.1 - *Model Summary*, R^2 was 0.630 which indicated that the independent variables explained 63.0 % of the variability of the dependent variable after an entry of eight independent variables into the regression equation as significant variables with the level set at 0.05.

Though the value of R^2 in the sample can explain the variation in the dependent variable, it does not indicate whether a regression model is adequate. Hence, Adjusted R^2 was used to better estimate the percentage of variation in the dependent variable by reporting that only the independent variables affecting the dependent variable were counted. As revealed in Table: 6.2.3.1.1 - *Model Summary*, R^2 was reduced from 0.630 to the Adjusted R^2 value of 0.616 which indicated a better estimate of the true value in the population for reporting the data set, thus reflecting the goodness of fit for the regression model (Pallant, 2001).

To conclude, the eight independent variables jointly contributed 61.6% of the variance in the dependent variable, or explained 61.6% of obstacles to the safety performance of organizations.

Table: 6.2.3.1.1 - Model Summary
Extracts from: the SPSS worksheets

Model	R	R Square	Adjusted R Square	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
				B	Std. Error	βeta		
	.794	.630	.616					
Constant				-.169	.236		-.719	.473
F1 – Management Commitment				.224	.057	.214	3.956	.000
F2 – Employee Empowerment				.170	.047	.214	3.644	.000
F3 – Communication				.214	.053	.237	4.013	.000
F4 – Learning				.153	.055	.151	2.761	.006
F5 – Reporting				.079	.055	.079	1.430	.154
F6 – Training				.076	.058	.066	1.310	.192
F7 – Teamwork				.022	.043	.023	.497	.620
F8 – Fairness				.137	.042	.160	3.278	.001

6.2.3.1.2 Analysis of Variance

In the Analysis of Variance, "the Sum of Squares, Degrees of Freedom (df), Mean Squares, *F*-statistic (F) and the Significance value of F (Sig.)" in association with the three sources of variance, namely "Regression, Residual, and Total" are used to examine the correlations between the independent variables and the dependent variable.

As revealed in Table: 6.2.3.1.2 - *Analysis of Variance*, the high value of F (43.67) with *p*=0.000 implied that the independent variables were significantly related to the dependent variable, and the variation explained by the model was not a coincidence.

Table: 6.2.3.1.2 – Analysis of Variance
Extracts from: the SPSS worksheets

Model	Sum of Squares	df	Mean Squares	F	Sig.
Regression	30.799	8	3.850	43.669	.000
Residual	18.073	205	.088		
Total	48.871	213			

6.2.3.1.3 Regression Coefficients

Regression Coefficients are used to examine the relationship between the dependent variable and independent variables, as well as their contributions towards the dependent variable, such as the safety performance of organizations for this study.

As revealed in Table: 6.2.3.1.1 - *Model Summary*, B-coefficients are the un-standardized coefficients that explain how much the dependent variable varies with a causal variable, while all other causal variables are held constant. For examples, the B-coefficient of 'F1 - Management Commitment' was estimated at 0.224 which explained an expected increase of 0.224-unit in the dependent variable for each unit increase in 'F1 - Management Commitment', while an anticipated increase of 0.214-unit in the dependent variable for every unit increase in 'F3 – Communication', and hence 'Y - Safety Performance of Organizations' was predicted.

As shown in Table: 6.2.3.1.1 - *Model Summary*, Beta is the standardized coefficient that is used to compare the contribution from each variable. The corresponding *t*-statistic (t) is to measure the statistical significance of each regression coefficient, whether the factors are significant or not, depending on the *p*-values. For example, 'F3 – Communication' had the largest βeta coefficient of 0.237, the significance level of which was 0.000 along with the

t-statistic of 4.013. Hence, 'F3 – Communication' positively and significantly contributed to the model most.

In contrast, three out of the eight factors had *ρ-values*>0.05 significance level, and hence were excluded. They were 'F5 – Reporting', 'F6 – Training', and 'F7 – Teamwork', not the significant predictors of the dependent variable, thus eventually not supported for inclusion.

Using the regression line to predict the dependent variable, the regression coefficients associated with the five significant factors could be adopted as independent variables in the regression.

The regression equation of ($Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + \epsilon$) was formulated, where:

Y	= the value of the Dependent Variable
β_0	= the Regression Constant (its value is zero)
$X_1, X_2, X_3, X_4 ... X_n$	= the Independent Variable
$\beta_1, \beta_2, \beta_3, \beta_4 .. \beta_n$	= the Regression Coefficients of Factor Scores
ϵ	= the Error term of the Regression Model

Hence, Y = -0.169+ 0.224 (F_1 Management Commitment) + 0.214 (F_3 Communication) + 0.170 (F_2 Employee Empowerment) + 0.153 (F_4 Learning) + 0.137 (F_8 Fairness) + ϵ

6.2.3.2 Analyses of the Findings

To test the effects of the eight extracted factors of safety culture on the HSC Officers' perceptions of safety performance of organizations, the author performed Multiple Regression Analysis subsequent to factor analysis.

Prior to analyzing the data, the author verified the data suitability, such as checking and eliminating the effect of missing values, fulfilling the assumptions of normality with no multi-collinearity (e.g. TOL>0.5, VIF<2.5), and ensuring sampling adequacy for each factor by the Kaiser-Meyer-Olkin measure and the Bartlett's test of Sphericity, as well as the normality of residuals with no outliers identified.

In an initial analysis of the correlations among the eight independent variables, including F1 - Management Commitment, F2 - Employee Empowerment, F3 – Communication, F4 – Learning, F5 – Reporting, F6 – Training, F7 – Teamwork and F8 – Fairness, all the

variables were uncorrelated but correlated with the dependent variable. Hence, they were included in the multiple regression analysis for hypothesis testing. While in the multiple regression analysis, the eight extracted factors of safety culture jointly contributed 61.6% of the variance in the dependent variable.

The results of hypothesis testing as summarized in Table: 6.2.3.2a - *Results of the Hypothesis Testing* indicated that the hypotheses of H_1, H_3, H_4, H_6, and H_7 as formulated in the Chapter III were significant, and hence were supported.

The five significant factors of safety culture were 'communication, management commitment, employee empowerment, fairness, and learning'. Amongst these five significant factors as sorted by size in Table: 6.2.3.2a - *Results of the Hypothesis Testing*, 'communication' (βeta = 0.237, ρ = 0.000) was the predictor that influenced the dependent variable most.

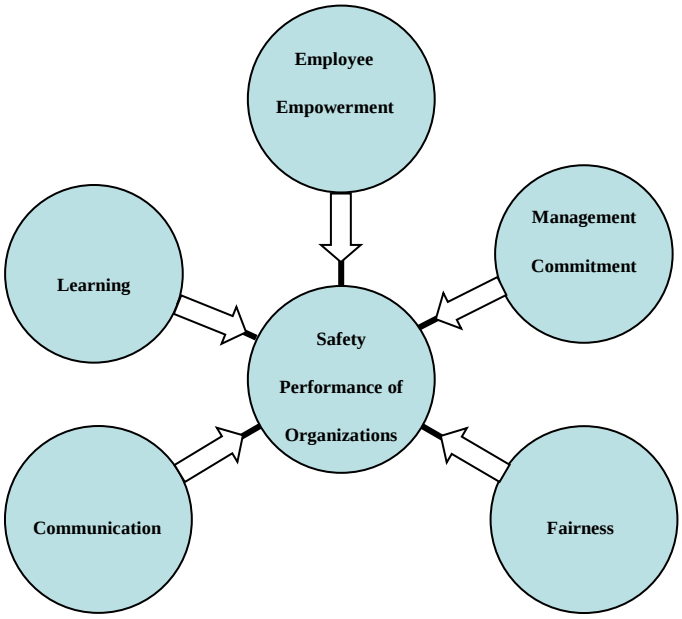
Table: 6.2.3.2a - Results of the Hypothesis Testing
Extracts from: the SPSS worksheets

Hypotheses	Independent Variables		Statistical Significance Level < 0.05	Statistical Results
	Influent Factors	Standardized Coefficients (Sorted by Size)		
H_4	Communication	(βeta = 0.237)	ρ = 0.000	Supported
H_1	Management commitment	(βeta= 0.214)	ρ = 0.000	Supported
H_3	Employee empowerment	(βeta = 0.214)	ρ = 0.000	Supported
H_6	Fairness	(βeta = 0.160)	ρ = 0.001	Supported
H_7	Learning	(βeta = 0.151)	ρ = 0.006	Supported

In essence, these five factors were identified as significant influences of safety culture, having positive impacts upon the HSC Officers' perceptions of the safety performance of organizations. For examples, organizations when strongly embracing communication, their effective communication could eliminate barriers, resolve problems and build stronger workplace relationships to increase productivity. While a high level of management commitment would be critical for organizations to sustain their safety performance, and for supporting employee empowerment to make employees responsible for the work and accountable for the results. Furthermore, when organizations embracing fairness and learning, a higher level of safety performance could be achieved for the continuous improvement of the organizations.

To illustrate the effects of these significant factors upon the dependent variable, their relationships in the form of a new model of safety culture for the Hong Kong context are presented in Figure: 6.2.3.2b - *A Model of Safety Culture for the Hong Kong HSC industry*.

Figure: 6.2.3.2b - A Model of Safety Culture for the Hong Kong HSC industry



6.3 Chapter Conclusion

This chapter presented the empirical findings and analyses of the survey research. Firstly, factor analysis reduced the items to fewer sets of related factors and transformed the items into a simpler data structure. Through factor analysis, a new measurement scale was established on the eight-factor structure for the HSC industry of Hong Kong.

The joint use of factor analysis and multiple regression analysis demonstrated that five out of the eight extracted factors after factor analysis were identified to have significantly influenced the HSC Officer's perceptions of the organization's safety performance in multiple regression analysis (Keskin, Kor & Karaca (2007).

The results of the empirical studies supported that the significant factors of safety culture influenced the safety performance of organizations in the HSC industry of Hong Kong. In addition, the results of hypothesis testing suggested that the severity of impacts from each of the significant factors upon the dependent variable was different. The factors sorted by

significance were ‘communication, management commitment, employee empowerment, fairness, and learning’. Through hypothesis testing, the research question of ‘Which of the factors of safety culture will significantly influence the HSC organization’s safety performance?’ was also responded.

In the next chapter, the author intends to verify whether the results of the survey research are consistent with the review of literature in the previous chapters. In addition, the author intends to explore the causes underlying the responses to each significant factor of safety culture for answering the research question of ‘How do the underlying causes behind the significant factors of safety culture influence the safety performance of organizations in the HSC industry of Hong Kong?’ Lastly, the author describes the limitations of the study.

CHAPTER VII: CONCLUSIONS AND MANAGERIAL IMPLICATIONS

7.0 Introduction

This chapter summarizes the major study findings. There are five sections in this chapter. Section 7.1 presents the conclusions drawn from the survey research results. In Section 7.2, the managerial implications of the research findings are discussed, and sets of recommendations are proposed. Section 7.3 addresses the limitations of this study, and Section 7.4 suggests the potential directions for future research before concluding the study in Section 7.5.

7.1 Empirical Conclusions

This section concludes the test results of the hypotheses for each significant factor of safety culture, with the objective of answering the research questions.

In the literature review, ten specific factors of safety culture were sourced from a number of previous studies. They were hypothesized to have significant influences on the safety performance of organizations.

After factor analysis, the ten factors were narrowed to eight that were labelled as management commitment, employee empowerment, communication, learning, reporting, training, teamwork, and fairness, according to the common themes of the items loaded on each factor.

As revealed in Table: 6.2.1.4a - *Eight-Factor Structure of Safety Culture*, factor loadings in each factor were above 0.4, which corresponded to the suggested threshold requirements by prior studies (Tabachnick & Fidell, 2010), and the extent of contribution from each of the items in a factor was presented by the size of factor loadings. It was also depicted in Table: 6.2.1.2a - *Total Variance Explained – Seventh EFA Run reduced 58 to 48 Items in Safety Culture* that the eight factors accounted for 72.504% of the total variance in the independent variable.

Subsequent to multiple regression analysis, the eight extracted factors were regressed to five significant factors through hypothesis testing. These five factors of safety culture significantly influenced the HSC Officer's perceptions of the organization's safety

performance. They were communication, management commitment, employee empowerment, fairness, and learning, sorted in the order of significance, and discussed in the following sub-sections.

7.1.1 Communication

Communication was identified as the most significant factor of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong.

In the survey research results, the research hypothesis statistically verified that communication positively and significantly influenced the safety performance of organizations. Hence, the hypothesis was accepted.

The survey research results as evidenced in Table: 6.2.3.1.1 - *Model Summary* suggested that communication constituted positive impacts upon the HSC Officers' perceptions of the safety performance of organizations. With B-coefficient estimate of 0.214, an increase of 0.214-units in the dependent variable was expected for each unit increase in communication being the predictive variable. Hence, the more the organizations could promote and support communication, the higher the level of organization's safety performance would be.

This positive relation between safety culture and organization's safety performance was raised by prior studies, which recognized the importance of communication as the main influence upon the employees' perceptions. Findings from the descriptive literature indicated that an organization with an effective safety culture was characterized by an effective communication (Khan, 2017). For examples, HSE (2019) stated that an effective communication could keep employees well informed of the conditions and circumstances of the workplace, while Davies et al. (2001) added that an effective communication should be able to keep employees well informed, such as the outcomes of safety meetings (Davies et al., 2001). Khan (2017) stressed that exchange of knowledge could be facilitated when there was an effective communication channel in place. Good communication should encourage discussions, thus promoting the creation of ideas and solutions (Davies et al., 2001). In an example of marine navigation, the HSC Officers receive the Maritime Safety Information (MSI) from the coast stations for them to make a full appraisal of the prevailing conditions and circumstances to predict the perils of the maritime adventure. Whilst in the survey research results, more than half of the responses agreed that safety information given from the management of organization were brought to employees'

attention, and they also received the outcomes of safety meetings.

Behind an effective communication, a mutual trust between management and employees of an organization was crucial (Jung, 2017). Nearly half of the responses agreed that there was a mutual trust between management and employees. The respondents trusted the confidentiality of the reporting and investigation processes. Jung (2017) stressed that employees once felt satisfied with the systems they would use and follow while doing their job, they should be willing to report (Jung, 2017). It was further agreed by Gordon et al. (2007) that employees were willing to report as long as they trusted the confidentiality of the reporting and investigation systems (Gordon et al., 2007).

In the survey research results, more than one-third of the responses trusted the systems they used, while more than half of the respondents felt satisfied with the ways by which they were informed of safety at work. The aforementioned findings were also identified in previous studies and models. For examples, communication is so-called reporting culture which is one of the sub-cultures of the Reason's informed culture. An organization which possesses an effective reporting culture makes information visible to employees. Employees are willing to report incidents including near misses, thus improving the safety performance of organizations (Reason, 2000; Eurocontrol, 2008).

Moreover, communication was ascertained as a factor of safety culture in the Fleming (2000)'s Safety Culture Maturity Model for measuring the maturity of an organization's safety culture (Fleming, 2000). While in the ABS's Model of Safety Culture, "*Communication and Mutual trust*" were used as the safety factors in the assessment of safety culture for improving safety performance in the maritime industry. In addition, the factors of "*Reporting incidents/communicating problems*", "*Communication about procedural / system changes*" and "*Trust within the organization*" were used as the factors of safety culture in the ATM (2007)'s Safety Culture Model affected the safety performance of organizations (Eurocontrol, 2008; Gordon et al., 2007; Shappell & Wiegmann, 2006; Von Thaden & Gibbons, 2008). Furthermore, the "*Existence of open communication links, and frequent contacts between workers and management*" was one of the factors to construct the climate of safety culture in the Zohar (1980)'s Model of Safety Climate. Hence, safety culture would influence safety performance through employees' perceptions of the current safety practices, namely safety compliance and safety participation of employees (Zohar, 1980).

To conclude, communication was a significant factor of safety culture affecting the safety performance of organizations. The result of the empirical testing on the influence of this specific factor indicated that the study findings were consistent with the implications of the findings derived from the literature review in the previous chapters.

Nevertheless, more than one-third of the responses expressed at neutral position, and more than 5% but less than 10% disagreed with the safety performance of organizations in the ways of communication. The negative feedback was a concern that management should address the gaps left between the employees' perceptions and the prevailing communication at workplace for further safety improvement.

7.1.2 Management Commitment

Management commitment in the order of significance was ranked the second significant factor of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong.

The research hypothesis statistically verified that management commitment positively and significantly influenced the safety performance of organizations, and its hypothesis was accepted.

The survey research results as indicated in Table: 6.2.3.1.1 - *Model Summary* suggested that management commitment constituted positive impacts upon the HSC Officers' perceptions of the safety performance of organizations. With B-coefficient estimate of 0.224, an increase of 0.224-units in the response variable was expected for every unit increase in the predictive variable. Specifically, when an organization could embrace a higher degree of management commitment, it should reach a higher level of safety performance. Hence, the safety performance of organizations was predictable.

This positive relation between safety culture and organization's safety performance was raised from prior studies which recognized the importance of management commitment as the main influence upon the employees' perceptions. Findings from the descriptive literature indicated that there was a close link between employees' perception of the safety performance of management and the management approach to safety.

For examples, Fernandez-Muniz et al. (2007) found that policy development could demonstrate an organization's commitment to workplace safety (Fernandez-Muniz et al., 2007). In addition, Jung (2017) in his study *on "the effectiveness of the ISM Code on the seafarers' awareness of safety"* recognized that management commitment to safety was associated with the safety policy of organizations (Jung, 2017). Not surprisingly, the shore-based management of the Maersk Line introduced additional safety measure, such as the Heavy Weather Checklist into the company's SMS to further protect the safety of ship's crew, thereby conveying a clear safety pledge to the crew that safety was a value, not priority (Browne, 2009; Warrack & Sinha, 1999). In contrast, the oil-platform explosion at Piper Alpha in 1988 proved the deficiency in exercising management commitment to safety. In the survey research results, nearly half of the respondents agreed that the HSC organizations were eager to invest money and effort to improve safety. Hence, the findings were in consistent with the literature.

Other than setting company policies, Reason (2013) added that how employees would perceive the management commitment to safety for the daily operations was crucial (Reason, 2013). In the survey, majority of the responding HSC Officers indicated that organizations cared for the safety of employees at workplace, with adequate human resources deployed to meet the safety procedures and the essential equipment supplied to support work completion following the code of safety practice. To promote organization's safety commitment, it was no wonder why Wiegmann et al. (2007) stressed that it should be the management commitment to provide sufficient resources essential to the safe operation and management of vessels, including a supply of competent crew and effective tools to achieve the desired work outcome (Wiegmann et al., 2007).

ABS (2012) and Jung (2017) expressed that management involvement in safety issues could sustain a high priority within an organization (ABS, 2012; Jung, 2017). Management involvement refers to the extent to which management gets personally involved in the safety activities on the daily routines (ABS, 2012; Jung, 2017). The survey research results indicated that nearly half of the respondents in the survey believed that management was personally involved in the safety activities or functions, and more than half in their belief that management involvement in safety was a high priority in organizations.

Some scholars viewed that employees' perceptions of management commitment were largely influenced by the management's attitudes and behaviours towards safety as a core

value (Zohar, 2000). Williams (2008) suggested that organizations should take an active role in promoting and keeping the workplace safe as the core value. For example, it can be demonstrated by physically attending the site for thoroughly understanding the workplace environment. A safety tour around the workplace may be a positive sign of management commitment to make sure that the HSC Officers are able to action all safety procedures as stated in the code of safety practice (Toellner, 2001).

In the survey research results, it was concluded that more than half of responding HSC Officers agreed that organizations tried their best to prevent accident or incident from happening. Organizations attained excellent safety maintenance standards, motivated and praised employees for working safely, and showed concern when safety procedures were not followed. The aforementioned findings were also identified in other prior studies and models. For examples, scholars and researchers including Pidgeon and O'Leary (2000) during the course of their studies identified that management commitment was a key component influencing the development of an effective safety culture (Pidgeon & O'Leary, 2000). Williams (2008) in his study of safety culture revealed that management commitment and involvement were obstacles to the SMS continuous improvement of organizations (Williams, 2008). Further findings from Wiegmann et al. (2002) indicated that management commitment was the most commonly recognized factor of safety culture (Wiegmann et al., 2002). More researchers including Cox and Flin (1998), Flin et al. (2000), Sawacha et al. (1999), Sorensen (2002) also indicated the influences of management commitment on the employees' perceptions of safety.

Management commitment was also a common but an influential factor in many models of safety culture or safety climate, for example, the ATM (2007)'s Safety Culture Model (Mearns, et al., 2013), the Fleming (2000)'s Safety Culture Maturity Model, the Guldenmund (2000)'s Model of Safety Culture, the ICAO (1992)'s Model of Safety (International Civil Aviation Organization, 1992), the INEEL's Model of Total Safety Culture (INEEL, 2001), the Reason's informed culture (Reason, 2000), and the Zohar (1980)'s Model of Safety Climate (Zohar, 1980).

To conclude, management commitment was a significant influence of safety culture affecting the safety performance of organizations. The results of this study were consistent with the implications of the findings derived from the literature review in previous chapters.

Nevertheless, about one-tenth of the respondents disagreed that management motivated and praised employees for working safely. The negative feedback revealed that management should address the gap between the employee's perception of the safety culture and the prevailing workplace environment for further improvement, with due regard to the issues including management involvement in safety activities or events, safety concern about non-compliance with safety procedures, and safety awareness of accident prevention measures.

7.1.3 Employee Empowerment

Employee empowerment was the third significant factor in the model of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong.

The research hypothesis verified that employee empowerment positively and significantly influenced the safety performance of organizations, and its hypothesis was accepted.

The survey research results indicated that employee empowerment constituted positive impacts upon the safety performance of organizations. As indicated in Table: 6.2.3.1.1 - *Model Summary*, the B-coefficient estimate was 0.170 that explained an expected increase of 0.170-units in the dependent variable for each unit increase in employee empowerment. Hence, the more the organizations could support employee empowerment, the higher the level of the 'Safety performance of organizations' would be.

This positive relation between safety culture and safety performance of organizations was also verified from the contexts of some prior studies. According to Jung (2017)'s study, employee empowerment was closely associated with shipmaster's responsibility and authority. Employee empowerment refers to employee's perceptions of the delegated authority and responsibility given to them by organizations for the purposes of fulfilling their responsibilities in the assigned roles (Stevenson, 2011). Under the ISM Code, shipmasters are empowered with responsibility and authority in all kinds of shipboard functions where the levels of accountability for the safety-related responsibility and authority were expressly written in the SMS (ABS, 2012). Hence, empowered employees have a good control over the safety outcomes of their job, so as to sustain and improve safety performance of organizations. Similar findings from Petersen (2013) expressed that empowered employees with given responsibility and authority written in the SMS were

accountable for their performance in safety, or even personal responsibility for the mistakes of other work-mates. According to Stevenson (2011), employee empowerment is a key factor that can underpin an organization's safety performance to build its safety culture.

In the survey research results, nearly half of the participating HSC Officers agreed that they got involved in keeping the management informed of important safety issues, they were consulted on matters relating to their job, and they could make decisions on safety issues, even if the decisions might lower the productivity. Therefore, they believed that management could ensure employees responsible and accountable for the safe operation of ships. Moreover, about half of the respondents agreed that they were given active control over the safety outcomes of their job, and they were actively encouraged to improve safety. The aforementioned findings were also identified in some prior studies and models. Some scholars and researchers including Sawacha et al. (1999), Flin et al. (2000), and Sorensen (2002) indicated the influences of employee empowerment on the respondents' perceptions of the response variable.

Whilst in the ABS's Model of Safety Culture, employee empowerment was proved to be a factor of safety culture for improving safety performance. Empowered employees were willing to take personal responsibility for safety when there was a clear delegation. Further findings from Wiegmann et al. (2002) indicated that employee empowerment was one of the most commonly-recognized factors of safety culture, by which employees could be effectively driven to a level of authority to successfully fulfill their responsibilities in the assigned roles for safe operation (Wiegmann et al., 2002).

To conclude, the results indicated that employee empowerment was a significant influence of safety culture affecting the safety performance of organizations. The results of this study were consistent with the implications of the findings derived from the literature review in previous chapters.

Nevertheless, more or less than one-tenth of the respondents disagreed with the safety performance of organizations about this factor, the negative feedbacks suggested that management should address the misalignment between the employees' perceptions of safety culture and the prevailing workplace environment for further safety improvement.

7.1.4 Fairness

Fairness was another significant factor of the model of safety culture affecting the safety performance of organizations in the HSC industry of Hong Kong. In the survey research results, the research hypothesis verified that fairness positively and significantly influenced the safety performance of organizations. Hence, the hypothesis was accepted.

It was indicated in Table: 6.2.3.1.1 - *Model Summary* that fairness constituted positive impacts upon the HSC Officers' perceptions of the safety performance of organizations. With B-coefficient estimate of 0.137, an increase of 0.137-units in the dependent variable for each unit increase in fairness. The more the management could embrace fairness, the higher the level of safety performance of organizations would be.

This positive relation between safety culture and organization's safety performance aligned with the findings of some earlier studies which recognized fairness or fairness as a key influence upon the employees' perceptions. For examples, Reason (1998) claimed that fairness was a key dimension influencing the development of an effective safety culture (Reason, 1998). Organizations on a balanced blame approach should increase the employees' willingness to report incidents or near misses. Gordon et al. (2007) stressed that employees when treated in a fair manner were willing to report. Whilst in the survey research results, nearly half of the participating HSC Officers felt that employees were willing to report incidents.

Furthermore, Marshall (2013) indicated that a large number of near misses were reported by the employees of the BC Ferries in 2013 where employees felt safe to report near misses or even uncover any unsafe behaviour in a fair management. Conversely, lack of fairness would affect the fairness of the management, behaviours of the workplace, and the eventual effectiveness of an organization (Cropanzano, Bowen, & Gilliland, 2007), thus consequently hindering employees from taking initiatives to reporting deficiencies in the workplace safety. In the survey research results, about one-third of the respondents believed that there was a consistency regarding the disciplinary measures for incidents or accidents, and a fair performance appraisal system was in place.

The aforementioned findings were also identified in some prior studies and models. For examples, just environment was a sub-culture of the informed culture in the Reason's Model (Reason, 1998), while the sub-cultures of the informed culture were subsumed

within the psychological factors (e.g. just culture) of the Cooper (1993)'s Reciprocal Model of Safety Culture affecting the safety performance of organizations (Reason, 1998).

To conclude, fairness was a significant influence of safety culture affecting the safety performance of organizations. The results of this study were consistent with the findings derived from the literature review in previous chapters. Nevertheless, less than one-tenth but more than 5% of the respondents disagreed with the safety performance of organizations with regard to this specific dimension, and more than half voted their neutral position. The feedbacks implied that there were concerns about the disciplinary measures taken by the management of organizations for incidents or accidents.

7.1.5 Learning

Learning was the last significant factor. The research hypothesis verified that learning positively and significantly influenced the safety performance of organizations. Hence, the hypothesis was accepted.

The survey results suggested that learning constituted positive impacts on the safety performance of organizations. Its B-coefficient estimate was 0.153 that explained an expected increase of 0.153-units in the dependent variable for each unit increase in learning. Hence, the better the management of organizations could encourage and support learning, the higher would be the level of safety performance of organizations.

The survey research results of this study aligned with the findings of some prior studies that recognized the importance of learning as a key influence upon the employees' perceptions. For examples, Pidgeon and O'Leary (2000) identified learning as one of the key factors influencing the development of an effective safety culture, and described that organizations with effective safety culture would consider incidents or accidents as valuable opportunities of learning to avoid re-occurrence of similar events (Pidgeon & O'Leary, 2000). Whilst in the survey research results, two-thirds of the participating HSC Officers agreed that the safety system was improved based on experience from learnt lessons, news related to the safety issues, and recommended solutions from the management of organizations.

In addition, Gordon et al. (2007) suggested that lessons learned from incidents or accidents could be announced in the newsletter or displaced in the bulletin board to promote learning,

while other issues of safety could be shared amongst employees through safety review meetings (Jung, 2017). In the survey research results, more than half of the responses agreed that management supported learning by promulgating the lessons learned from incidents and accidents through company's notices or newsletters. They also agreed with the learning approach of management through which the safety-related issues shared amongst employees in the safety meetings.

According to Petersen (2013), recognition and reward should make employees accept accountability in most cases. Once employees learned that their endeavors would be rewarded or compensated, they would feel accountable for their performance in safety, or even personally responsible for the safety and mistakes of other work-mates (Petersen, 2013).

In the survey research results, about half of the respondents felt that management would recognize and reward the employees who had good safety performance. In addition, nearly half of the responses agreed that employees who caused an accident or incident were held accountable for their actions.

The aforementioned findings were also identified in several of previous models. Amongst the Fleming's Safety Culture Maturity Model, the INEEL's Model of Total Safety Culture, the Zohar's Model of Safety Climate, the ICAO's Model of Safety, and the ATM (2007)'s Safety Culture Model, Learning was identified as a common factor. While other scholars and researchers, including the Reason's informed culture, in their studies on the characteristics of learning organizations found that lessons learnt was one of the perspectives (Reason, 2000; Eurocontrol, 2008).

To conclude, learning was a significant factor of safety culture influencing the safety performance of organizations. The study findings were consistent with the findings derived from the relevant literature review in the earlier chapters. Nevertheless, less than 5% of the respondents disagreed with the safety performance of organizations in this factor, and about one-third voted their neutral position. The feedbacks implied that the management of organizations should draw attention to the perceived learning environment at workplace for further safety improvement.

7.2 Managerial Implications

The research findings reflect that the factors of safety culture, including communication, management commitment, employee empowerment, fairness and learning, significantly affect the safety performance of organizations in the HSC industry.

Along with the safety climate factors, behaviors of leadership play a critical role in the safety performance of employees. Previous studies revealed that leadership practices on the part of front-line leaders did influence the safety-related behaviors of subordinates, in particular to their routine safety compliance behaviors (Borgersen et al., 2014; Chen, 2017; Du & Sun, 2012; Kapp, 2012; Li et al., 2015; Lu & Yang 2010; McFadden et al., 2009; Muzaffar, et al., 2021; Oladipo et al., 2013; Wu, Chen & Li, 2008). For example, Wu, Chen and Li (2008) indicated in their research study that leadership style directly affected safety climate, and indirectly influenced the safety performance of subordinates (Wu, Chen & Li, 2008). It was also revealed by Muzaffar, et al. (2021) that the moderating role of leadership positively affected safety performance through a positive safety climate.

In essence, a positive safety climate is essential to the success of a company's SMS. Specifically, the degree of the success of a company's SMS is influenced by the effectiveness of the leader's safety leadership, '*the more positive the perceived safety leadership, the more positive the perceived safety climate will be'* (Du & Sun, 2012).

The ISM Code mandates that each operating organization should designate a leader to be in charge of the company's SMS for monitoring all safety and pollution prevention activities in the operation of each vessel (ISM, 2018). This designated person as defined in the ISM Code, whose safety leadership practices significantly affect the subordinates' perceptions of the leader's commitment to safety, plays a leadership role in the effective implementation of the company's SMS and its continuous improvement through cultivating, promoting and sustaining a long-term positive safety culture (Lu et al., 2016; Lu & Yang, 2010).

To improve the workplace safety climate, leadership having a significant impact on the desired safety behavior of subordinates remains crucial (Du & Sun, 2012; Shen et al., 2015). Without a strong and positive leader-subordinate relationship, it is hard for operating organizations to attain good safety performance (Hofmann, Morgeson, & Gerras, 2003; HSE, 2003; Shen et al., 2015).

Amongst the many leadership styles, safety climate can be more effective if leaders exhibit transformational leadership style. First, transformational leadership has been an effective leadership strategy for organizations in Hong Kong where the workforce is relationship-oriented (Fellows, Liu, & Cheung, 2003; Shen et al., 2017). Second, transformational leaders care about the specific needs and development of subordinates, having their focus placed on inspiring, empowering, and stimulating fellow subordinates to go beyond their normal levels of performance.

It was evidenced in the previous studies that transformational leadership directly and positively related to safety performance, while safety climate was positive (Shen et al., 2017). The safety compliance behavior of subordinates should improve when the transformational leadership practices of a leader increased under a perceived positive safety climate. Prior studies also demonstrated that leaders who were believed to treasure safety would attain stronger safety compliance from their subordinates than those leaders who were perceived to have a low value on safety (Adjekum, 2017; Dahl & Olsen, 2013; Smith et al., 2016).

Compared to other types of leadership, transformational leaders with relationship-oriented leadership foster closer relationships with subordinates (Zohar & Luria, 2004). Riggio (2009)'s study further revealed that teams when directed by transformational leaders should have greater performance and stronger satisfaction than others led by any other leadership styles (Riggio, 2009).

Transformational Leaders as generally described by scholars and researchers are those persons '*who stimulate and inspire followers to both achieve extraordinary outcomes, and in the process, develop their own leadership capacity*' (Bass, 1996; Riggio, 2009). According to the Kouzes and Posner's transformational leadership model, leaders build relationships and motivate subordinates through managing people tactics of leadership and motivation, such as '*Modelling the way, Inspiring a shared vision, Challenging the process, Enabling others to act and Encouraging the heart*' (Kouzes & Posner, 2017), rather than focusing on the rigid controls effected by stringent rules and regulations.

In practicing transformational leadership, the designated person in charge of the company's SMS implementation should be able to help the HSC Officers grow and develop into

leaders for each vessel by caring individual HSC Officers' needs, delegating authority, and mapping the goals of the individuals, the teams, and the organization to an overall vision or common purpose. Therefore, the leadership practices of the designated person should be devoted to inspiring and motivating the HSC Officers. Through adopting one or more of the four influence tactics of transformational leadership, they can perform beyond their boundaries, contribute more to the organization's safety performance, and escalate their needs to the next higher needs in the hierarchy according to the Maslow's hierarchy of needs' theory (Gawel, 1997).

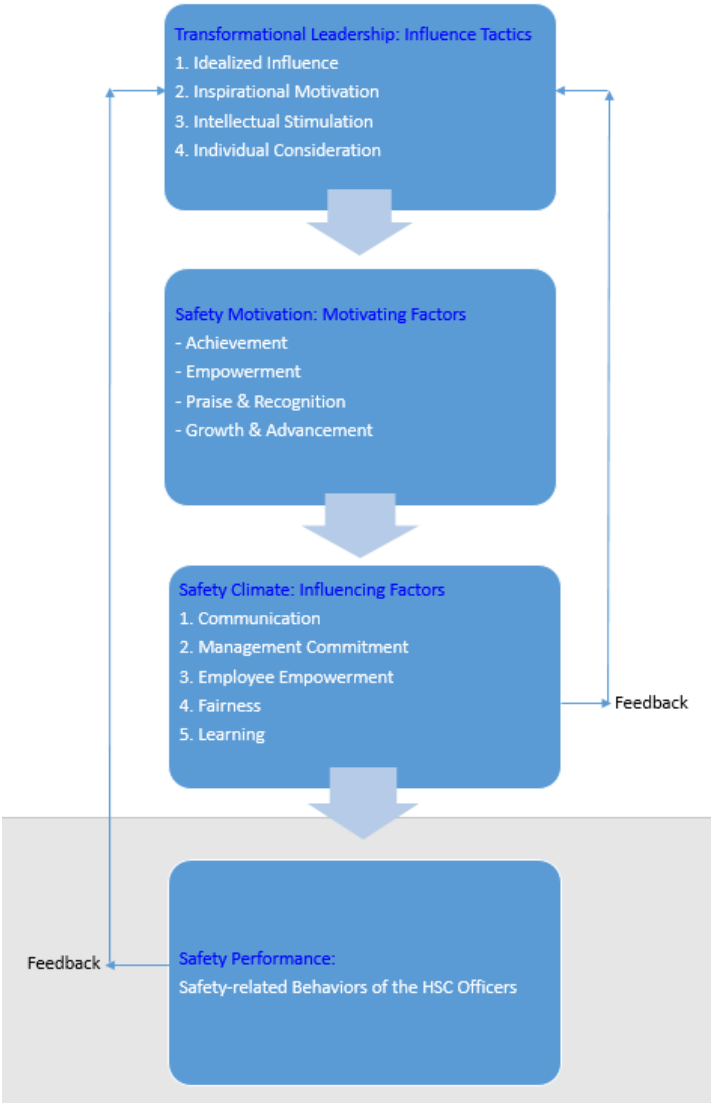
Applying transformational leadership skills in the workplace, the designated person may exhibit 'Idealized influence' to be a role model for the HSC Officers; implement 'Inspirational motivation' to encourage the HSC Officers to commit a shared vision by stimulating team spirit and fostering a sense of purpose to push the team and their goals forward; provide 'Intellectual stimulation' to build the problem-solving skills of the HSC Officers to be pioneering in the decision-making process for the SMS continuous improvement; and give 'Individualized consideration' to empathize with the unique needs and abilities of individual HSC Officers for their personal growth and achievement (Adjekum, 2017; Bass, 1996).

Each of these motivating tactics may help transform the HSC Officers into the desired safety behaviors. Nevertheless, trust and loyalty of subordinates remain crucial to the success of this leadership style (Bass, 1996; Kapp, 2012; Shen et al., 2017).

In Figure: 7.2a, the Safety Performance Improvement System depicts the process flow from transformational leadership to safety performance through safety climate, with safety motivation to serve as a mediator in the relationship between leadership and safety climate. The system indicates that there are interactions between the leadership practices of the designated person and the factors of safety climate to influence the safety-related behaviors of the HSC Officers. While in a positive safety climate, the leadership of the designated person is the driving force for the HSC Officers' safety motivation, encouraging the HSC Officers to move beyond their boundaries towards the desired safety behaviors for the SMS continuous improvement of the organizations. Feedback revealed to the designated person through the safety performance of the HSC Officers and the perceived workplace safety climate brings about appropriate adjustments to the leadership practices of the designated person.

According to the Herzberg's two-factor theory, motivating factors are intrinsic. *'A sense of achievement from the work-done, Empowered to be responsible for an interesting job, Praise & recognition from the organization, and Growth & advancement with promotion opportunities'* are strong motivators, which can lead to job satisfaction with long-term positive effects on performance (Bellott & Tutor, 1990; Gawel, 1997).

Figure: 7.2a: The Safety Performance Improvement System

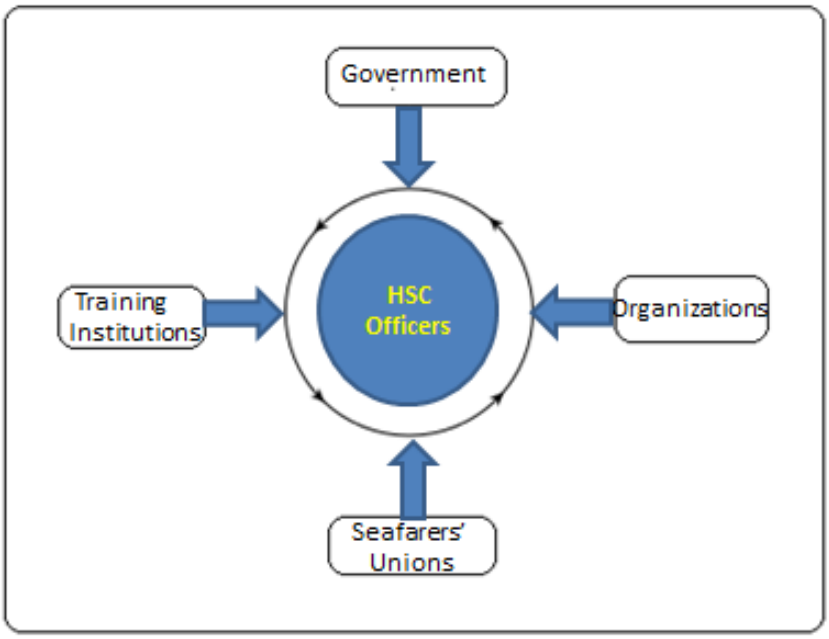


In essence, subordinates when subject to a high level of safety motivation should show strong safety compliance (Adjekum, 2017; Conchie, 2013; Shen et al., 2017). Transformational leadership style positively influences safety climate. Safety practices under a strong leader-subordinate relationship should lead to greater safety compliance behaviors. Nevertheless, the mediating role of motivation works only when a high trust

relationship exists between the leader and subordinates (Conchie, 2013; Shen et al., 2017).

Despite the significant role of the leader in promoting safety culture within the organizations, the safety preferences, attitudes and behaviors of the HSC Officers are influenced by a variety of stakeholders in the industry (See Figure: 7.2b – Stakeholders including the government, training institutions, seafarers' unions, and the HSC organizations influence the HSC Officers).

Figure: 7.2b - Stakeholders' Forces imposing upon the HSC Officers



Based on the implications derived from the conclusions, recommendations to the HSC organizations and other stakeholders are suggested, with a view to enable them to share the same beliefs and behaviours to facilitate the development of an effective safety culture.

7.2.1 Communication

The research findings concluded that communication constituted a positive and significant direct impact upon the safety performance of organizations. If an organization had an effective communication, it would have a high degree of organization's safety performance.

In the literature, there were suggested recommendations for improving communication. HSE (2019) suggested that the management of an organization should adopt an open-door approach to communicate with employees (HSE, 2019). To establish an effective communication, Dyer (2001) advised that the management should schedule regular

meetings with employees (Dyer, 2001). Davies et al. (2001) added that employees should be informed of the conclusive outcomes of the safety meetings (Davies et al., 2001). Khan (2017) stressed that an effective communication channel should be in place between the management and employees of an organization to facilitate transfer of knowledge, such as transceiving the Maritime Safety Information between ship and shore (Khan, 2017).

7.2.1.1 Recommendations to HSC Organizations

Based on the empirical conclusions, the implications are that the HSC organizations should make the HSC Officers feel that an open-door policy does exist, and is not simply a token gesture. An open door policy indicates to employees that an organization is open to suggestion, queries, complaints, and challenges from employees.

An effective communication is the key to successful operations of HSC safety. The organizations should encourage open communication for discussion and feedback about any safety issues that employees may concern. Further to regular safety meetings, employee forums, newsletters, and the traditional paper-based notices in keeping the HSC Officers informed of all safety issues, organizations by applying 'intellectual stimulation' should introduce more communication channels or systems to increase the capability of information transfer and exchange amongst all parties concerned. An open door policy indicates to employees that an organization is open to suggestion, queries, complaints, and challenges from employees.

As a result of the technological advancement in communications, information can be transferred and exchanged through internet, and recorded in the data bank. To improve communication, internet may help facilitate quicker dispatch of information and timely responses between the HSC Officers and the organizations to promote the two-way communication. Hence, textual e-messages through mobile devices or computers for keeping a close contact with the HSC Officers should be made available and easily accessible to them. Then, they will not miss any safety-related information, and will feel free to share their ideas.

The HSC organizations should care for the specific needs and development of individual HSC Officers by practicing 'individualized consideration' to actively listen to their safety concerns and needs, and provide them with necessary support. Therefore, they can safely perform their duties according to the safety practice in place. In addition, the organizations

should consistently keep employees sufficiently informed of any proposed changes. Their participation, involvement, and compliance are dependent on how far they understand the change process of the organizations, and how such change may affect or benefit them. As the Kurt Lewin's Unfreeze-change-freeze Model for managing change describes, employees tend to resist change. To introduce change effectively, organizations need to unfreeze by changing employees' current beliefs, values, attitudes and behaviors, and then followed by convincing them about the needs and benefits for the change, until they believe and act in the ways that can support a new direction. Ultimately, management refreezes in order to sustain the change by continuously providing employees with training and support (Mindtools, 2006). Then, employees can more easily and quickly adapt themselves to a new culture of safety practice.

7.2.1.2 Recommendations to Other Stakeholders

The government, which is the flag state administration, should ensure that effective communication channels between management and the HSC Officers of the organizations are properly functioning, such as monthly safety meetings. On the other hand, the government should keep the stakeholders informed in advance of any changes in the IMO Conventions, with particular reference to any new requirements for the trade competency or qualifications of the HSC Officers.

Seafarers' unions should ensure a platform is available for exchanging views amongst all interests in the industry, while serving as conciliators to help resolve differences or even break the deadlock. Besides, they may facilitate the HSC Officers in the process of applications and enrolments into any trade courses offered by the local or overseas training institutes.

Training institutes should get the trade courses ready and known to the learners, while the process of enrolment can be completed on-line. Furthermore, a list of courses together with class timetables can be made available on-line for the HSC Officers to plan their study.

The HSC Officers themselves should read and acknowledge receipts of all safety messages to ensure that they have the information. When in doubt, they should discuss the issues further with other HSC Officers or the management of organization. When they observe any "Non-conformity" (NC), they should feel free to issue the NC and raise it in the safety meetings for further discussion. Regarding an update of their trade

qualifications, the HSC Officers should express their training needs to the management, and should prepare themselves to attend the courses.

7.2.2 Management Commitment

The research findings concluded that management commitment constituted a positive and significant direct impact upon the safety performance of organizations. As long as an organization could embrace a high degree of management commitment, it would have a high degree of safety performance.

Kennedy and Kirwan (1998) described that it was the management commitment of organizations, which would influence the effectiveness of organization's policies, the deployment of resources for safety, management involvement in safety, work procedures and safety practice (Kennedy & Kirwan, 1998). Other scholars viewed that it was the employees' perceptions of whether or not organizations would consider safety as a core value (Zohar, 2000).

In the literature, there were suggested recommendations. According to ABS (2012) and Jung (2017), management involvement in the safety issues and activities should remain a high priority within an organization. Organizations should demonstrate management commitment by getting personally involved in the safety activities (ABS, 2012; Jung, 2017). Williams (2008) further suggested that organizations should take the lead to proactively promote and keep the workplace safe. Management involvement could be demonstrated by physically attending the site for understanding thoroughly the workplace environment to ensure that employees could action all safety procedures as stated in the codes of practice (Toellner, 2001; Williams, 2008). Organizations should demonstrate commitment by supplying resources and investing capital for improving safety (Wiegmann et al., 2007).

7.2.2.1 Recommendations to HSC Organizations

Based on the empirical conclusions, the implications are that it is not about organizations prioritizing safety, but safety fundamentally has to be the organization's core value in every decision.

An HSC organization should ensure that all employees clearly know and understand the company's safety and environmental-protection policy which should be effectively communicated throughout the organization. To this effect, the HSC organizations should

promote and demonstrate that safety is a value, not considered a priority, while unsafe practices are never acceptable. It was advised by Zohar (2002) that organizations if prioritizing safety would be perceived by employees to have relative low value for safety, whereas a low-rated safety climate would result in an increase of unsafe behavior at workplace (Zohar, 2002). Hence, the HSC organizations should allocate adequate resources for their safety obligations under the ISM Code. Other than a high commitment to the passenger service quality, the organizations in preparing budgets should reserve sufficient funds, facilities and support for fulfilling the safety commitments of the ISM Code. For example, the organizations should merely keep seaworthy vessels to the scheduled departures but never urging the HSC Officers to accept minor or not very serious defects before sailing, immediately handle vessel defects and repairs but never leaving defects and repairs unattended, or delaying vessel repair and maintenance responsibilities to the next dry-dock cycle.

The HSC organizations through inspiration and motivation should encourage their HSC Officers to commit a shared vision that safety practice should be closely observed, such as complying with the "International Regulations for Preventing Collisions at Sea" (COLREG). The organizations should also serve as role models for the desired safety behaviors of employees through performing 'idealized influence'. Under no circumstance should the organizations be proud of, or praise an on-time departure or arrival of vessels in adverse weather, such as poor visibility. On the contrary, organizations should query if any risk-taking behaviours are involved. Furthermore, the organizations should closely observe the provisions of the "Permit-to-operate" (PTO) to support the safe navigation in this fast ferry trade route, such as caring and respecting the restrictions imposed on the crew working hours. In observing 'individualized consideration', the organizations should care for the likelihood of crew fatigue due to the long hours of watch-keeping duties. To this respect, the organizations may arrange some kinds of incentives, such as scheduling longer breaks during off-peaks or even early-leave after peak hours. When the organizations are able to consistently demonstrate to employees that safety is a value, and always positioned on top of the passenger services, safety behaviors increase.

As the rule of thumb, a more effective solution to a situation is to be in someone's shoes to feel what another feels. Similarly, safety climate is based upon the value an organization place on safety, as perceived by employees at workplace (Zohar, 2002). Therefore, the HSC organizations should serve as role models, as advocated by 'idealized influence', to

personally observe in the workplace, and consult the HSC Officers during vessel inspections. According to Zohar (2002), employees understand organization's expectations for safety through daily observations and interactions with organizations (Zohar, 2002). The HSC Officers who are the in-charge of the shipboard safety should know and care more about the state of workplace safety.

In keeping team's spirits high, organizations should communicate expectations of organizations, demonstrate commitments to the safety goals of organizations, and inspire confidence and a sense of purpose (Mahmood, 2019). Hence, the organizations having discussed with the HSC Officers in the spirit of 'inspirational motivation', may understand more about the workplace climate and their safety concerns. In this way, the organizations build a safety climate which serves as a frame of reference to guide and promote proper safety behaviors of the HSC Officers in the workplace. In no circumstance, should the organizations build the risk control strategies solely on the organizations' perceptions of risks to the vessels; otherwise, the management solutions or decisions may not be practicable to reduce the risk and severity of accidents (Gawel, 1997).

7.2.2.2 Recommendations to Other Stakeholders

The government is responsible for monitoring organization's compliance with the SMS. Whilst exercising flag-state control, the government should check the safety performance of the organizations against the provisions of the company's SMS.

Without prejudice, the government should closely monitor the safe conduct of the organizations. For example, the government should ensure that the organizations are able to demonstrate the organization's safety commitment as specified on the company's safety policy, with due regard to the strict compliance with the relevant legislations, such as the seaworthiness of the HSC Officers in terms of daily hours of work under the Permit-to-work requirements.

Seafarers' unions are committed to promote the importance of the SMS compliance in the industry, with special reference to the requirements of workplace safety inspections where the safety performance of the organizations and the HSC Officers are demonstrated, and the requirements of adhering to the PTO that governs the safe operation of the HSC.

Training institutes are responsible for ensuring that trade courses are available and ready at campus, with the curriculums updated to the latest amendments to the STCW Convention, the PTO, and any other local rules and regulations. In addition, offering institutes should ensure the teaching and learning materials, teaching aids, and the assessment rubrics are effective, enabling the learning outcomes are achievable and acceptable to the requirements of the regulatory instruments.

The HSC Officers should always keep safety first in mind. For example, the HSC Officers should ensure an adequacy of rest hours before reporting duty, and ensure vessel seaworthiness before vessel departure. The HSC Officers owe a duty to report defects in vessels to organizations without an excuse. In addition, when there is a discrepancy in any shipboard functions, such as working out the draft survey results for the vessel stability, or any contradiction between the company's safety policy and the actual practice of organizations, the HSC Officers should issue the NC or even major ones without prejudice. Above all, the HSC Officers should be able to converse with the contents of the SMS and the PTO, particularly the consequences of their violations.

7.2.3 Employee Empowerment

The research findings concluded that employee empowerment constituted a positive and significant direct impact upon the safety performance of organizations. Specifically, when an organization could support a high degree of employee empowerment, it would have a high degree of organization's safety performance.

In the literature, there were suggested recommendations for improving employee morale. According to Ruvolo (2003), empowered employees with a high morale would work beyond scope (Ruvolo, 2003). Petersen (2013) added that when employees felt supported, they would feel that they were valued. Then, they would feel proud of their work, accountable for their performance in safety, and a sense of responsibility for the actions or mistakes of work-mates in most cases (Petersen, 2013). Hence, employees should feel meaningfully engaged with their work. When a safe and supportive work environment is provided, and safety resources adequately supported, employee morale would be improved (Ranney & Deck, 1995; Roughton et al., 1999).

7.2.3.1 Recommendations to HSC Organizations

The implications of the findings are that the HSC organizations should ensure that the HSC

Officers are genuinely empowered to be able to discharge their duties, responsible and accountable for the safety outcomes.

Organizations practicing ‘intellectual stimulation’ should support and collaborate with independent work unit to explore new approaches and develop feasible ways of dealing with operational issues (i.e. vessel repair and maintenance responsibilities), so as to be autonomous to act independently.

Furthermore, organizations should inspire the independent work unit through motivating their self-efficacy. Through ‘inspiration and motivation’, these independent parties should believe that they can go beyond their boundaries. For example, the HSC organizations should designate or create an independent department or division through empowerment to handle matters relating to the defect rectification or immediate repairs for the fast ferries in the ferry terminal premises, particularly beyond the office hours. So in this way, the independent work unit can make prudent decisions with no conflict of interest or interferences from any other departments.

Through ‘inspiration and motivation’, the HSC organizations should collect views from the HSC Officers to make them feel inspired and empowered to be part of the decision-making process of any safety initiatives, such as involving them in consultation before imposing any change to the work process that may affect how they discharge their duties (i.e. incorporating any new or revised safety procedures into the company’s SMS).

In the problem-solving process of any safety issues, the organizations should practice ‘intellectual stimulation’ to encourage individual HSC Officers who have unique talents to share and identify solutions, so as to overcome obstacles that may impede their safety performance or safety-related behaviors for the SMS continuous improvement.

In essence, praise and recognition for work performance should make employees feel inspired and empowered to be part of the team in the problem-solving process. When they HSC Officers feel motivated, they will engage more in their work.

7.2.3.2 Recommendations to Other Stakeholders

The government should ensure that the HSC Officers are empowered in the execution of their responsibilities and obligations as explicitly stated in the company’s SMS.

Seafarers' unions should organise safety seminars, forums, conferences, visits periodically for the information updates and exchange, as well as the shared understandings or agreements on certain trade practices amongst the stakeholders for continuously improving the safe operation of ships and pollution prevention from ships.

Training institutes should work together with other stakeholders, like the seafarers' unions to address the practical implications of any updates or changes in the conventions, such as the latest amendments to the STCW Convention or the new Polar Convention, by holding technical conferences, safety seminars, or even application workshops, thus encouraging the HSC Officers' participation and engagement.

The HSC Officers out of their professional ethics should take responsibility to attend the safety-related functions or events, and actively get personally involved in the safety initiatives or campaigns. Any changes in the workplace environment likely affect the HSC Officers' safety performance. Hence, their enthusiastic participation and involvement in the process of any safety initiatives are expected. Most importantly, the HSC Officers should adapt themselves to any changes at workplace, and provide feedback in a responsible manner in the interest of continuous improvement in any safety initiatives or campaigns.

7.2.4 Fairness

The research findings concluded that fairness constituted a positive and significant direct impact upon the safety performance of organizations. More specifically, when a strong degree of fairness could be embraced, the organizations' level of safety performance would be high.

In the literature, there were suggested recommendations for improving fairness. According to Gordon et al. (2007), the number of reporting accidents, incidents, or even near misses could be increased when organizations adopted a fair performance appraisal system and applied consistent award or punishment measures to all employees in all cases when the safety-related rules were breached (Gordon et al., 2007). Moreover, employees would become more willing to lift up to their ethical responsibility in uncovering their unsafe acts and the mistakes of others at workplace when they trusted that they would be treated in a fair manner with no fear of reprisals (Gordon et al., 2007). By the same token, Roberts et al. (1994) warned that individuals when feeling fearful or stressful would likely display

defensive behaviours (Collinson, 1999; Roberts et al., 1994).

Prior studies suggested that organization's attitudes and behaviours should demonstrate fairness and integrity. Hence, organizations should practice a fair performance appraisal system by applying a consistent disciplinary measure to all employees (Gordon et al., 2007). In addition, organizations should make employees trust the systems that it is safe to report, such as ensuring the confidentiality of the reporting and investigation processes (Gordon et al., 2007).

7.2.4.1 Recommendations to HSC Organizations

The implications of the findings are that the HSC organizations should ensure that all HSC Officers have a clear picture of the performance expectations of the organizations from their job responsibilities and accountabilities.

The HSC organizations should let the HSC Officers aware of the performance appraisal system with special reference to the reward and punishment mechanisms. Through 'inspiration and motivation', organizations should inspire those who demonstrate positive safety attitudes by rewarding them for their good safety performance but challenging unsafe behaviors (Mahmood, 2019). Without prejudice, organizations should apply the appraisal system fairly and consistently to those whose performance should be awarded or penalized.

The organizations should demonstrate their commitment to safety about incident reporting. Workplace safety climate becomes effective when employees treat their organization as a role model. Through 'inspiration and motivation', the HSC organizations should let the HSC workforce trust that all incidents including hazardous occurrences are worth reporting. The organizations have been on a well-balanced blame approach, to which a fair treatment is applied. Hence, the HSC Officers should feel eased to report their own errors or mistakes.

7.2.4.2 Recommendations to Other Stakeholders

The government should investigate into the root causes when determining the verdict of an accident. The accident report should clearly indicate the findings, or the verdict of the wrongdoer's error or mistake may become a question of doubt.

Seafarers' unions should promote the duties and obligations of the HSC Officers in reporting incidents, and propose industrial guidelines for fair judgments and treatments after accidents.

Training institutes should ensure that applicants' admissions into any trade courses are based on the first-come-first-served principle without prejudice. Vacant places for course admission can be tracked in real-time and applied by applicants on-line, as well as their enrollment application status can be checked at the institute's website. On the other hand, training institutions should identify the deficiencies in teaching and learning issues. They should learn from the learners' feedbacks through the end-of-course assessment questionnaire by the last day of the course they study.

The HSC Officers should understand well how the reward and punishment systems of their organizations work. At the same time, they should give trust to their organizations in treating them fairly, and in case of accidents, the organizations are unbiased in holding accountable the employees concerned.

7.2.5 Learning

The research findings concluded that learning constituted a positive and significant direct impact upon the safety performance of organizations. If an organization could embrace learning, its safety performance would be enhanced.

In the literature, there were suggested recommendations that learning organizations should be informed and should learn from incidents by encouraging employees to report any unsafe act or event (HSE, 2019). Nevertheless, the willingness of individual employees and the adaptiveness of a learning organization's safety attitude to learn from incidents or near misses are critical to the continuous improvement of an organization's safety performance.

Prior studies suggested that organizations should promote and support a learning culture (Anderson, 2003; Withington, 2006). Gordon et al. (2007) advised that lessons learned from incidents could be properly announced in the company's notices and newsletters (Gordon et al., 2007), while other safety issues could be shared through reviews or analysis of incident reports (Jung, 2017).

7.2.5.1 Recommendations to HSC Organizations and Other Stakeholders

The implications of the findings are that the HSC organizations should let the HSC Officers learn that all incidents are preventable (Mahmood, 2019). The only blueprint the organizations appreciate should be the company's SMS, to which the HSC Officers and the organizations should strictly adhere, and in which the responsibilities and accountabilities of the parties concerned are clearly defined.

The organizations should demonstrate that an adherence to "Duty to Report" as specified in the company's SMS is highly demanded, and lessons learnt are supported, while failing to submit reports of incidents or keeping silent on any breach of safety requirements are subjected to a penalty. For example, the organizations who serve as role models in accord with 'idealized influence', motivate each HSC team on the one-on-one coaching and mentoring basis for developing their desired reporting behaviours on-board (Shen et al., 2017).

Through 'inspiration and motivation', the organizations should let the HSC Officers learn that the organizations are responsible and accountable, accepting human errors at work. To these effects, the HSC organizations should investigate into the root causes of human errors in safety. After concluding an accident investigation, the organizations should take every opportunity to praise the right and correct the wrong for an effective safety culture to develop, rather than shifting responsibilities to individuals, or even blaming the parties involved for the damage caused. Furthermore, lack of a fair performance appraisal system to praise safe behaviour or punish any unsafe act or perceived blame culture in the HSC Officer's belief, it is hard for the organizations to learn from lessons, because the parties involved may not accurately report the event, due to fear of blame or queries about their competency.

7.2.6 Summary of the Recommendations

Leadership is vital in motivating and guiding employees to realize the organizational goals. The designated person who is the leader in charge of the company's SMS should build trust and respect among the HSC Officers.

The success of any safety initiatives for the SMS continuous improvement relies largely on the employee loyalty, but being influenced much by the leadership style of the designated person. By applying as many motivating factors as practical and keeping the HSC Officers

motivated with the hygiene factors enhanced, the designated person of the company's SMS should boost the job satisfaction of each HSC team (Bellott & Tutor, 1990; Gawel, 1997). After transforming the attitudes, beliefs, and values of the HSC Officers through the influence tactics of leadership, safety performance should reach the desired safety outcomes, including improved safety climate and increased safety behaviors in safety compliance, as long as employee's trust in the organizations remains high (Bass, 1996; Shen et al., 2017).

Either ship-owning or managing organizations should attend carefully to the leadership practices in managing the company's SMS. To create a positive safety climate, an organization should welcome discussions, and appreciate views of employees from all levels within the organization, and other stakeholders in the industry. While giving efforts on improving safety climate, the organizations should give safety as their core value by caring more for the HSC Officers' safety concerns and the statutory requirements, in order to increase the employees' safety behaviors in safety compliance. It is thus implied that the organizations should closely observe the provisions of the company's SMS, the PTO, and other applicable IMO conventions; otherwise it will be hard for the organizations to rectify any deficiencies in the work procedures, or even implement any process of change.

To enhance safety leadership in the designated person, a leadership training program may be an effective way to enrich the skillset (Shen et al., 2017). For example, the IMO Model Courses for training leadership and managerial skills of seafarers (IMO, 2018).

As far as other stakeholders are concerned, the governments should continue to exercise an effective control in administrative, technical and social matters over the HSC by enforcing the applicable legislations, and monitoring compliance to ensure a strict observance of the SMS procedures by all parties concerned without any substantial commercial interference.

Seafarers' unions should provide the stakeholders, including the HSC organizations, the governments, training institutes and the HSC Officers, a platform to strengthen their ties, thus enabling team spirits in identifying safety issues and training needs, as well as maintaining the ethical standards across the HSC profession. In addition, seafarers' unions should organize and coordinate seminars, conferences, forums or similar functions to promote new conventions and any amendments to the existing regulatory instruments. They should also collect views and ideas of the HSC Officers on the aspects of safety

improvements, and propose safety guidelines and recommendations to the industry, thus keeping the industry abreast of the existing and new knowledge for continuous improvement.

Training institutes should ensure availability and readiness of trade courses to meet the job requirements of the maritime industry, and the specific training needs of the HSC Officers in meeting the qualification requirements of the STCW Conventions. For further improvements, training institutes should simplify the procedural process of course application, enrolment, and the tuition payment, enabling the process to go through on-line electronically. They should also attempt to rationalize the obvious delays in the approval process for the in-demand trade courses to cater for the training needs of seafaring practitioners. Specifically, training institutes may develop an integrated curriculum with a flexible timetable structure to cater for the shift work nature of the HSC Officers.

The HSC Officers should endeavor to adapt themselves to any change, get involved in any safety improvement initiatives, and prepare themselves to attend safety-related meetings, updating or refresher courses. They should share their feedback on any change or safety initiatives, and provide professional views on any safety-related issues during the safety-related meetings.

As far as the professional ethnics of the HSC are concerned, the HSC Officers should always think about safety before making every safety-related decision. Regarding the mandatory requirements of “Duty to report” and “Rest periods”, reporting accidents and taking sufficient rest before duty are the implied duties of the HSC Officers. The HSC Officers are well aware of their obligations and liabilities, with the responsibilities and authorities expressly stipulated in the company’s SMS.

In conclusion, the HSC organizations should apply the influence tactics of leadership to achieve a trustful leader-subordinate relationship and through motivating factors create job satisfaction for driving the HSC Officers’ safety motivation to go beyond their boundaries towards the desired safety behaviors for the SMS continuous improvement of the organizations.

7.2.7 Enabling Technologies Applied

With technological advancements in information technology, innovative technologies such

as Artificial intelligence (AI) may help improve the safety performance of the HSC organizations in the maritime industry. Artificial intelligence, which performs human-like tasks, makes it possible for machines to learn and recognise, analyse and predict risks, and proactively exhibit autonomous behavior without human intervention.

The power of Artificial intelligence (AI) is used in many fields of different industries. In the maritime industry, a number of AI innovation projects are underway. The application of autonomous system to route optimization, fuel saving and cyber security are proved to be viable solutions, while the autonomous ship concept has been in the research and development phase (Gerber, 2021). Several successful trials on physical ships including the car ferry "Falco" (Ship Intelligence, 2018) and the trimaran research vessel "Mayflower" have demonstrated its feasibility, though the autonomous ship concept is still far from widespread application (Lang, 2022).

As far as incident reporting in the maritime industry is concerned, reporting deficiencies and non-conformities are regarded as an effective way to increase employees' safety awareness for continuously improving safety performance of an organization. An effective reporting culture is dependent on employee's experience through learning about the fairness of treatment after reporting accidents, incidents or near misses (Gatfield, 1999; IMO, 2008b).

Perceived unfair treatment and lessons learnt from negative experience discourage employees to report. In the maritime industry, non-reporting of near misses, incidents or accidents has been a typical safety issue to be resolved, which may be managed by the artificial intelligence technologies.

To deal with non-reporting issues, a combined use of Voyage data recorder (VDR) and Artificial intelligence (AI) may be a feasible solution. First, the voyage data recorder (VDR) functions as a black-box carried on aircraft, with the recorded data to be examined only after an accident. VDR continuously logs key parameters, such as ship's position, courses and speeds, rudder deflections and turn rates, as well as radar information on land and ships in vicinity, bridge communication, and many other key indicators of the ship's performance. They also record near misses and any other incidents that occur during voyage. Second, a sensor technology which is known as the Orca AI combines sensor data from the thermal & ultra-low-light camera-based vision system to add image recognition to

the AI-based navigation systems, and integrates the vessel positioning systems, including the "Automatic Identification System (AIS), Electronic Chart Display Information Systems (ECDIS), Global Positioning System (GPS)", and shipboard marine radars (Gerber, 2021). The Orca AI relies on the built-in "Deep learning algorithms" to automatically detect, identify and track multiple targets (i.e. vessels or floating objects in the ship's path, even when visibility is poor) with risks of collision at any one time, thus raising situational awareness in real time to alert the navigators of other vessels or hazards, or even any navigational near-misses in the close proximity during a voyage.

According to the OCIMF report (2013), VDR if treated as recording and monitoring devices, operating organizations may do more with the data than just store them for accident investigation. They may use VDR data to improve their operations and prevent incidents or dangerous activities (OCIMF, 2013). In 2014, the Hong Kong-based ship operator "Fleet Management" tried using VDR data as real-time information to improve navigational safety on its managed vessels, including near miss reporting (Wingrove, 2014).

In effect, electronic reporting and monitoring of a vessel's compliance performance is technically feasible, and rather cost effective. First, the long-term investments of AI on ship safety demonstrate the safety commitment of the organizations. Second, recorded data embraces fairness to the employees and promotes learning. Due to data transparency, each action taken by the navigational teams in the wheelhouse is accurately recorded and unable to be altered. Any deliberate or undesirable deviation in course and or speed from the set parameters, and the prevailing traffic situations including navigational near misses will be recorded and alerting the HSC Officers in real time to raise their situational awareness for decision making. Simultaneously, the data is routed through Cloud serving as data storage to the organizations for monitoring the continuous improvement of vessel performance.

As a matter of fact, all incidents including hazardous occurrences are worth reporting. The real-time data and images including the reporting behaviors of the HSC Officers are recorded and hence closely monitored, which strengthen the communication linkage between ship-and-shore for the organizations to better understand the weaknesses in the navigational procedures and shipboard systems, and to mitigate navigational risks on route.

The main obstacles in changing to a computer-based system are the reliability of computers, crew's computer literacy, and the very limited repair & maintenance of automation system knowledge available onboard. The organizations should ensure that the HSC Officers are properly trained in the operations of each automated system, and they can recognize and respond to the alarm appropriately, and take appropriate corrective action in the event of a system failure. Above all, the HSC Officers should know how to reverse the AI-based autonomous systems from automation to manual controls. If empowered, the HSC Officers can take self-control of the vessel by disenabling automation when it is deemed necessary, such as in the event of severe issues like virus infection, cyber-attack, or out of internet coverage.

In conclusion, the AI-based autonomous systems enhance situational awareness of the HSC Officers to keep them engaged, alert, to be competent to make best decisions in a quick and safe manner in the prevailing circumstances and conditions, and promote incident reporting culture without human intervention.

With the AI application, the HSC organizations can leverage the strengths of the computers' and systems' capabilities to compensate human factors like fatigue, distraction, and personal problems. Hence, AI technologies are tools to help eliminate human errors, while the HSC Officers play the active role of confirming each action taken correctly by the AI-based autonomous systems.

The HSC Officers should in no circumstance let the automation overrule them; unless they know exactly what is happening. The vessels are still manned and commanded by humans. The AI-based autonomous systems do not relieve the duties and obligations of the HSC Officers in monitoring the autonomous operations.

Profoundly, the AI-based autonomous systems do support the reporting and monitoring of a vessel's compliance performance. To gain full benefits from the AI-based autonomous systems, it is necessary for the HSC Officers to have trust in the organizations, the same as in the leadership of the designated persons.

7.3 Limitations of the Study

This study was bound to cover that the survey research was limited to an investigation of the HSC Officers serving on the Hong Kong-registered HSC into the effects of safety culture on their perceptions of organization's safety performance.

Data collated through survey questionnaires during the survey period was the sole perceptions of the HSC Officers of the two HSC organizations in Hong Kong, without

getting shore-based employees of the organizations and other stakeholders in the HSC industry involved in the questionnaire survey.

The significant factors, which could either promote or hinder the development of safety culture in the HSC organizations, were identified in the research findings, but some other factors that might cause effects would likely be neglected due to the sole unit of sampling. It would be arguable that the survey research results derived from this asymmetric measurement could be the norm, representing all stakeholders in the industry.

Though the survey research results were based on an assumption that the respondents duly completed the survey questionnaires were in good faith, the likelihood of their bias did exist due to beliefs from different cultural subsets. The analytical results might to a certain extent be affected.

In principle, the research findings may serve as a guide for further studies in this endeavor. Neither should they be used to represent the safety performance of any individual HSC organization, nor should the research findings hold good for the validity and reliability, unless otherwise subsequent survey(s) is conducted and followed up.

7.4 Directions for Future Research

The limitations of this study provided meaningful directions for future research on this topic of interest. Due to time constraints, this study examined the impacts of safety culture on the safety performance of the HSC organizations in Hong Kong, solely based on the perceptions of the HSC Officers.

For further studies in the future, it is suggested to get more stakeholders involved, in the exploration of other impacts upon the safety performance of organizations. Other stakeholders play important roles, including the government, seafarers' unions, and training institutions. Their involvement in survey may make the survey more meaningful.

Data can be collated from both shore-based and shipboard employees of the organizations, in order that respondent bias is eliminated to an extent, thus enabling a more reasonable generalization of the findings.

When resources in terms of time and labor allow, a mixed methods of questionnaire survey

supplemented by interviews or other qualitative methods may also be applied to gain further insights into the causes.

With more stringent regulations coming into force, the HSC organizations are likely facing stronger challenges and impacts upon their safety performance. In future studies, more influential factors may be uncovered from the review of literature, and incorporated into the research model, so that the applicability of the research results can be more practicable. Subject to the nature and objectives of further studies in the future, the questionnaire and the model built for this study may serve as tools, but the validity and reliability of the measurement tools should be taken into account.

7.5 Conclusive Summary

This research study explored the effects of safety culture on the organization's safety performance in the HSC context of the maritime industry in Hong Kong. The research study proposed and tested a model of relationship between safety culture and the safety performance of the HSC organizations. The survey research results recognized communication, management commitment, employee empowerment, fairness, and learning as the significant factors of safety culture in the workplace, and concluded the achievement of aims and objectives of the study.

To the author's best knowledge, this was the first study done to investigate the effects of safety culture on the safety performance of the HSC organizations, and this study contributed towards the knowledge of safety culture in the HSC context of the maritime industry in Hong Kong.

The study has yielded valuable research results that may support other researchers to engage in a more complex research in future, with intent to gain deeper insights of different safety perspectives.

In conclusion, the study has made a positive contribution to the HSC industry of Hong Kong for sustaining the continuous improvement of the HSC organizations.

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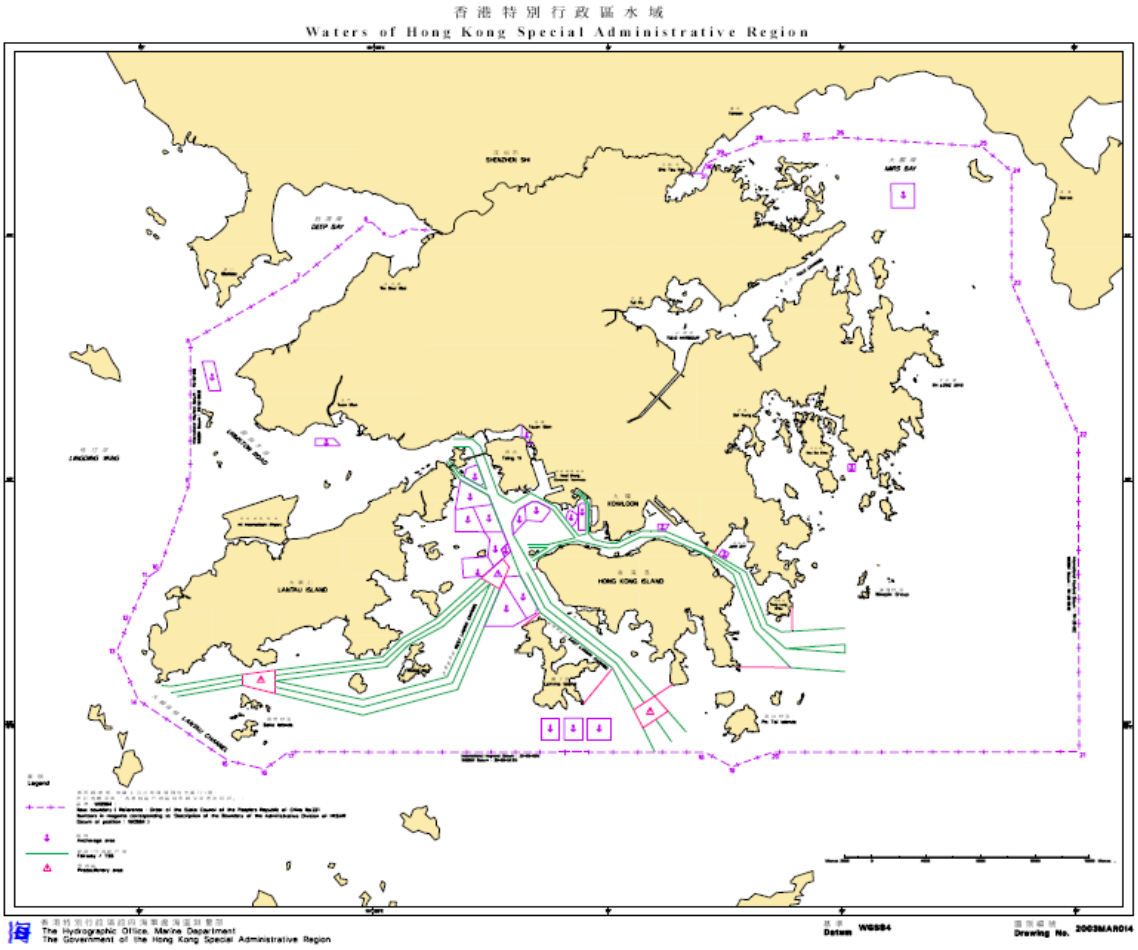
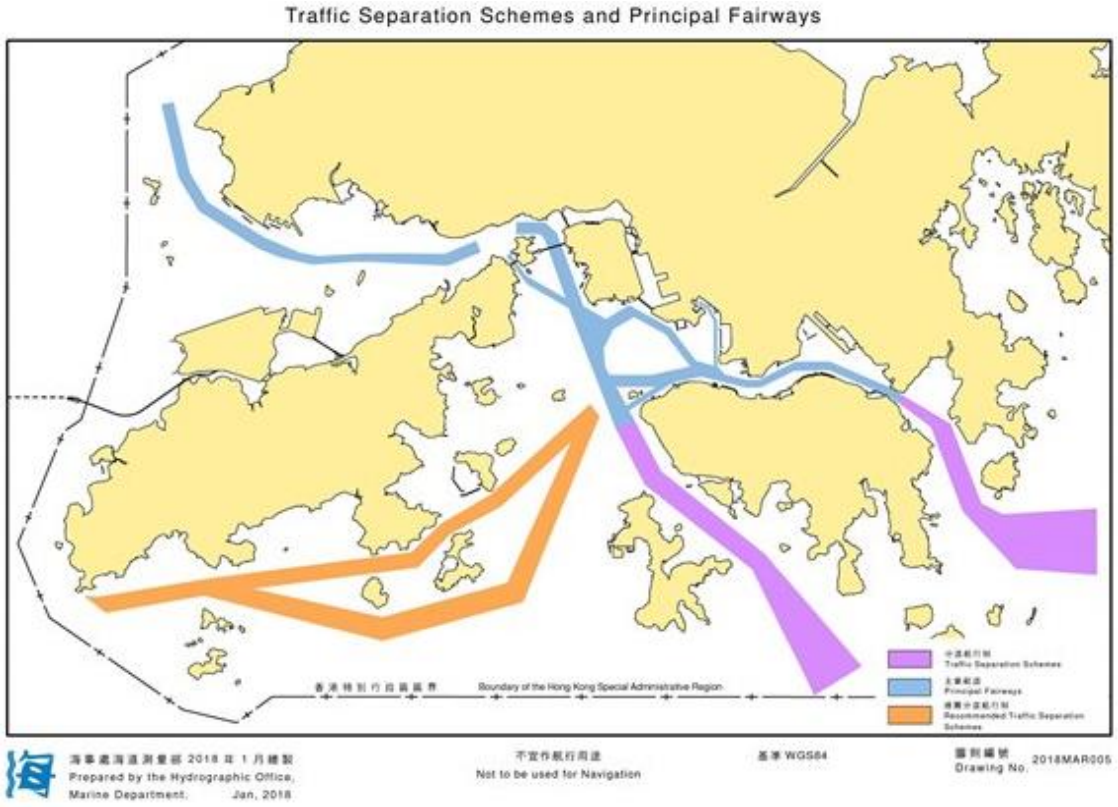
APPENDICES

Appendix: A
Figure 2.1 - Hong Kong Waters
Sourced from: Marine Department, Hong Kong



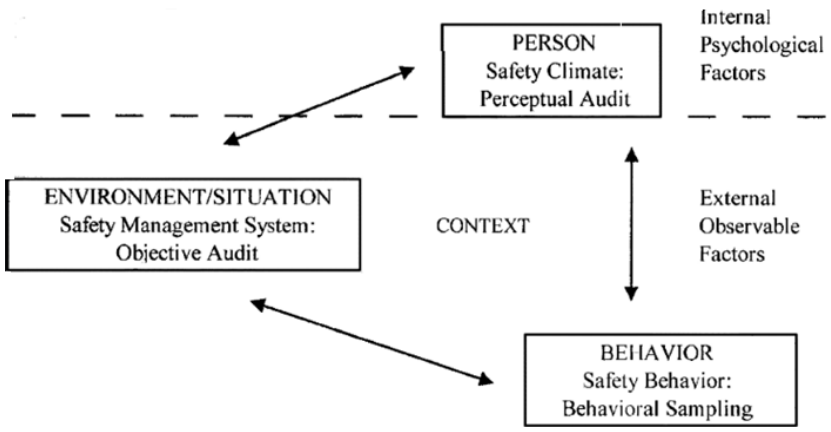
Appendix: A
Figure 2.5.2 – Separation Scheme and Principal Fairways
Sourced from: Marine Department of HKSAR



Appendix: B

Figure: 3.9.3 – The Cooper (1993)'s Reciprocal Model of Safety Culture

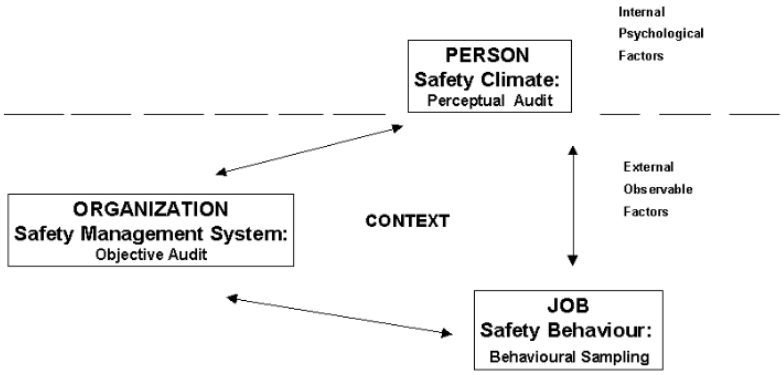
Sourced from: Cooper (1993)



Appendix: B

Figure: 3.9.4 – The Cooper (1999)'s Extended Reciprocal Model of Safety Culture

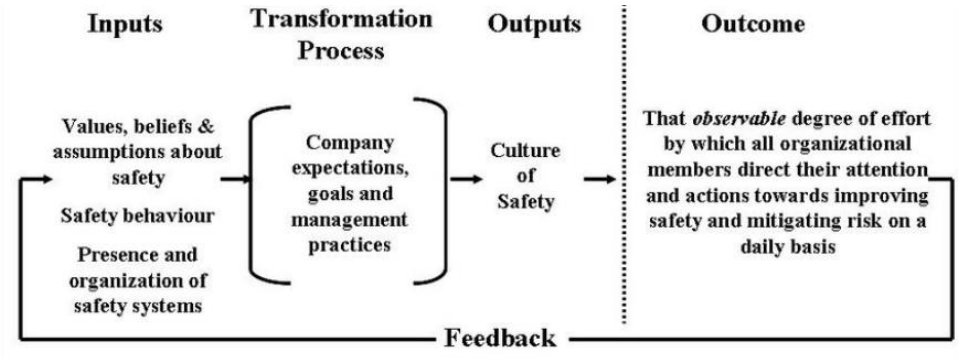
Sourced from: Cooper (1999)



Appendix: B

Figure: 3.9.5 – The Cooper's (2002a) Business Process Model of Safety Culture

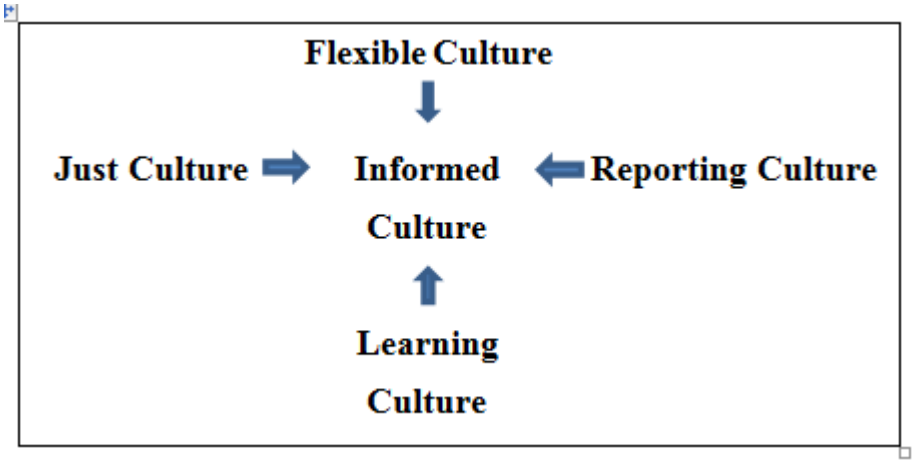
Sourced from: Cooper, 2002a



Appendix: B

Figure: 3.9.6 - Key Components of the Reason (1997)'s Model of Safety Culture

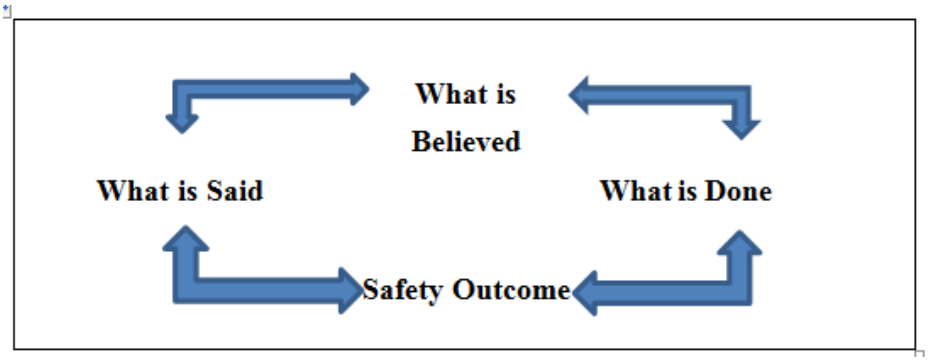
Sourced from: Reason (1997)



Appendix: B

Figure 3.9.7 – The Gordon (2007)'s Simplified Model of Safety Culture

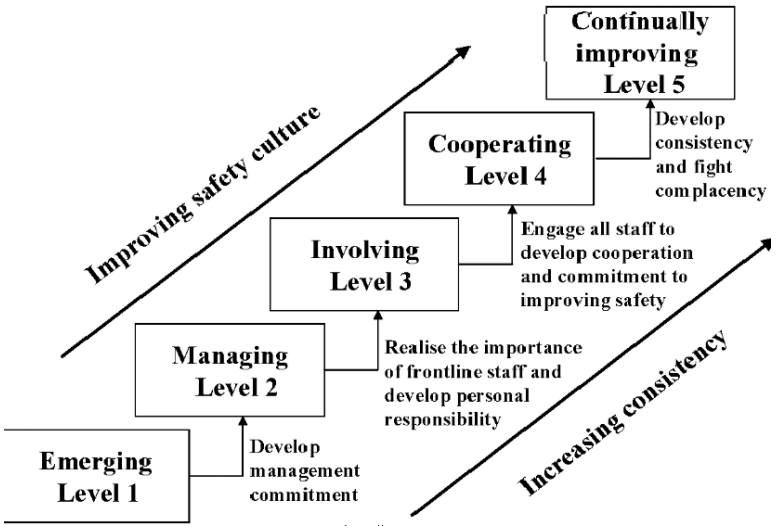
Sourced from: Gordon, Kirwan, and Perrin (2007)



Appendix: B

Figure: 3.9.8 – The Fleming (2000)'s Safety Culture Maturity Model

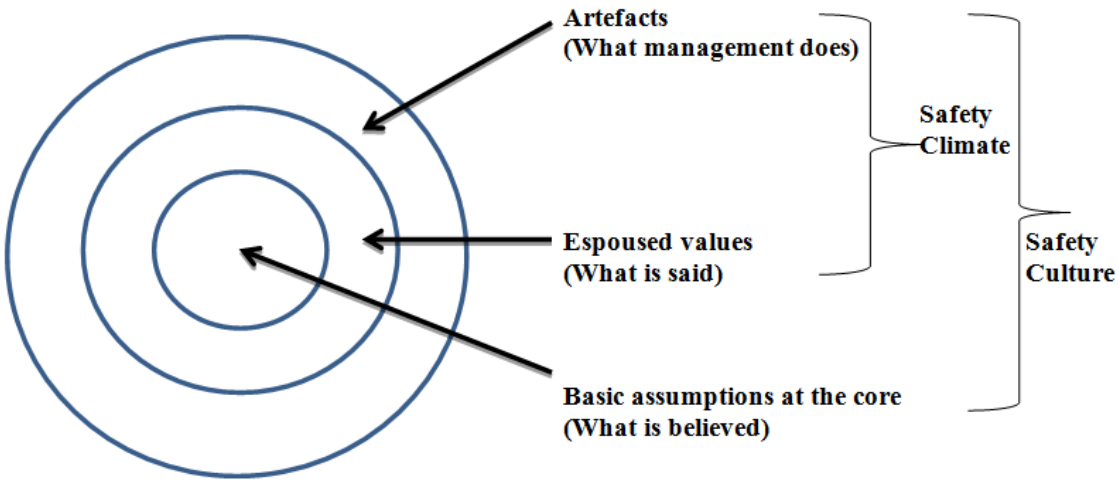
Sourced from: Fleming (2000)



Appendix: B

Figure: 3.9.9 – The Guldenmund (2000)'s Model of Safety Culture

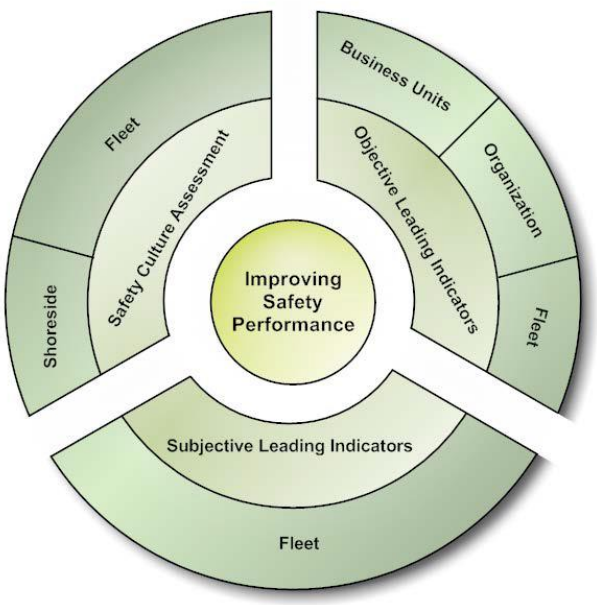
Sourced from: (Guldenmund, 2000)



Appendix: B

Figure: 3.9.11 – The ABS (2012)'s Model of Safety Culture and Leading Indicators of Safety

Sourced from: ABS (2012)



Appendix: B

Table: 3.10.4 – The Gittell (2013)'s Theory of Effective Communication

Sourced from: Gittell (2013)

Dimensions of Viable Information	Description
Frequent Communication	How frequently do people in each of these groups/roles communicate about work or organizational focus?
Timely Communication	Do people in these groups/roles communicate with you in a timely way about work or organizational focus?
Accurate Communication	Do people in these groups/roles communicate with you accurately about work or organizational focus?
Problem-solving Communication	When there is a problem with work or organizational focus, do people in these groups/roles blame others or work with you to solve the problem?
Shared Goals	Do people in these groups/roles share your goals in addressing work or organizational focus?
Shared Knowledge	Do people in these groups/roles know about the work you do to address work or organizational focus?
Mutual Respect	Do people in these groups/roles respect the work you do to address work or organizational focus?

Appendix: C
Questionnaire Survey

Dear HSC Officers (Deck & Engine),

Re: Request for Opinion Survey

I am Ricky Chan, conducting a research study titled '**A study of the High-speed Passenger Craft industry in Hong Kong**'. Given your expertise and experience with the Hong Kong High Speed Craft industry, I cordially invite you to participate in this questionnaire survey.

The aim of this questionnaire is to measure the HSC watch-keeping Deck Officers or Engineering Officers' perceptions of the company's safety culture.

Your support to this research is highly appreciated, and I would like you to spend a few minutes to complete the attached questionnaire. I will keep all information confidential, and will use them for my academic research study only. Please read the terms of consent at the back of this letter.

Please feel free to contact me at 6031XXXX (e-mail: rickychanXXXX@hotmail.com), if you have any questions about this research study. In case, you are not able to return the completed questionnaire to me today, you may contact the undersigned for further collection arrangement.

Yours faithfully,

_____
Chan Chi Keung, Ricky
Tel: 6031- XXXX
E-mail: rickychanXXXX@hotmail.com

Encl.:
The questionnaire

Terms of Consent

- By submission of a completed questionnaire, I hereby consent to participate in the captioned research.

- I understand that information obtained from this research may be used in future research and may be published. However, my right to privacy will be retained, i.e., my personal details will not be revealed and the survey is completely anonymous.

- I understand there are no benefits or risks associated with participation in this study. My participation in the project is voluntary. I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without negative consequences.

- I acknowledge that I have the right not to give consent, and may opt out of the survey by not submitting a completed questionnaire.

Opinion Questionnaire Survey

Part I - General Information (please tick as appropriate)

A1	**What is your job position?** ☐1 Master ☐2 Chief Officer ☐3 VAS or Night Vision Officer ☐4 Chief Engineering Officer
A2	**Which of the following qualification(s) you have?** ☐1 Class 1, Deck ☐2 Class 2, Deck ☐3 Class 3, Deck ☐4 Marine Engineer
A3	**How many years of sea experience you have (Including onboard cadetship)?** ☐1 Less than 1 year ☐2 1 – 3 years ☐3 Above 3 – 6 years ☐4 Above 6 – 9 years ☐5 Above 9 years
A4	**How many years have you been in the HSC industry (Local or River Trade)?** ☐1 Less than 1 year ☐2 1 – 3 years ☐3 Above 3 – 6 years ☐4 Above 6 – 9 years ☐5 Above 9 years
A5	**How many years have you worked for your present employer?** ☐1 Less than 1 year ☐2 1 – 3 years ☐3 Above 3 – 6 years ☐4 Above 6 – 9 years ☐5 Above 9 years
A6	**Which of the following age group are you?** ☐1 20 to 30 ☐2 31 to 40 ☐3 41 to 50 ☐4 51 to 60 ☐5 Above 60 Years old
A7	**Which of the companies you are employed?** ☐1 TurboJet ☐2 CotaiJet
A8	**What is your gender?** ☐1 Male ☐2 Female

In Part II, please indicate your level of agreement by putting a 'tick' in the box:
Strongly Disagree 1, Disagree 2, Somewhat Agree & Disagree 3, Agree 4, Strongly Agree 5 .

Part II – Question Statements

To what extent do you agree or disagree with the following statements concerning Management Commitment (D1)		**Level of Agreement**				
		1	**2**	**3**	**4**	**5**
V1	Management really cares about the safety of employees who work here.					
V2	Management motivates and praises employees for working safely.					
V3	Management is willing to invest money and effort to improve safety.					
V4	Management shows concern if safety procedures are not followed.					
V5	Management does all it can to prevent accident or incident from happening.					
V6	There are enough employees available to get the job done according to the safety procedures.					
V7	Employees can get the equipment that they need to work according to the safety procedures.					
V8	Management has excellent safety maintenance standards.					
V9	Management involvement in safety issues has a high priority in the organization.					
V10	Management gets personally involved in safety activities or events.					
To what extent do you agree or disagree with the following statements concerning Employee Involvement (D2)		**1**	**2**	**3**	**4**	**5**
V11	Employees are involved in informing management of important safety issues.					
V12	Employees feel involved when safety procedures / instructions / rules are developed or reviewed.					
V13	Employees have an opportunity of influencing the decisions to be made by management.					
V14	Employees clearly understand their responsibilities for safety.					
V15	I am satisfied with employee involvement in safety at work.					
To what extent do you agree or disagree with the following statements concerning Employee Empowerment (D3)		**1**	**2**	**3**	**4**	**5**
V16	Employees are consulted on matters that affect how they do their job.					
V17	Employees are actively encouraged to improve safety.					
V18	Employees have good control over the safety outcomes of their job.					
V19	Employees can make decisions on safety issues, even if the decisions may lower the productivity.					
V20	Management ensures that employees are responsible and accountable for safe operations.					
To what extent do you agree or disagree with the following statements concerning Communication (D4)		**1**	**2**	**3**	**4**	**5**
V21	Employees are informed of the meeting outcomes that address safety.					
V22	Safety information is brought to employees' attention by management.					
V23	I am satisfied with the way I am kept informed of safety at work.					
V24	There is mutual trust between management and employees based on honesty and truthfulness.					
V25	Employees trust the confidentiality of the reporting or investigation process.					
V26	Employees are willing to report near misses.					
V27	Employees trust the systems that they need to use and follow in their job.					
To what extent do you agree or disagree with the following statements concerning Reporting (D5)		**1**	**2**	**3**	**4**	**5**
V28	Employees are familiar with the systems for formally reporting safety issues.					
V29	When an employee reports a safety problem, management acts quickly to correct the safety issues.					
V30	Safety issues raised by employees are communicated regularly to all employees.					
V31	Employees do not hesitate to report minor injuries or incidents. *For example, when there is an incident, the prevailing culture will encourage employees to report the incident to management.*					
V32	I am satisfied with the way management deals with the safety reports. *For example, when there is an incident, the employee's incident report about the causes does not affect the job security or management will not count the number of incidents as a measure of the employees' safety performance.*					

To what extent do you agree or disagree with the following statements concerning Fair ness (D6)						
		1	**2**	**3**	**4**	**5**
V33	Investigation team members are trained to identify the root causes rather than blaming the human error.					
V34	There is a consistency regarding disciplinary measures for incidents or accidents.					
V35	Employees are willing to report incidents because they know that they are treated in a fair manner.					
V36	Management practices a fair appraisal system.					
V37	I am satisfied with the follow-up measures taken after accidents, incidents or near misses.					
To what extent do you agree or disagree with the following statements concerning Learning (D7)						
		1	**2**	**3**	**4**	**5**
V38	The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.					
V39	Lessons learned (事後檢討) from incidents or accidents are published, such as in company's notice or newsletter.					
V40	The issue of safety is shared by employees as a best practice through review and analysis.					
V41	Employees are encouraged to report unsafe conditions.					
V42	Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident					
To what extent do you agree or disagree with the following statements concerning Teamwork (D8)						
		1	**2**	**3**	**4**	**5**
V43	Management rewards individual performance (個別組員的表現), and rewards other team members based on team performance (組別的表現).					
V44	Employees who work in my team are fully committed to safety.					
V45	Co-workers give advice to each other on how to work safely.					
V46	When things get busy, employees can seek help from others.					
V47	I must work safely if I want to keep the respect of others in my team.					
To what extent do you agree or disagree with the following statements concerning Reward System (D9)						
		1	**2**	**3**	**4**	**5**
V48	Employees' performance relating to safety is evaluated according to the standards.					
V49	Employees understand 'acceptable and unacceptable safety behaviors' at workplace.					
V50	Employees who cause an accident or incident are held sufficiently accountable for their actions.					
V51	Consistent actions are taken & applied to any employees who violate safety procedure or rule.					
V52	Employees with good safety performance are recognized and rewarded by management.					
To what extent do you agree or disagree with the following statements concerning Training (D10)						
		1	**2**	**3**	**4**	**5**
V53	Training covers all the safety risks associated with the work for which employees are responsible.					
V54	Adequate safety training is given by management to perform the job safely.					
V55	Employees are consulted to establish their training needs.					
V56	Management places a high priority on safety training.					
V57	I am satisfied with competency of training, such as the ways of training.					
V58	All the safety rules or procedures are strictly followed here.					

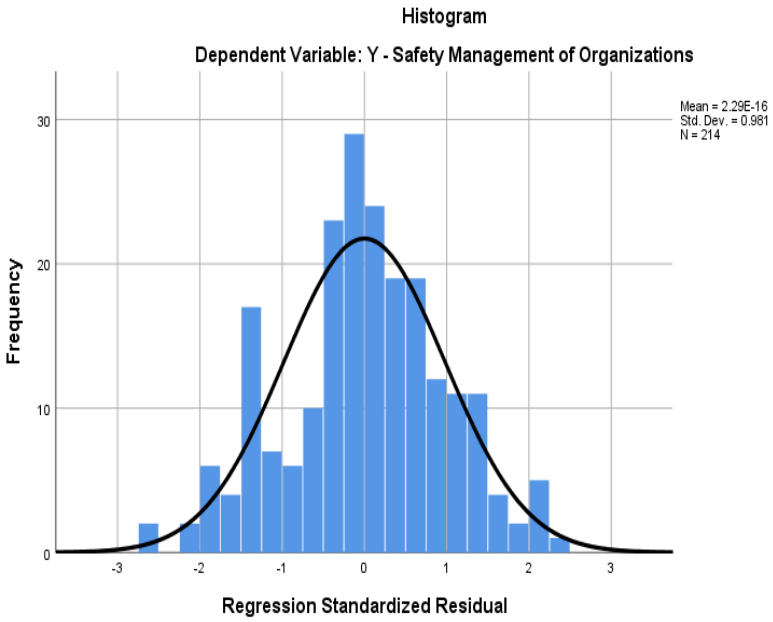
To what extent do you agree or disagree with the following statements concerning Safety Performance		1	2	3	4	5
Y1	The risk of accidents has been kept to a minimum.					
Y2	The frequency of equipment failure is reducing.					
Y3	The current state of the organization's SMS Continuous Improvement has been effective.					
Y4	The current state of the management's Safety Performance has been good.					

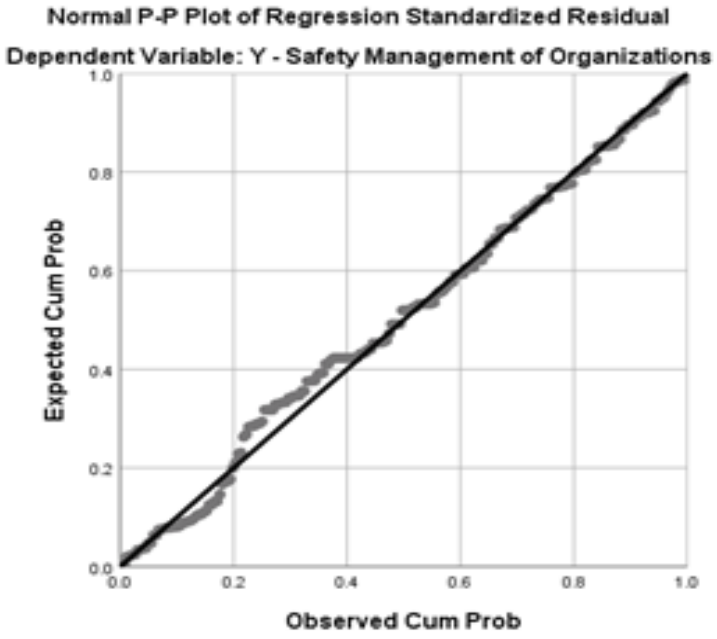
Thanks for spending your time to complete this questionnaire survey!

Appendix: D

Figure: 6.1.1.1.4 - Normal P-P Plot of Regression

Sourced from: the SPSS worksheets





Appendix: D
Table: 6.1.1.2.4 - Communalities before and after Extraction for the Items of Safety Culture

Extracts from: the SPSS worksheets

Communalities	Initial	Extraction
V1 Management really cares about the safety of employees who work here.	1.000	.807
V2 Management motivates and praises employees for working safely.	1.000	.867
V3 Management is willing to invest money and effort to improve safety.	1.000	.736
V4 Management shows concern if safety procedures are not followed.	1.000	.793
V5 Management does all it can to prevent accident or incident from happening.	1.000	.750
V6 There are enough employees available to get the job done according to the safety procedures.	1.000	.813
V7 Employees can get the equipment that they need to work according to the safety procedures.	1.000	.817
V8 Management has excellent safety maintenance standards.	1.000	.806
V9 Management involvement in safety issues has a high priority in the organization.	1.000	.576
V10 Management gets personally involved in safety activities or events.	1.000	.646
V11 Employees are involved in informing management of important safety issues.	1.000	.857
V16 Employees are consulted on matters that affect how they do their job.	1.000	.793
V17 Employees are actively encouraged to improve safety.	1.000	.852
V18 Employees have good control over the safety outcomes of their job.	1.000	.863
V19 Employees can make decisions on safety issues, even if the decisions may lower the productivity.	1.000	.859
V20 Management ensures that employees are responsible and accountable for safe operations.	1.000	.531
V21 Employees are informed of the meeting outcomes that address safety.	1.000	.798
V22 Safety information is brought to employees' attention by management.	1.000	.686
V23 I am satisfied with the way I am kept informed of safety at work.	1.000	.850
V24 There is mutual trust between management and employees based on honesty and truthfulness.	1.000	.715
V25 Employees trust the confidentiality of the reporting or investigation process.	1.000	.656
V27 Employees trust the systems that they need to use and follow in their job.	1.000	.656
V28 Employees are familiar with the systems for formally reporting safety issues.	1.000	.793
V29 Management acts quickly to correct the safety issues, when an employee reports a safety problem.	1.000	.685
V30 Safety issues raised by employees are communicated regularly to all employees.	1.000	.728
V32 I am satisfied with the way management deals with the safety reports.	1.000	.414
V34 There is a consistency regarding disciplinary measures for incidents or accidents.	1.000	.862
V35 Employees are willing to report incidents because they know that they are treated in a just and fair manner.	1.000	.634
V36 Management practices a fair appraisal system.	1.000	.870
V37 I am satisfied with the follow-up measures taken after accidents, incidents or near misses.	1.000	.560
V38 The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.	1.000	.668
V39 Lessons learned from incidents or accidents are published, such as in company's notice or newsletter.	1.000	.797
V40 The issue of safety is shared by employees as a best practice through review and analysis.	1.000	.574
V41 Employees are encouraged to report unsafe conditions.	1.000	.730
V42 Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident.	1.000	.764
V43 Management rewards individual performance, and rewards other team members based on team Performance.	1.000	.635
V44 Employees who work in my team are fully committed to safety.	1.000	.837
V45 Co-workers give advice to each other on how to work safely.	1.000	.787
V46 Employees can seek help from others, when things get busy.	1.000	.797
V49 Employees understand 'acceptable and unacceptable safety behaviors at workplace.	1.000	.486
V50 Employees who cause an accident or incident are held sufficiently accountable for their actions.	1.000	.792
V52 Employees with good safety performance are recognized and rewarded by management.	1.000	.659
V53 Training covers all the safety risks associated with the work for which employees are responsible.	1.000	.758
V54 Adequate safety training is given by management to perform the job safely.	1.000	.718
V55 Employees are consulted to establish their training needs.	1.000	.732
V56 Management places a high priority on safety training.	1.000	.742
V57 I am satisfied with competency of training, such as the ways of training.	1.000	.563
V58 All the safety rules or procedures are strictly followed here.	1.000	.489
Average	**1.000**	**.725**
Extraction Method: Principal Component Analysis		

Appendix: D

Table: 6.2.2.4 - Breakdown of Means, Mean Scores and Standard Deviations

Extracts from: the SPSS worksheets

48 Items		Mean	S.D.
Factor 1	**Items relating to Management Commitment**		
V1	Management really cares about the safety of employees who work here.	3.6028	.59433
V2	Management motivates and praises employees for working safely.	3.4860	.69017
V3	Management is willing to invest money and effort to improve safety.	3.4486	.55214
V4	Management shows concern if safety procedures are not followed.	3.4953	.62610
V5	Management does all it can to prevent accident or incident from happening.	3.5327	.60231
V6	There are enough employees available to get the job done according to the safety procedures.	3.5701	.49622
V7	Employees can get the equipment that they need to work according to the safety procedures.	3.5794	.49481
V8	Management has excellent safety maintenance standards.	3.5888	.51189
V9	Management involvement in safety issues has a high priority in the organization.	3.5748	.56628
V10	Management gets personally involved in safety activities or events.	3.4346	.63757
Mean Score		**3.5313**	
Factor 2	**Items relating Employee Empowerment**		
V11	Employees are involved in informing management of important safety issues.	3.3925	.69549
V16	Employees are consulted on matters that affect how they do their job.	3.3551	.74117
V17	Employees are actively encouraged to improve safety.	3.2897	.71219
V18	Employees have good control over the safety outcomes of their job.	3.3411	.67169
V19	Employees can make decisions on safety issues, even if the decisions may lower the productivity.	3.3598	.68961
V20	Management ensures that employees are responsible and accountable for safe operations.	3.4813	.56263
Mean Score		**3.3699**	
Factor 3	**Items relating to Communication**		
V21	Employees are informed of the meeting outcomes that address safety.	3.5140	.63341
V22	Safety information is brought to employees' attention by management.	3.5701	.62966
V23	I am satisfied with the way I am kept informed of safety at work.	3.5047	.63355
V24	There is mutual trust between management and employees based on honesty and truthfulness.	3.3832	.66636
V25	Employees trust the confidentiality of the reporting or investigation process.	3.4252	.62912
V27	Employees trust the systems that they need to use and follow in their job.	3.3364	.61199
Mean Score		**3.4556**	
Factor 4	**Items relating to Learning**		
V38	The safety system (issues) is improved based on experience, news related to the safety issues, or recognized solutions.	3.7103	.49427
V39	Lessons learned from incidents or accidents are published, such as in company's notice or newsletter.	3.5748	.59853
V40	The issue of safety is shared by employees as a best practice through review and analysis.	3.5654	.58376
V50	Employees who cause an accident or incident are held sufficiently accountable for their actions.	3.4486	.63147
V52	Employees with good safety performance are recognized and rewarded by management.	3.4019	.59513
Mean Score		**3.5402**	
Factor 5	**Items relating to Reporting**		
V28	Employees are familiar with the systems for formally reporting safety issues.	3.4299	.61457
V29	When an employee reports a safety problem, management acts quickly to correct the safety issues.	3.4673	.58651
V30	Safety issues raised by employees are communicated regularly to all employees.	3.4206	.61342
V32	I am satisfied with the way management deals with the safety reports.	3.3411	.69909

V37	I am satisfied with the follow-up measures taken after accidents, incidents or near misses.	3.3037	.58646
V41	Employees are encouraged to report unsafe conditions.	3.1682	.71845
V42	Employees receive 'feedback on the status' and 'results of the investigation' when they report an incident or accident	3.3224	.70794
Mean Score		**3.3505**	
Factor 6	**Items relating to Training**		
V53	Training covers all the safety risks associated with the work for which employees are responsible.	3.5421	.49940
V54	Adequate safety training is given by management to perform the job safely.	3.5140	.51938
V55	Employees are consulted to establish their training needs.	3.4953	.55452
V56	Management places a high priority on safety training.	3.5374	.56169
V57	I am satisfied with competency of training, such as the ways of training.	3.5093	.54593
V58	All the safety rules or procedures are strictly followed here.	3.5748	.57451
Mean Score		**3.5288**	
Factor 7	**Items relating to Teamwork**		
V43	Management rewards individual performance, and rewards other team members based on team performance	3.1402	.71796
V44	Employees who work in my team are fully committed to safety.	3.4486	.61642
V45	Co-workers give advice to each other on how to work safely.	3.5234	.61813
V46	When things get busy, employees can seek help from others.	3.4953	.63355
V49	Employees understand 'acceptable and unacceptable safety behaviours' at workplace.	3.4065	.61144
Mean Score		**3.4028**	
Factor 8	**Items relating to Fairness**		
V34	There is a consistency regarding disciplinary measures for incidents or accidents.	3.2804	.62490
V35	I feel that employees are willing to report incidents because they know that they are treated in a fair manner.	3.4299	.59909
V36	Management practices a fair appraisal system.	3.2804	.62490
Mean Score		**3.3302**	

END