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## The legal, administrative and operational framework for the safe maritime transport of dangerous goods: Myanmar as a case study

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**WORLD MARITIME UNIVERSITY**

Malmö, Sweden

**THE LEGAL, ADMINISTRATIVE AND  
OPERATIONAL FRAMEWORK FOR THE SAFE  
MARITIME TRANSPORT OF DANGEROUS  
GOODS: MYANMAR AS A CASE STUDY**

By

**MYO MIN THANT**

**The Republic of the Union of Myanmar**

A dissertation submitted to the World Maritime University in partial  
Fulfilment of the requirements for the award of the degree of

**MASTER OF SCIENCE**

**In**

**MARITIME AFFAIRS**

**(MARITIME SAFETY AND ENVIRONMENTAL ADMINISTRATION)**


2018

**DECLARATION**

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views and are not necessarily endorsed by the University.

(Signature):



.....

18 September 2018

(Date):

.....

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Supervisor's affiliation:

.....

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## **ABSTRACT**

Title of Dissertation: The Legal, Administrative and Operational Framework for the Safe Maritime Transport of Dangerous Goods: Myanmar as a Case Study

Degree: Master of Science (MSc)

The dissertation is a study of the maritime transport of dangerous goods in Myanmar to identify and analyze opinions about the current legal, administrative and operational framework governing such transport and to examine gaps to be addressed in seeking to optimize the collaboration between key stakeholders.

This dissertation uses Myanmar shipping industry as a case study and takes a brief look at the current status of transporting dangerous goods internationally, the importance of conducting this study for Myanmar and the nature of the collaboration and interrelation of the stakeholders in the contemporary Myanmar maritime industry.

The legal framework includes the body of law adopted or framed to control the maritime transport of dangerous good. The administrative framework encompasses the administrative processes governing the performance of the port state, coastal state and flag state in fulfilling the State's obligations. The operational framework covers the packaging, the detailed inspection, tracking, monitoring, the essential shipboard and shore-based procedures.

Additionally, a comparative analysis between Myanmar and other developed nations such as EU member states and the US is carried out from different perspectives and different opinions on this subject by different organizations are collated and evaluated.

The concluding chapter provides recommendations to prepare the overall umbrella legislation covering all modes of dangerous goods transport in Myanmar; to supplement the additional organizational plan for the optimum implementation of dangerous goods legislation; to form a National Container Inspection Program; to conduct frequent meetings with stakeholders, and to reconsider the training needs for updating all trainers and administrative personnel under a sustainable training system to address the human error factor in accidents.

**KEYWORDS:** Maritime transport, Safety, Dangerous goods, Legal, Administrative and Operational Framework, Collaboration, Stakeholders, Benchmarks or norms

## TABLE OF CONTENTS

DECLARATION .....	ii
ACKNOWLEDGEMENTS .....	iii
ABSTRACT .....	iv
TABLE OF CONTENTS .....	v
LIST OF TABLES .....	vii
LIST OF FIGURES .....	viii
LIST OF ABBREVIATIONS .....	ix
Map of the Republic of the Union of Myanmar .....	xi
1. The safe maritime transport of dangerous goods: A general overview .....	1
1.1 Background .....	1
1.2 Need for the study .....	2
1.3 Objectives and research questions .....	9
1.3.1 Objectives .....	9
1.3.2 Research questions .....	10
1.3.3 Key assumption .....	10
1.3.4 Potential limitations .....	11
1.3.5 Expected results .....	11
1.4 Methodology .....	11
1.5 Organization of the study .....	14
2. The legal, administrative and operational framework .....	15
2.1 Definitions of dangerous goods and marine pollutants .....	15
2.2 The global legal framework .....	17
2.3 The national legal framework in Myanmar .....	20
2.4 Regional cooperation in ASEAN and other neighboring countries .....	23
2.5 The administrative framework at IMO level .....	26
2.6 The administrative framework for the transport of dangerous goods in Myanmar .....	28
2.7 The operational framework .....	30
2.8 How Myanmar is operating in term of the transport of dangerous goods .....	32
3. Research methodology .....	37
3.1 Secondary data collection .....	37
3.2 Primary data collection .....	38
3.3 The questionnaire .....	38
3.4 Risk management in dangerous cargo operation and handling in Myanmar .....	39

3.5 Recommendation .....	39
4. Analysis of questionnaire results and discussion .....	40
4.1 Analysis of questionnaires responses .....	40
4.2 The volume of import and export of dangerous goods in Myanmar .....	49
4.3 Risk management .....	52
5. Recommendations and conclusion .....	57
5.1 Recommendation for legal framework .....	57
5.1.1 Legislation .....	57
5.1.2 Implementation and enforcement.....	59
5.2 Recommendation for administrative framework.....	59
5.2.1 Monitoring .....	59
5.2.2 Inspection.....	61
5.2.3 Stakeholders .....	62
5.3 Recommendation for operational framework .....	64
5.3.1 Public awareness .....	64
5.3.2 Training .....	64
5.4 Conclusion .....	66
REFERENCES .....	68
Appendices .....	72
Appendix A.....	72
Appendix B.....	79
Appendix C.....	80
Appendix D.....	82
Appendix E.....	83
Appendix F .....	84
Appendix G .....	86

## LIST OF TABLES

Table 1	Active number of officers and ratings	8
Table 2	Container handling status in Yangon ports for last ten fiscal years	9
Table 3	2017 Hazmat summary by results in U.S.	18
Table 4	Acceptance and accession of international maritime treaties in Myanmar	23
Table 5	Classification of dangerous goods	30
Table 6	Dangerous goods classification by MPA	35
Table 7	Number of vessels calling Yangon ports	50
Table 8	Record of maritime accidents in Myanmar	53
Table 9	Number of inspection on container in the top (10) countries	55
Table 10	Frequency Index(FI)	61



## LIST OF FIGURES

Figure 1. World merchandise exports by major product groups, 2017 (Percentage share).....	3
Figure 2. Top ten exporters of chemicals, 2017 (US\$ billion and annual percentage change).....	4
Figure 3. Trend of the cause of DG accidents. ....	5
Figure 4. P& I cargo claims 2007-2016.....	6
Figure 5. Dissertation structure.....	13
Figure 6 The trend of chemicals transport by world seaborne trade.....	16
Figure 7 Myanmar legal framework under the Burma Code Volume VII.....	22
Figure 8 Myanmar's strategic location with regional economic corridors.....	25
Figure 9 Non-conformities with reference to SOLAS 1974.....	27
Figure 10 Administrative authorities for TDG in Myanmar.....	28
Figure 11 Analysis of the global operational information on all cargo and container related accidents.....	31
Figure 12 Online dangerous goods declaration via Port EDI.....	33
Figure 13 System integration of Port EDI system.....	34
Figure 14 Map of Yangon River Estuary.....	36
Figure 15 Time Line.....	37
Figure 16 Question number 3.....	40
Figure 17 Question number 4.....	42
Figure 18 Question number 5.....	43
Figure 19 Question number 6.....	44
Figure 20 Question number 7.....	44
Figure 21 Question number 8.....	45
Figure 22 Question number 10.....	46
Figure 23 Question number 19.....	47
Figure 24 Question number 20.....	48
Figure 25 Container handling throughput in Yangon Ports (TEU).....	50
Figure 26 General cargo handling Statement in Yangon ports.....	51
Figure 27 Chemicals export and import in Myanmar (Unit: Ton).....	51
Figure 28 The Swiss Cheese Model.....	53
Figure 29 Key actors in Myanmar Maritime Industry.....	54
Figure 30 Emergency procedure in case a dangerous goods incident.....	56
Figure 31 Number of findings under Part 1 of the III Code- Common Areas.....	58
Figure 32 DMA and other related stakeholders.....	63
Figure 33 Factors influencing human performance.....	65

## **LIST OF ABBREVIATIONS**

The following abbreviations are used in the dissertation:

ADB	Asia Development Bank
ADR	International Carriage of Dangerous Goods by Road
AND	International Carriage of Dangerous Goods by Inland Waterways
ASEAN	Association of Southeast Asian Nations
CCC	Sub-Committee on Carriage of Cargoes and Containers
CINS	Cargo Incident Notification System
CTU	Cargo Transport Unit
DG	Dangerous goods
DMH	Department of Meteorology and Hydrology
DOF	Department of Fisheries
DMA	Department of Marine Administration
EC	European Community
ECOSOC	United Nations Economic and Social Council
EDI	Electronic Data Interchange
EDP	Electronic Data Processing
EU	European Union
ESCAP	The United Nations Economic and Social Commission for Asia and the Pacific
FAL	The Convention on Facilitation of International Maritime Traffic
GIZ	Germany International Cooperation
GMS CBTA	Greater Mekong Sub-region Cross-Border Transport Agreement
HNS	Hazardous and noxious substances
HAZMAT	Hazardous Materials
HCT	Hazardous Cargo Training
IAEA	International Atomic Energy Agency
IBC	Intermediate Bulk Container
ITCSD	Information Technology Cyber Security Department
IMO	International Maritime Organization
IWT	Inland Water Transport
IMO	International Maritime Organization

ICAO	International Civil Aviation Organization
IMDG	International Maritime Dangerous Goods Code
MPA	Myanma Port Authority
MPF	Myanmar Police Force
MRCC	Maritime Rescue Coordination Center
MA	Maritime Administration
MTC	Maritime Training Center
MARPOL	The International Convention for the Prevention of Pollution from Ships
MACCS	Myanmar Automated Cargo Clearance System
MSW	Maritime Single Window
Navy HD	Navy Hydrographic Depot
ND	Nautical Division
NORAD	Norwegian Agency for Development Cooperation
NEA	New Explosive Anchorage
OEA	Old Explosive Anchorage
RID	International Carriage of Dangerous Goods by Rail
SOLAS	The International convention on the Safety of Life at Sea
SD	Seafarer Division
SSE	Maritime Safety, Security and Environmental Protection
TEU	Twenty-foot equivalent unit
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
US	United States
USCG	United States Coast Guard
UN	United Nations
USD	United States Dollar
UK P& I	United Kingdom Protection and Indemnity Club
WTO	World Trade Organization
WMU	World Maritime University
YCDC	Yangon City Development Committee

## Map of the Republic of the Union of Myanmar



Source: NORAD, 2017

## **1. The safe maritime transport of dangerous goods: A general overview**

### **1.1 Background**

International shipping is indispensable to the performance of global trade. The maritime industry transports food, manufactured and semi-manufactured products, raw materials, energy and consumer goods amounting to approximately 90% of world trade. Maritime transport has similarly evolved year by year under the influences of many transformations such as containerization, globalization and digitalization. Present-day global shipping is driven by over 50,000 merchant ships trading internationally in the transport of goods (solid, liquid and gas). These ships are registered in over 150 nations and manned by over 1.6 million seafarers, comprising multi-national crews. The International Maritime Organization, a specialized United Nations (UN) agency, benefits the world by providing the necessary expertise and experience in safety, security and environmental protection for the worldwide shipping. The harsh and risky working environment, combined with the likelihood of encountering severe weather, increasing economic pressure, tight schedules, and fatigued seafarers have contributed to the maritime industry's ranking as one of the most dangerous occupations in the world. The potential hazards make it necessary to embrace the wide range of marine technologies, boosting maritime safety, as well as the overarching regulations for environmental protection. The benchmarks of vessels and the norms for all seafarers are virtually identical in every corner of the world due to the effect of the international conventions adopted by the International Maritime Organization (IMO). However, there are several distinctions between countries depending on their different levels of implementation with respect to the transport of cargoes, particularly the processes and procedures. Moreover, the involvement of numerous stakeholders in the multimodal transport of goods might lead to more sophisticated issues. Among those, the transport of dangerous goods by sea is likely to be the riskiest undertaking.

As the cargoes themselves are the most imperative and centralized units in merchant shipping, all stakeholders have to collaborate and cooperate to move them safely from the port of departure to the port of destination. This demands the reliable, proficient and environmentally friendly movement of cargo along the multimodal chain. An accident triggered by a ship's cargo is unusual but deadly. A comparative study to find gaps and similarities among countries can be an onerous task owing to their diverse profiles, such as social condition, economy, education, working culture and organizational behavior. On the other hand, the comparative approach offers prospects for identifying Myanmar's current position, where it intends to proceed, as well as how it can emulate other developed countries in the maritime sector.

## **1.2 Need for the study**

10.3 billion metric tons of goods were internationally shipped and world container port throughput reached 701 million TEUs in 2016 (UNCTAD, 2017b). Containerization and the use of intermodal transportation have unrelentingly increased since the invention of containers by Malcom Mclean in 1956 (Levinson, 2005). That is why container shipping has become the backbone of global trade, with approximately 60% of the world's seaborne trade and a total value of around USD 12 trillion in 2017 (GSCP, 2018). Multimodal transport comprised of container ships, road vehicles, rail and air, operated by enormous logistics companies and shipping lines, serves the entire planet with the delivery of dangerous cargoes in diverse packagings. IMO has indicated that approximately 5.4 million units are packed with dangerous goods annually (IMO, 2017a). Despite this, the number of inspections performed has never exceeded 80,000, and currently represents something less than 4 per 100,000 packed containers moved (IMO, 2017a). Nobody can estimate the consequences of incidents if chemicals carried inside containers or other kinds of packaging are brought into environmentally sensitive areas or public areas and something goes wrong. In order to enhance safety and human health as well as the prevention of environmental pollution in maritime transport, legislative measures are developed and adopted in many countries and regions (EC, 2002). In the recent decade, warehouses storing many dangerous goods have catastrophically exploded in Myanmar, resulting in many casualties and economic losses. Not long ago, the mega container ship,

“Maersk Honam” was abandoned in the middle of the Arabian sea due to a massive fire. While the primary cause of fire accidents on container ships are not an easily found, it is highly probable that the fire was caused by dangerous cargo. According to the World Trade Organization (WTO) report shown in Figures 1 and 2, 12% of world merchandise exports are chemicals, representing almost 1000 billion USD in the European Union alone.

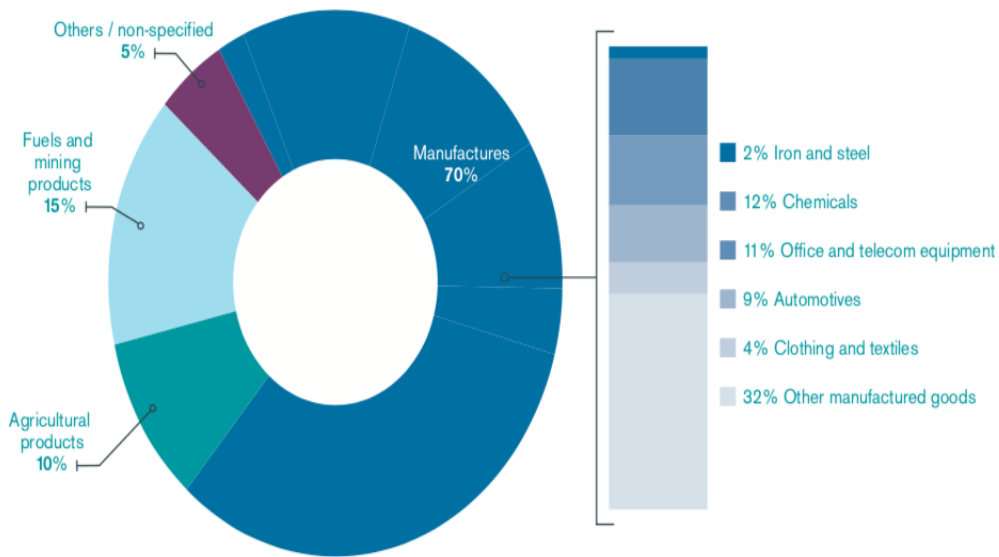


Figure 1. World merchandise exports by major product groups, 2017 (Percentage share).

Source: WTO, 2018

While both the Ministry of Transport and Communications and the Ministry of Rail Transportation administer the transport of dangerous goods, the Ministry of Industry deals with chemical-related matters in Myanmar. The Pre-Audit of the IMO Member State Audit Scheme (IMSAS), conducted in Myanmar by Mr. Leslie Hemachandra from Sri Lanka, on 25.12.2017 to 27.12.2017, pointed out the lack of adequate procedures for the handling of dangerous goods and monitoring of their movement and no evidence of using the IMO FAL<sup>1</sup> form for the declaration of dangerous goods. Moreover, the auditor observed that there was no record of operations related to the

<sup>1</sup> The convention on Facilitation of International Maritime Traffic (FAL Convention)

International Maritime Dangerous Goods (IMDG) cargoes and the training for shore base personnel was inadequate. This study emphasizes the legal, administrative and operational framework of the safe maritime transport of dangerous goods by using Myanmar as a case study to discover whether it needs to improve to the next comprehensive level.

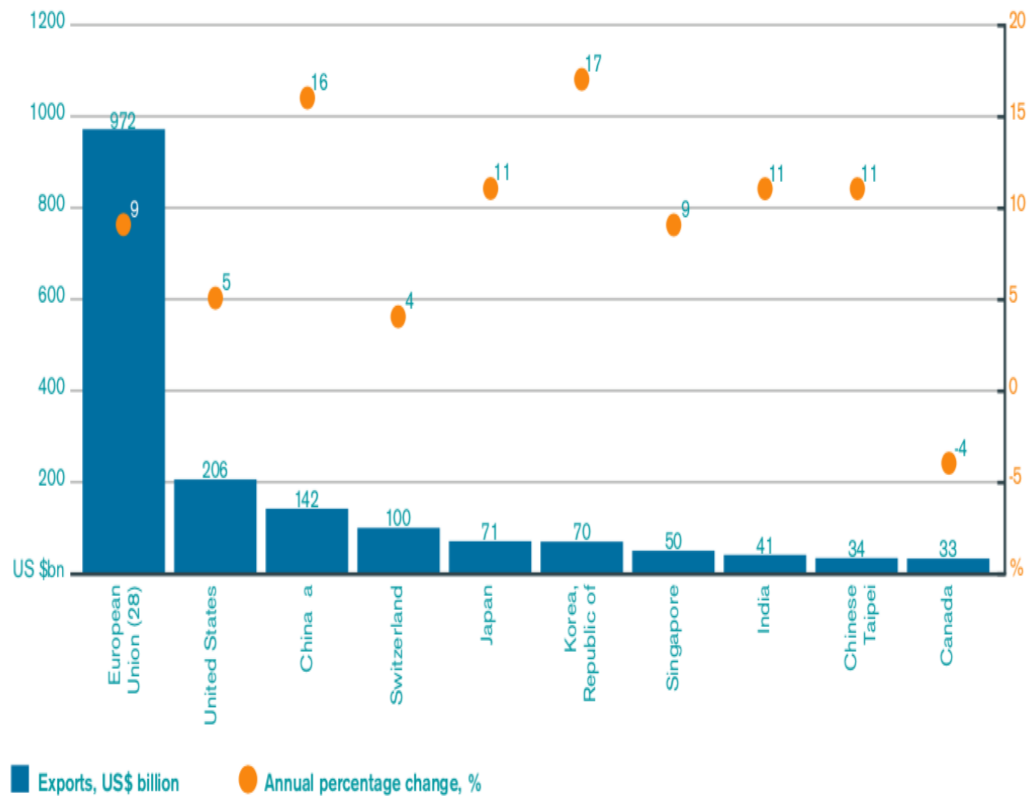


Figure 2. Top ten exporters of chemicals, 2017 (US\$ billion and annual percentage change). <sup>a</sup> Includes significant shipments through processing zones.

Source: WTO, 2018

For example, the German-flagged full container ship MSC FLAMINIA was carrying 149 dangerous goods containers when a cargo fire started, resulting in an explosion with loss of lives. Seen from the safety perspective, the reason why this happened was that three containers of divinylbenzene and 38 containers on the ship exhibited shortcomings or negligence in the declaration and 12.96% of the goods were inaccurately declared. (Federal Bureau of Maritime Casualty Investigation, 2014). In relation to the accident caused by dangerous goods in port area, a good example is



the explosion that happened at the Tianjin seaport in northeast China which is regarded as the vastest man-made insurance loss experience ever recorded in Asia. (Swiss Re, 2016). In this case, the two devastating explosions on 12 August 2015 were triggered by a fire in a warehouse storing hazardous and flammable materials, such as ammonium nitrate. Although many insurance claims on losses have yet to be settled, they have estimated the insurance losses resulting from the Tianjin explosion to be around USD 2.5 billion to USD 3.5 billion (Swiss Re, 2016). The number of container ships carrying packaged HNS increased dramatically from 2600 in 2005 to 5000 in 2015, almost doubling within only five years, according to statistics from the Paris Port State Control Memorandum of Understanding's database, Equasis (IMO, 2018a).

As can be seen in Figure 3, deficiencies in "Placarding and Marking" (which is the key visual risk alert for all supply chain stakeholders), rapidly increased to 67.5% in 2015. (IMO, 2017a). More importantly, "Stowage and Securing" deficiencies, reported to be causative in many cargo-related incidents, average in excess of 20% (IMO, 2017a).

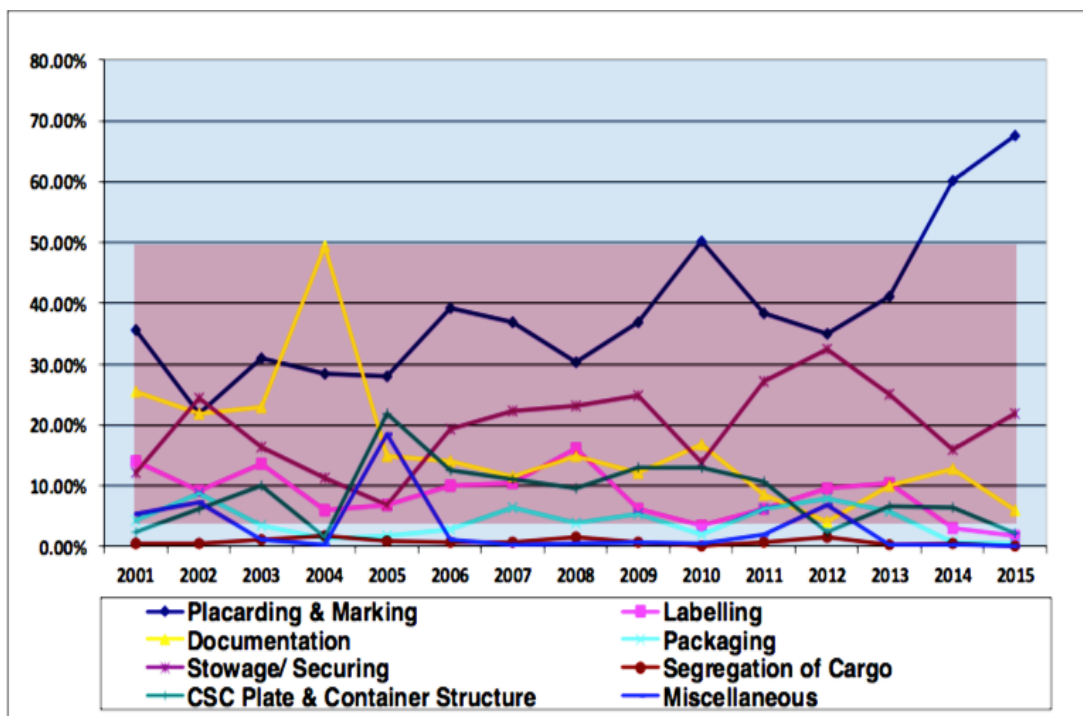


Figure 3. Trend of the cause of DG accidents.

Source: IMO, 2017a

Insurance companies in the private sector, such as UK P & I Club, Swedish Club and Gard, never fail to give free advice and helpful publications on container matters because of the constantly increasing compensation for damaged cargoes. When looking at all cargo claims at present, the cost for fire stands at the highest ranking with 28.04% of total cost among many other causes as illustrated in Figure 4. Many cargo fire are triggered by IMDG cargoes.

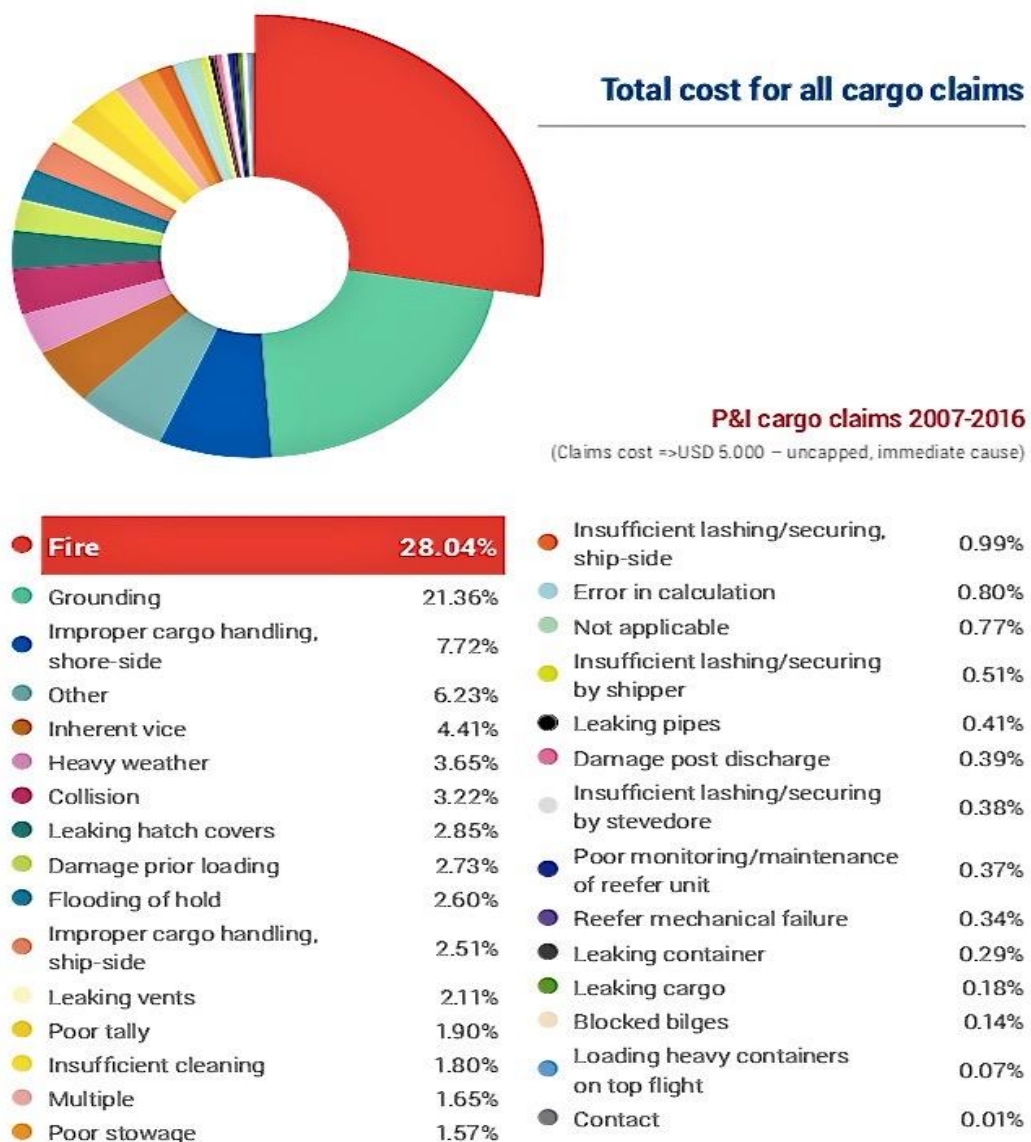


Figure 4. P & I cargo claims 2007-2016

Source: The Swedish Club (2017)

Myanmar has both strengths and weaknesses in the maritime industry as it was formerly a well-developed shipping nation in the ASEAN region. However, the country has faced many difficulties and challenges in the last five or six decades and has lagged behind other neighboring nations. However, there are many frameworks and systems in place as the maritime industry was well-developed in the British Colonial era. Currently most of them are out of date due to the lack of timely and appropriate maintenance. Myanmar has geographical features of long international borders, long coastline and vast state-owned sea areas. It is strategically located in the Bay of Bengal and Andaman sea. Despite this, containerization in Myanmar was introduced in the Port of Yangon only in August 1990. Furthermore, Myanmar is a maritime labor supplying country that continuously nurtures many qualified professional seafarers for work in the domestic and overseas shipping markets. From the human resources perspective, many maritime professionals, such as ship captains, chief engineers, and naval architects have come from Myanmar. The number of active seafarers in Myanmar is listed in Table 1. However, the maritime infrastructure and technology and professionals working in the port and logistics sectors are still insufficient compared to other developed nations, such as the US and EU member states. The cooperation among national maritime clusters to perfectly harmonize systems under a unique integrated regime is still difficult.

Table 1

*Active number of officers and ratings (15 Aug-2018)*

<b>Capacity</b>	<b>Rank</b>	<b>STCW ref</b>	<b>Number of CoC</b>	<b>Capacity</b>	<b>Rank</b>	<b>STCW ref</b>	<b>Number of CoC</b>
<b>Deck Officer Class I</b>	Master	II/2	1360	Rating as Able Seafarer Deck	Bosun/ ABD	II/5	10371
<b>Deck Officer Class II</b>	Chief Mate	II/2	1342	Rating forming part of Navigation Watch	WK- DR	II/4	7619
<b>Deck Officer Class III</b>	OOW	II/1	4068	Deck Rating	DR	-	4395
<b>Marine Engineer Officer Class I</b>	CE	III/2	971	Rating as Able Seafarer Engine	Fitter/ ABE	III/5	5937
<b>Marine Engineer Officer Class II</b>	2E	III/2	1337	Rating forming part of Engine- room Watch	WK- ER	III/4	6382
<b>Marine Engineer Officer Class III</b>	OEW	III/1	3480	Engine-room Rating	ER	-	4392
<b>Electro- Technic al Officer</b>	ETO	III/6	852	Electro- Technical Rating	ETR	III/7	310

Note. Certificate of Competency (CoC)Source: DMA

As shown in Table.2, Myanmar’s trade in container transportation has grown for ten consecutive years, between 2007 and 2017. It peaked with a growth of 28% in 2013-2014 and slightly decreased to 18% in 2016-2017. Import and export TEU were nearly the same over the duration of ten years.

Table 2

*Container handling status in Yangon ports for last ten fiscal years*

Sr	Fiscal Year	Import (TEU)	Export (TEU)	Total (TEU)	growth
1	2007-2008	119201	127095	246,296	25%
2	2008-2009	134457	151497	285,954	16%
3	2009-2010	150041	147938	297,979	4%
4	2010-2011	175315	171327	346,642	16%
5	2011-2012	209,932	203,445	413,377	19%
6	2012-2013	239,347	238,993	478,340	16%
7	2013-2014	309,767	303,804	613,571	28%
8	2014-2015	377,557	367,232	744,789	21%
9	2015-2016	459,037	434,164	893,201	20%
10	2016-2017	519,728	538,160	1057,888	18%

Source: MPA

### 1.3 Objectives and research questions

#### 1.3.1 Objectives

Although Myanmar is undergoing implementation of maritime safety and environmental protection, abiding by the international conventions laid down by IMO, the author observes, from the preceding discussion, that the cargo operation of dangerous goods still needs to be updated as a priority to meet those requirements. Hence, this research seeks to examine the current condition regarding this matter and to encourage the elimination or reduction of the problems related to dangerous goods by finding possible pragmatic solutions.

The more detailed objectives for the dissertations include:

- To examine the current legal, administrative and operational frameworks of dangerous goods handling in Myanmar
- To determine the collaboration and coordination activities of stakeholders in the process of import and export of dangerous goods in Myanmar
- To verify the gap between the international standard and the present national implementation and enforcement
- To compare the condition of implementation of the carriage and handling of dangerous goods in Myanmar with suitable benchmark countries

### 1.3.2 Research questions

1. What is the volume of import and export of dangerous cargoes in Myanmar? To what extent is Myanmar engaged in the maritime transport of Dangerous Goods?
2. What are the current legal, administrative and operational frameworks for the implementation and enforcement of the requirements for the safe handling and the transportation of International Maritime Dangerous Goods in Myanmar?
3. What is the nature of the collaboration and interrelation of the involved stakeholders in the Myanmar maritime industry?
4. How can the existing framework and collaborative effort be improved to meet the international and benchmark norms?

### 1.3.3 Key assumption

A key assumption of this study is that by upgrading the existing working practices, by strengthening the legal and administrative framework, by mapping the existing problems in the transportation of dangerous goods in Myanmar and finding the best answer, the risks related to their transportation on shore and at sea can be minimized to as low as reasonably practicable.

#### 1.3.4 Potential limitations

The constraint of the key stakeholder's confidentiality will be one of the potential limitations in collecting data. All suitable experts within Myanmar maritime fields and other participating organizations were difficult to identify and communicate with within this short period to answer my interview and survey questions. Due to some administrative restrictions and hindrances from the provisions of the Burma Official Secrets Act 1923, the collection of data in a timely manner was, to some extent, problematic. Secondary data regarding dangerous cargoes is not always readily available due to the lack of statistical records. Furthermore, academic or scientific research papers are very rare in Myanmar. In light of those reasons, some difficulties were experienced in gathering data. A primary data collection method was used for this study but the amount of data received was limited due to the short time frame and for the reasons stated above.

#### 1.3.5 Expected results

After completion of this research, it is expected to be able to find a way to solve the current problems in Myanmar's shipping industry and to close the gaps between national and international standards. The better condition of handling and safe management of dangerous goods is addressed by this study.

### **1.4 Methodology**

In developing this dissertation, the research process was broken down into four phases, namely (i) Preparation, (ii) Data collection, (iii) Data analysis/discussion and (iv) Recommendations as shown in Figure.5.

#### i. Preparation

An initial review of governmental control of dangerous cargoes was carried out to get a fundamental understanding of the gaps between the current situation in Myanmar and the international norms concerning the management of dangerous goods. Publications, reports, soft and hard copies of national and international laws were

assessed. Reviews of available databases, reports, documents and records related to dangerous goods, including stakeholder's annual reports, were performed to optimize comprehension of the subject matter. The assessment was constituted from industrial level and organizational level to individual level in terms of the capacity of handling of hazardous cargoes in Myanmar. All of these documents such as SOLAS, IMDG code and Myanmar Merchant shipping act were collected and scrutinized on the IMO Website, the relevant Myanmar Ministry website, the wider internet and WMU's e-library.

ii. Data collection

Both qualitative and quantitative data collection and analysis methods were applied to get as much data as accessible. Data collection related to both primary and secondary data; primary data was gathered from survey questionnaires and interviews (both face-to-face and online). Qualitative approaches to data collection, analysis, and report writing were applied. Secondary data was gathered from regulatory agencies such as the Department of Marine Administration (DMA), Myanmar Port Authority (MPA), Media Interviews, web data, industry news, journals, articles and magazines.

iii. Analysis

The analysis of the data and information collected consisted of the qualitative analysis of the whole cargo operation processes for dangerous goods at the port and stowage and segregation of dangerous goods at port and onboard vessel. The system thinking approach was used to identify solutions for the optimization and improvement of the current situation. Weinberg (1975) explained that "a system is a way of looking at the world".

iv. Recommendation

The study results will be used as a consideration for the improvement of all frameworks for the handling of dangerous goods in Myanmar.



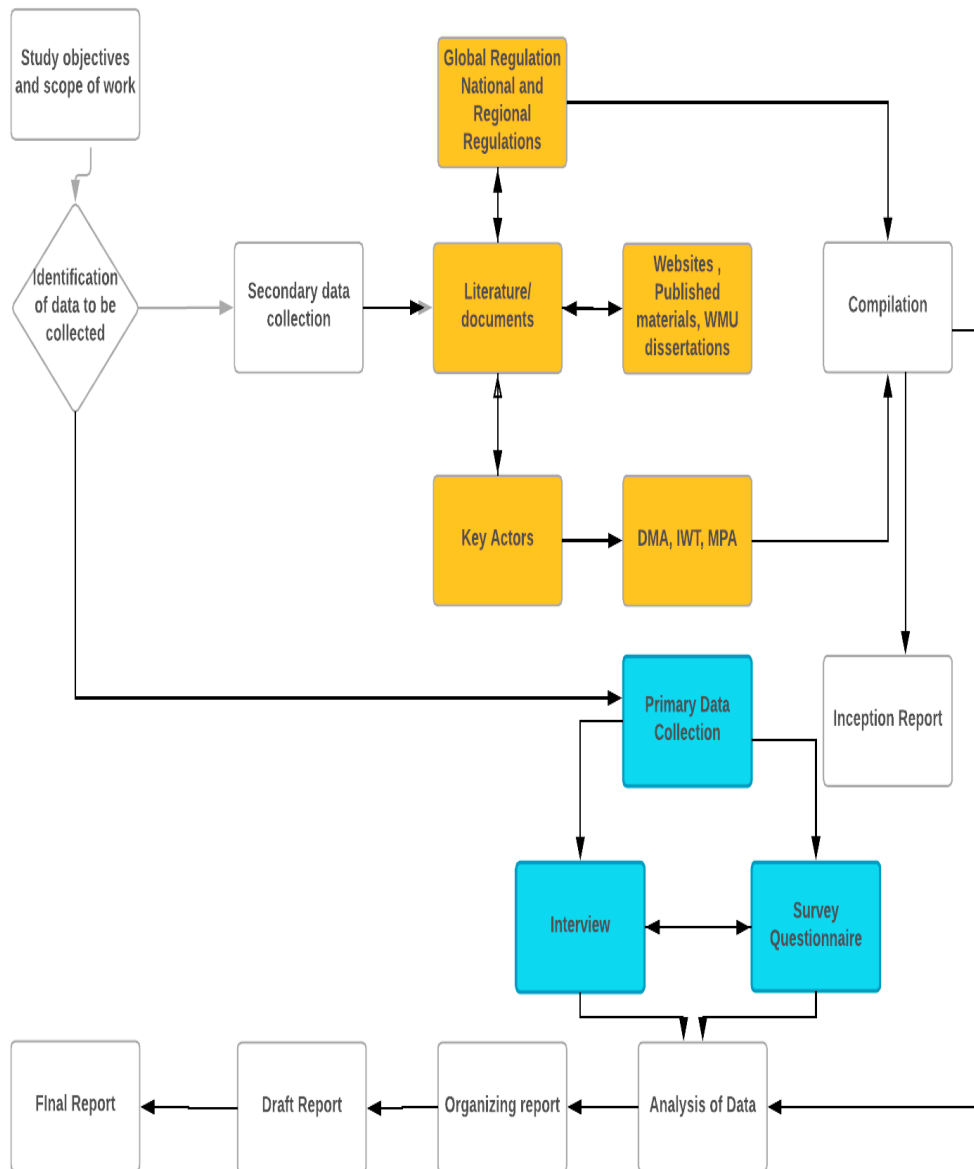


Figure 5. Dissertation structure

Source: author

## **1.5 Organization of the study**

This dissertation includes five chapters. Chapter 1 consists of the background, need for the study, objectives and research questions, scope and methodologies along with the dissertation structure.

In Chapter 2, the author reviews the literature on various aspects of dangerous goods. A detailed discussion of the related national laws and international laws is covered in this chapter. Moreover, the administrative process and the operational practices at IMO and national levels are examined thoroughly along with regional cooperation.

In Chapter 3, the writer describes the methodology for this study including primary data collection, secondary data collection, questionnaires, risk management and the dissertation schedule.

In Chapter 4, the existing condition of the handling and transportation of dangerous goods in Myanmar is evaluated and the frameworks of Myanmar and selected developed nations are assessed. Chapter 4 presents the findings of the research and examines the whole situation of the transportation of dangerous goods and its associated risks on shore and at sea in light of chapters two and three.

Chapter 5 gives a summary of this dissertation and concludes with a number of applicable recommendations and solutions to speed up the optimization process for the carriage, stowage and handling of dangerous goods on shore and at sea in Myanmar.

## **2. The legal, administrative and operational framework**

### **2.1 Definitions of dangerous goods and marine pollutants**

The terms “dangerous cargoes”, “dangerous goods”, “dangerous materials” or “hazmat”, are used interchangeably. The term “hazmat” is mainly used in United States.

Merriam Webster dictionary provides the definition of “hazmat”:

Hazmat means a material (such as flammable or poisonous material) that would be a danger to life or to environment if released without precautions and it was formed by combining the first three letters of each of two words: “hazardous” and “material”.

According to the IMO, “dangerous goods mean the substances, materials and articles covered by the IMDG Code” (IMO, 2014a). Dangerous goods are substances that could cause serious hazard to public health and damage to properties and environment by explosion or fire, spillage, gas dispersion and toxicity. Thus, they require extreme care, skillful supervision, special documentation, systematic packaging, good management of stowage and segregation, monitoring by administration.

Harmful substances are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the appendix of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex III. (IMO, 2017b). The criteria for the identification of harmful substances in packaged form is shown in Appendix F. If such marine pollutants are lost overboard at sea, serious negative impact on ecosystem and marine organisms is inevitable.

The Federal Ministry of Transport and Digital Infrastructure in Germany explains the perils of marine pollutants (MP):

Marine pollutants according to the IMDG code are dangerous goods with properties adverse to the marine environment, e.g. hazardous to aquatic life (marine fauna and flora), impairing the taste of seafood, or accumulating pollutants in aquatic organisms (BMVI, n.d).

Rowbotham (2014) notes that “hazardous and dangerous goods can be flammable, toxic or explosive, and often require dedicated and specialist handling facilities at the ports of loading and unloading” (p.23). The safe maritime transport of dangerous goods is critical for both shipping lines and sea ports. The trend of chemicals transport by world seaborne trade nearly doubled between 2000 and 2017 as indicated in Figure 6 since shipping in relation to the amounts of cargo carried, is the most fuel efficient, cheapest mode of intercontinental transport and the most volumetrically capable carrier of consumer products.

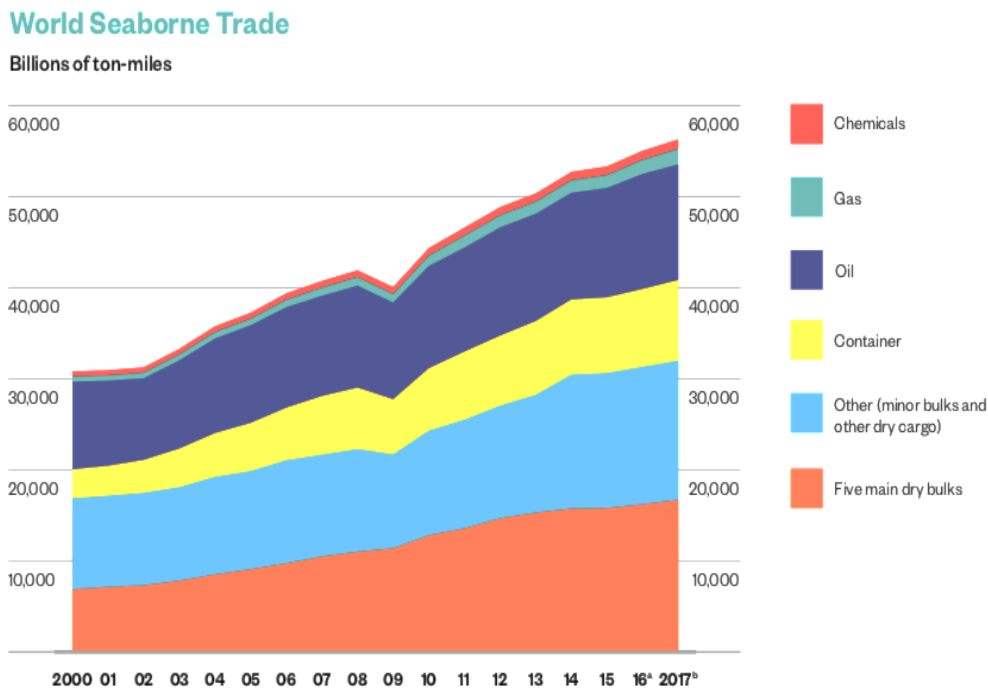


Figure 6 The trend of chemicals transport by world seaborne trade

Note: <sup>a</sup> Estimated <sup>b</sup> Projected figures  
Source: UNCTAD (2017a)

## **2.2 The global legal framework**

In 1956, the Committee of Experts on the transport of dangerous goods of the United Nations Economic and Social Council (ECOSOC) produced the first version of the UN Recommendations on the Transport of Dangerous Goods (often referred to as the UN Orange Book). It established the minimum requirements for the transport of such goods by road, rail, air and sea. Although the requirements of the UN orange book are not necessarily obligatory or legally binding on individual countries, they are the foundation of several international agreements and many national laws and have a wide degree of international acceptance. Mullai (2007) emphasized, “The transport of dangerous goods is, at various levels (international, regional, national, local and even organizational), governed by a complex system of regulations” (p.66). Packard (2005) pointed out, “General cargo vessels and container ships can expect to carry numerous classes of dangerous goods at any one time, the relative effect of which in relation to stowage and reaction can be somewhat complicated” (p.237).

IMO has already adopted many recommendations and guidelines, codes, protocols, amendments and more than 50 international conventions. It is proof of the organization’s hard work that the fulfillment of the maritime industry’s needs has persisted over 70 years. The early 1929 International Conference on Safety of Life at Sea (SOLAS 29) recognized the demand of universal regulation for the carriage of dangerous goods by sea. Subsequently, the categorization of dangerous goods and certain general provisions pertaining to their shipping were adopted by the 1948 SOLAS Conference (IMDG, 2018).

MARPOL (73/78) was adopted in 1973 as a result of the Torrey Canyon (1967) and Amoco Cardiz (1978) oil pollution disasters. Its annex III provides the regulations regarding harmful substances carried at Sea in Packaged form. Therefore, the transport of IMDG cargo is required to follow SOLAS chapter VII amplified by IMDG code in relation to the safety. With regard to the environmental protection, it is needed to apply the provisions of MARPOL Annex III, which are also elaborated in IMDG code (IMO, 2018b).

The transport of dangerous goods in developed countries such as the United States of America and the European Union countries is heavily regulated to control/restrict its elevated likelihood for the environmental damage, public health and loss of properties. In contrast, most developing countries are still lacking in strict control over this sector and are still in the infant stages of implementation and enforcement of legislation. According to the 2017 Hazmat Summary the U.S. Department of Transportation, fatalities and damage arising from incidents such as environmental damage, fire, explosion and spillage are enormous, as seen in Table 3. Spillage causes the greatest amount of damages up to \$ 41,947,929 and the maximum number of fatality up to 6 persons during the 15,717 incidents in the single year of 2017.

Table 3

*2017 Hazmat summary by results in U.S.*

Result	Incidents	Hospitalized	Non-Hospitalized	Fatalities	Damages
Environmental Damage	43	0	1	1	\$6,834,941
Explosion	12	1	0	2	\$1,023,406
Fire	91	4	6	4	\$11,849,648
Material Entered Waterway/Sewer	51	0	10	1	\$4,773,117
None	871	0	0	0	\$2,588,061
Spillage	15,717	4	103	6	\$41,947,929
Vapor (Gas) Dispersion	294	1	40	0	\$21,061,227

Source: Hazmat Intelligence Portal, U.S. Department of Transportation.

Data as of 4/24/2018

For this reason, the industrialized countries pay much attention on this sector to restrict jeopardizing the environment and people by the power of the proper set of

laws and supervision. Federal Hazardous Materials Transportation Law (FHMTL), International Safe Container Act (ISCA), Convention for Safe Containers (CSC), Port and Waterways Safety Act (PWSA), Magnuson Act and Title 49 of the Code of Federal Regulations are the legal instruments that control the safe movement of hazardous material in the United States. Equally, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) and Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) are exercised in the European Union (EU). The neighboring country, Thailand also adopted these EU agreements to be a dependable transport of dangerous goods. Myanmar and Thailand work together in the road transport sector with the support of the Germany International Cooperation(GIZ). The author discusses more details on the subject of the regional cooperation afterward. The International Maritime Dangerous Goods (IMDG) code, International Maritime Solid Bulk Cargoes (IMSBC) code and the International Civil Aviation Organization (ICAO) Technical Instructions (TI) for the Safe Transport of Dangerous Goods by Air are unanimously recognized and adhered to as global regulations in the maritime and aviation sector.

Other significant IMO conventions and codes in connection with dangerous goods (DG) or hazardous materials (Hazmat) are:

- The Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances 2000 (OPRC-HNS Protocol)
- International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 2010 (HNS convention)
- Code of Safe Practice for Cargo Stowage and Securing (CSS Code)
- IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units. (CTU Code)

### 2.3 The national legal framework in Myanmar

The goals of the ministry of transport in Myanmar are widely covered all areas, ambitious and magnificent for planning of implementation of national, sub-regional and international transport networks and to abide by international norms and benchmarks. To upgrade expertise in management and develop maritime infrastructure are also included in its purposes. On the other hand, the international conventions that have entered into force through ratification of a minimum number of states shall be codified into the national legislation of a ratifying country. Myanmar practices a common law system originated from British regime and Hluttaw is a “law making” body for national law. Laws are useful tools to guide the people for the desirable pattern of behavior in given society. The national legislation process entails all such conventions being translated into the national official language. This constitutes a significant barrier in the legislation process. Myanmar’s legislative process is bureaucratically extensive requiring comprehensive reviews by many organizations. For maritime issues, it includes having the language checked by the Union Attorney General’s office, having its validity checked by the Ministry of Transport and Communication and a final examination by the Security, Tranquility and Law Enforcement Committee before submitting to the President’s office. After that, the proposed bills have to be sent to Hluttaw<sup>2</sup> for discussion, scrutiny and approval. Myanmar Hluttaw’s legislation procedure is stated as following:

A bill, tendered in accordance with the law, will be first presented to either the Pyithu Hluttaw<sup>3</sup> or the Amyotha Hluttaw<sup>4</sup>. If there is no discrepancy on the bill between the two Hluttaws, it shall be regarded as approved by the Pyidaungsu Hluttaw<sup>5</sup>. In case of disagreement between the two houses, the Pyidaungsu Hluttaw will review the bill for consideration and approval. The approved bill

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<sup>2</sup> One term of a Hluttaw is five years from the day of the first session of Pyithu Hluttaw (House of Representatives).

<sup>3</sup> Pyithu Hluttaw (House of Representatives)

<sup>4</sup> Amyotha Hluttaw (House of Nationalities)

<sup>5</sup> Pyidaungsu Hluttaw (Union Parliament)



can be signed by the President within 14 days of receipt from the Pyidaungsu Hluttaw or the President can return the bill to the Pyidaungsu Hluttaw with recommended amendments. The Pyidaungsu Hluttaw may agree to amend the bill accordingly or may not agree to amend it. In both cases, the bill will be sent back to the President and it will become law within seven days with or without the President's signature (HBWG, 2017).

In the field of maritime administration, to manage maritime activities in Myanmar, there is the Burma Code (Myanmar Code) Volume VII, which applies presently as the national maritime law. Myanmar (Burma) Merchant Shipping Act [India Act XXI, 1923] and its amendments is under the Burma Code Volume VII, Part VIII, Section H: Merchant Shipping and it is separated into nine parts and two schedules. It has been revised to be corresponded with the rate of recent Myanmar currency (Kyat). The Bills of Lading Act (1856), the Carriers Act (1865) and the Myanmar (Burma) Carriage of Goods by Sea Act [India Act XXVI, 1925] exist under Section C: Carriers. The Inland Stream Vessel Act relates barely to Section F: River Transport. Figure 7 illustrates the structure of laws under Burma Code Volume VII. Additionally, there are some key legislations ruling Myanmar shipping industry in relation to the transport of goods and they are:

Other valid national statutes pertaining to the transport of goods by sea include;

1. The Multimodal Transport Law 2011
2. The Sea Customs Act of 1878
3. Inland Vessel Law, The Republic of The Union of Myanmar (19th May,2015)
4. The Myanmar Coastal and Inland Water Transport Service License Law (3rd March, 2015)
5. The Ports Act of 1908 [INDIA ACT XV,1908]
6. The Myanmar Port Authority Law (9th April,2015)
7. Prevention of Hazard from Chemical and Related Substances Law (26th August, 2013)

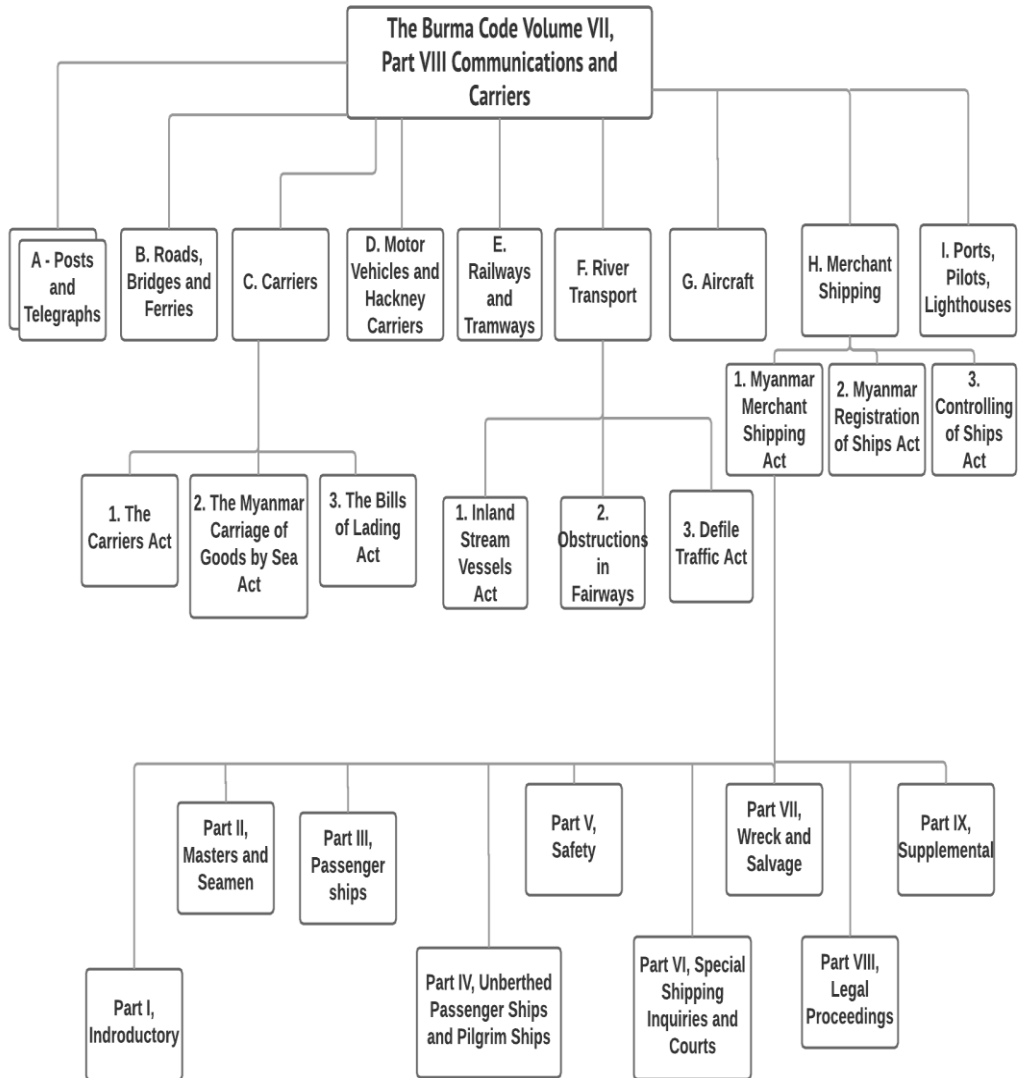


Figure 7 Myanmar legal framework under the Burma Code Volume VII

Source: Burma Code Volume VII

Because of the Union of Myanmar's membership in International Maritime Organization (IMO), the Government of the Union of Myanmar has by now acceded to the following IMO Conventions as shown in Table 4. Moreover, Maritime Labour Convention (MLC 2006) was entered into force in Myanmar on 25 May 2017.

Table 4

*Acceptance and accession of international maritime treaties in Myanmar*

Treaty	Ratification type	Date of treaty entry into force	Date of entry into force in country
IMO CONVENTION	Acceptance	17.03.1958	17.03.1958
IMO AMEND-93	Acceptance	07.11.2002	07.11.2002
BUNKERS 2001	Accession	21.11.2008	19.04.2018
CLC PROT 1992	Accession	30.05.1996	12.07.2017
COLREG 1972	Accession	15.07.1977	11.11.1987
LL 1966	Accession	21.07.1968	11.02.1988
MARPOL 1973/1978	Accession	02.10.1983	04.08.1988
MARPOL ANNEX III	Acceptance	01.07.1992	05.07.2016
MARPOL ANNEX IV	Acceptance	27.09.2003	05.07.2016
MARPOL ANNEX V	Acceptance	31.12.1988	05.07.2016
OPRC 1990	Accession	13.05.1995	15.03.2017
SOLAS 1974	Accession	25.05.1980	11.02.1988
SOLAS PROT 1978	Accession	01.05.1981	11.02.1988
STCW 1978	Accession	28.04.1984	04.08.1988
SUA 1988	Accession	01.03.1992	18.12.2003
SUA PROT 1988	Accession	01.03.1992	18.12.2003
TONNAGE 1969	Accession	18.07.1982	04.08.1988

Source: IMO GISIS

## **2.4 Regional cooperation in ASEAN and other neighboring countries**

Under the assistance of United Nations: The United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), Asian Development Bank (ADB) and Mekong River Commission, East- West Economic Corridor project has been implemented for the development of transport network across the Mekong sub-region as shown in Figure 8. Road transport of dangerous goods in Myanmar is regulated by the “2002 PROTOCOL 9: dangerous goods” signed in Jakarta, Indonesia on 20 September 2002, by ten Contracting Parties in ASEAN. For the safe road transport

of dangerous goods, the members reach agreement to adopt the provisions of the UN Model Regulations, ADR and the Restructured ADR (ASEAN, 2002). Myanmar has begun its implementation of the provisions of ADR for the safety of road sector. Moreover, Myanmar also signed the Greater Mekong Sub-region Cross-Border Transport Agreement (GMS CBTA) in 2003 as Myanmar has some 5,000 km of navigable waterways, of which about 2,400 km make up the primary inland waterway network. (ADB, 2012). The transport of dangerous goods by inland waterway is also especially beneficial in Mekong region. However, the cooperation for the transport of IMDG cargoes has not been as active as road transport at the regional level. For this regard, the goals of ASEAN communities are to intensify regional cooperation for safer and environmentally sustainable shipping and develop EDP<sup>6</sup>- based Information System for Dangerous Goods.

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<sup>6</sup> Electronic Data processing (EDP)



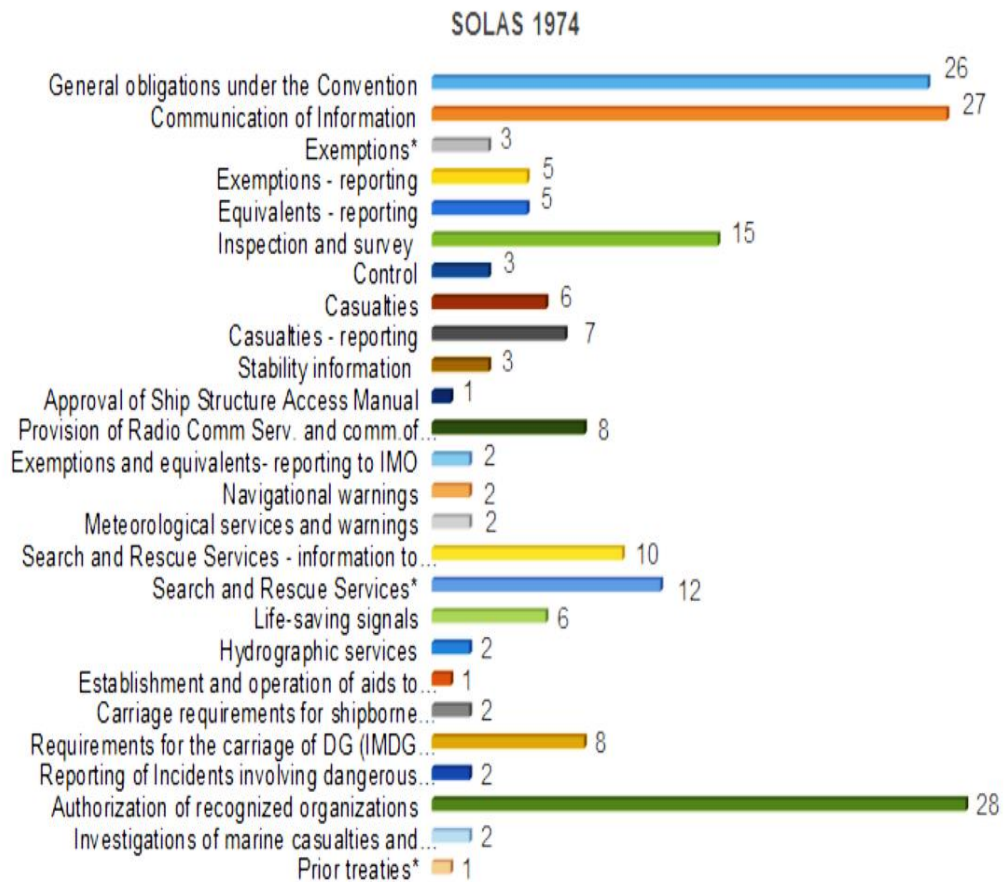
Figure 8 Myanmar's strategic location with regional economic corridors

Source: ADB, 2018

## **2.5 The administrative framework at IMO level**

The world has recognized by consensus that the way to enhance safety and environmental protection globally, is to progress, execute and put into effect of international norms through the individual country. The governments of each nation are in authority for employing these benchmarks. However, some member states have difficulties in this regard because of the most common underlying causes such as absence of documented procedures, insufficient resources available to maritime administrations, lack of national provisions, lack of co-ordination among various entities of the State and lack of training programs (IMO, 2016a). With that background, IMO realized that the existing legislations for safety and environmental protection were sufficient, and that it was time to focus on Member State implementation. The conception of IMO stands to uphold the uniform and effective implementation of applicable instruments, chiefly main pillars, such as SOLAS, MARPOL and STCW, by giving a hand to raise Member State's overall performance and building the capabilities.(IMO, 2013). IMDG Code under SOLAS convention elaborates the technical benchmarks, the exhaustive operational procedures and the precise interpretations for the provisions.

After the revision of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) in 1995, the so-called "White List" appeared and succeeded as an oversight measure on Member States regarding STCW. This direction of IMO oversight (in the STCW and other instruments) was extended to the IMO audit scheme. Figure 9 shows the non-conformities with reference to SOLAS 1974, identified in the IMO voluntary audit scheme and resulting in most states being unable to achieve fully effective implementation of the requirements for the carriage of dangerous goods as per IMDG Code.



\*Not listed in Code for the Implementation of Mandatory IMO Instruments

*Figure 9 Non-conformities with reference to SOLAS 1974*

source: IMO, 2014b

The International Chamber of Shipping used to issue the “Shipping Industry: Flag State performance table” yearly to put pressure on the flag administrations to affect any improvements (ICS, 2018). It is a useful indicator for the flag states. Although the enforcement of IMO conventions is dependent upon the governments of Member parties, IMO implemented Port State Control(PSC) regime as the second line of defense for controlling the lack of responsibilities of flag states, which was first initiated with the Paris Memorandum of Understanding(MOU). The concept of “no more favorable treatment” is universally accepted and applied. PSC regime is based on the regional agreement. Myanmar has recently become one of the nineteen members of Indian Ocean MOU (IOMOU) by having signed in 2017. SOLAS chapter

VII, Carriage of dangerous goods, regulation 8 allows the member states to conduct port state control inspections on the vessels visiting their ports for the purpose of carrying out control over operational requirements specifically provided in the SOLAS Convention.

## 2.6 The administrative framework for the transport of dangerous goods in Myanmar

Maritime administrations are the focal points in this multi-dimensional process to collaborate and cooperate with all other stakeholders in the world. The competent authority means anybody or any authority designated or otherwise recognized as such for any purpose in connection with these Regulations (UN, 2017). Figure 10 presents a description of the various key actors in administration for the transport of dangerous goods in Myanmar together with their functions. The Ministry of Transport and Communications is composed of 5 departments, 4 enterprises and 2 institutions. Inland Water Transport (IWT) is only responsible for the security and safety of domestic inland vessels carrying passengers or cargoes and not to make environment polluted in Myanmar river. Inspection department under IWT carries out regular checking at jetty, onboard checking, surprised checking and special checking for inland vessels and jetties. The certification of master and seafarer served on such vessels is conducted by DMA.

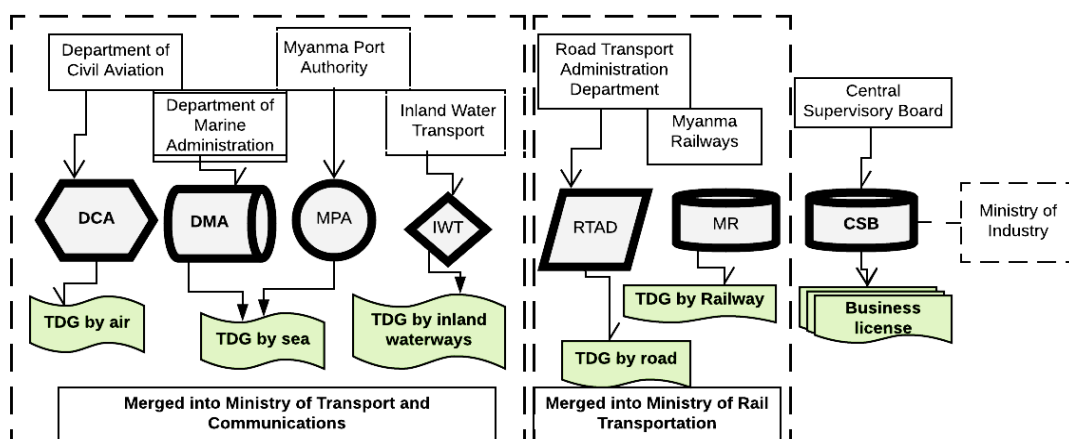


Figure 10 Administrative authorities for TDG in Myanmar

Source: author



Myo Thant (1999) stressed, "DMA is the only specialized executive arm of the Government to perform the implementation of the regulatory functions, embodied in the national maritime legislation" (p.6). DMA policies emphasize to improve the performances of Myanmar flagged vessels and the competencies of Myanmar seafarers. Additionally, the policies are aimed at saving lives in distress at sea and the protection of marine environment. There are 21 functions committed and dedicated by DMA, such as maritime legislation, port state control implementation, flag state control implementation, coastal state control implementation and maritime accident investigation. The division for Maritime safety, security and environmental protection is one of nine divisions under DMA that performs the safety related matters and port state control implementation. This division also managed to the transport of dangerous goods including keeping record of the dangerous containers exported or imported to and from Myanmar. Nautical division under DMA conducts the survey of Myanmar registered vessels for Document of Compliance (DOC) for carrying dangerous goods onboard in accordance with SOLAS II-2/19 and VII, that is obliged as flag state control implementation. For this regard, recognized organizations have no authority to issue such DOC on behalf of DMA. The division for the legal and technical standards handles the legal and drafting affairs with regard to the international conventions and benchmarks.

With regard to the port sector, all seaports of Myanmar are being administered by a single organization, Myanmar Port Authority (MPA). Marine department under MPA is responsible for issuing regulations concerned in all vessels which are using port limit area and monitoring them if they abide by such regulations. Traffic division under MPA functions the loading exported dangerous goods in accordance with ship's stowage plan and unloading and stowage of imported dangerous cargoes temporarily. Its duties include to recruit and train workers and assign stevedores. Ensuring safety and security of persons and properties within port area and issuing working instructions or by-laws to be abided are equally the functions of Traffic division. The duty of shipping agency department (SAD) is to check the dangerous goods manifest and disperse such information to other related agencies.

## 2.7 The operational framework

The transport hazards posed by dangerous goods can be categorized into nine classes and also subdivided into divisions and/or packing groups. The nine classes according to the United Nations are shown in Table 5.

Table 5

### *Classification of dangerous goods*

Class	Description	Example
1	Explosives	Pyrotechnic material, munitions
2	Gases	Propane, dioxygen
3	Flammable liquids	Fuel, ethanol
4.1	Flammable solids	Matches, celluloid
4.2	Self-flammable solids	White phosphor
4.3	Water reactive solids	Calcium carbide
5.1	Oxidizing substances	Fertilizer containing ammonium nitrate
5.2	Organic peroxides	Plastic adhesive
6.1	Toxic substances	Insecticide
6.2	Infectious substances	Hospital waste
7	Radioactive substances	Uranium metal
8	Corrosives	Oil, wax
9	Miscellaneous dangerous goods	

Source: Dischinger, Daigl, & Dreykorn (2005)

The governments are urged to implement inspection programs for Cargo Transport Units (CTUs) carrying dangerous goods and to report their findings to the Organization (IMO, 2016b). However, all states except four countries have been unable to fulfil this obligation until recently. The competent authority is obliged to ensure the training of the shore-side personal and is required to keep a record of training according to IMDG 1.3.1.

Moreover, it is very important to train the container inspectors to ensure their own safety and provide adequate capacity in identifying mis-declared and undeclared cargoes, which currently account for 21% of total accidents as illustrated in Figure 11.

The competent authority of the State has the obligation to ensure the use of packagings, including intermediate bulk containers (IBCs) and large packagings for the safe carriage of dangerous goods and to issue the approval of packagings as referred to in chapter 4.1 of the IMDG code. According to the cargo Incident Notification System (CINS) data, poor packing and incorrect packing account for 50% of the total dangerous goods related accidents as shown in Figure 11. Nowadays, shore cargo operators plan to load dangerous goods on the container ships by using computer software that provides automatic stowage and segregation in accordance with IMDG code. In relation to operation, IMDG code which covers approximately 3500 products is for the packaged DG and the rest of the products are covered in International Maritime Solid Bulk Cargo Code (IMSBC), IGC<sup>7</sup> code and MARPOL (Wankhede, 2018). Chief officer is the responsible person who keeps full record of all detailed stowage plans and manifests, checks the location with references to the plan and cares during the ship's voyage in term of dangerous goods.

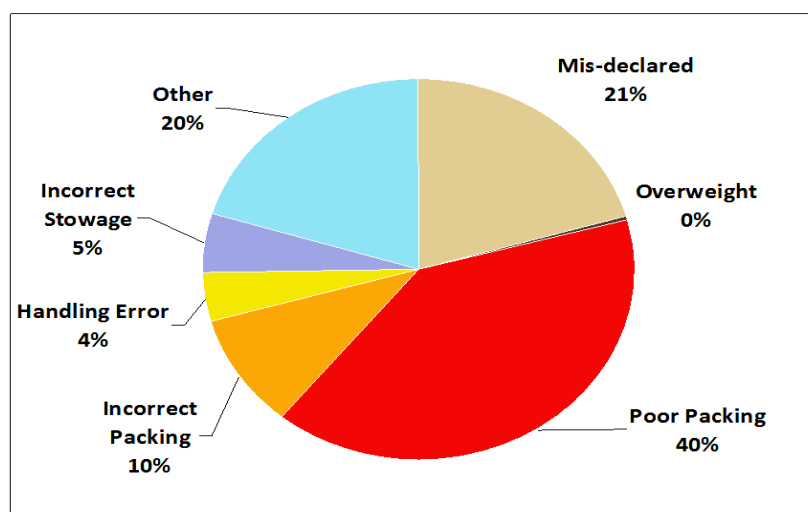


Figure 11 Analysis of the global operational information on all cargo and container related accidents

Source: Cargo Incident Notification System database, 2018

<sup>7</sup> International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)

The root cause of the Tianjin port accident was the lack of training of the shore-based personnel who were operating in the transport of dangerous goods and the lack of reliable inspections by the competent authority. With regard to the operation, IMDG Code relaxes many provisions for those who intend to transport only small amount of dangerous goods. Nowadays, many shippers steer clear of the strict IMDG regulations by packing small quantities (limited quantity) or very small volumes (excepted quantity). Moreover, this could save the packaging costs but they still have to apply the exclusive packaging and labelling requirements as instructed by IMDG Code. The simple pattern of marking and labelling for dangerous goods is demonstrated in Appendix G.

## **2.8 How Myanmar is operating in term of the transport of dangerous goods**

Myanmar has nine ports on its continuous coastline of over 2000 km stretching along the Bay of Bengal and Andaman Sea, namely Sittwe, Kyauk Phyu, Thandwe, Pathein, Yangon, Mawlamyine, Dawei, Myeik and Kawthaung. Yangon is the main port city handling about 90% of all imported and exported cargo. It has 33 international wharves, 23 wharves in Yangon inner harbour area and 10 wharves in the Thilawa area. The Department of Marine Administration and Myanmar Port Authority require arrival and departure notification relating to safety, security, and fairway/lighthouse fees. Myanmar custom successfully launched Myanmar Automated Cargo Clearance System (MACCS) on 12 November 2016 for the facilitation of cargo clearance. Myanmar Port Authority, Port Health, Marine Police, Port security and Myanmar Customs conventionally require arrival and/or departure notification relating to cargo import and export. Electronic messages sent in accordance with IMO FAL form can be accepted through Port Electronic Data Interchange (Port EDI) 72 hours before arrival to port, which will be later shared by MPA with other government agencies for the ship's outward clearance.

In this regard, Myanmar Port Authority (Shipping Agency Department) plays a key role in the distribution of the received information. The notification of the carriage of dangerous goods to the competent authority is extremely important as stated in IMDG 5.4.1.1. In light of this, the use of electronic data processing (EDP) and electronic data

interchange (EDI) transmission techniques as an alternative to paper documentation is also allowed by the convention. An example of online reporting of a dangerous goods list from ship to all relevant authorities such as MPA and DMA is shown in Figure 12. IMO FAL form. 7 (see Appendix B) shall be used as mandatory reporting for Myanmar ports.

*Bridge copy*

DEP. SINGAPORE

MV. SINAR BATAM DATE: 09 MARCH 17

SR.	CONTAINER NO.	CELL	LOAD PORT	DISCH PORT	UN NO	IMO CLASS	WEIGHT (KG)
1	CAIU 7252222	100362	SIN	MITT	1300*	3	31000
2	DFSU 3140888	100782	SIN	MITT	3272	9	3291
3	DFSU 6454560	140482	SIN	MITT	1300	3	31000
4	DFSU 7636883	060182	SIN	MITT	1300	3	31000
5	MEDU 4588263	140582	SIN	MITT	1300	3	31000
6	MEDU 4779545	140682	SIN	MITT	1300	3	31000
7	OOCU 7211557	060208	SIN	MITT	3268	9	248
8	TCLU 4992176	100882	SIN	MITT	1300	3	31000
9	TEMU 8113099	140382	SIN	MITT	1300	3	31000
10	TEMU 8270190	100682	SIN	MITT	1300	3	31000
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Figure 12 Online dangerous goods declaration via Port EDI

Source: DMA

The diagram shown in Figure 13 describes how the system integrates government departments with MACCS, terminals, Myanmar port authority, immigration, health and department of marine administration and private companies. The Myanmar port EDI system encompasses six separate systems such as a port-related procedures system, a berth allocation system and so on. The concept of port EDI is to integrate Port EDI (Myanmar Port authority), MACCS (customs) and e-Trade (Commerce) to become a Maritime Single Window (MSW). Statistics Management System and Logistics Monitoring System are the useful platforms to share data for container cargo

status and location information. The system allows to be visible the invisible stages of the cargo supply chain. Seen from the safety point of view, such assistant of technology helps much to mitigate many probability of risks in relation to the dangerous goods.

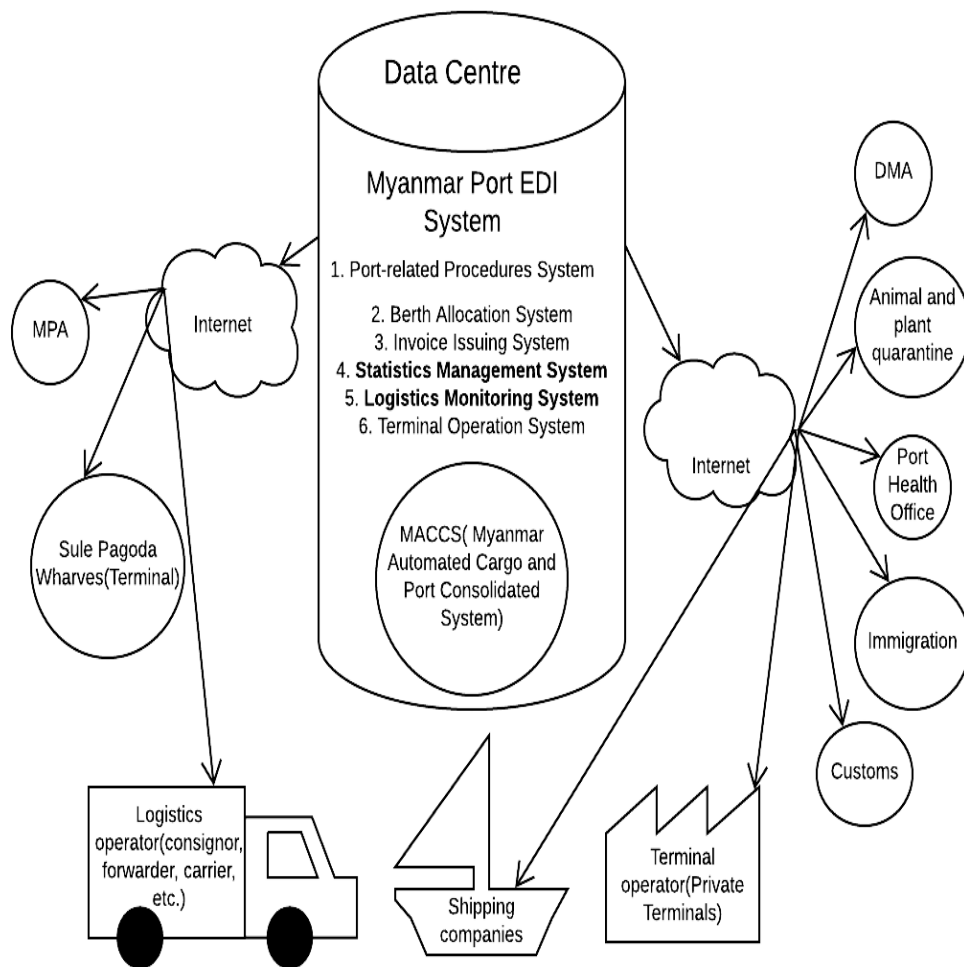


Figure 13 System integration of Port EDI system

Source: MPA

Based on the IMDG Code, Myanmar Port Authority categorizes dangerous goods into only three different groups according to their degree of danger. In Table 6, they can

be seen as listed as Group I , Group II and Group III, depending on the severity of danger together with handling methods of these goods.

Table 6

*Dangerous goods classification by MPA*

Group I	Substances presenting High Danger	Not allow to berth alongside  Unloaded or loaded at Explosive Anchorage (OEA or NEA)
Group II	Substances presenting Medium Danger	Discharge direct onto consignee's vehicle or loaded direct from shipper's vehicle.  Allow the operation only period during daylight hours i.e. from 6 am to 6 pm.
Group III	Substances presenting Low Danger	Allow to discharge into Port custody but arrangements must be made to clear the cargo as soon as possible by the consignee.  If the consignee fails to clear the cargo within 3 days, Port Authorities shall remove the cargo for safety purpose.

Source: MPA

In Myanmar, old explosive anchorage (OEA) and new explosive anchorage (NEA) are the designated areas permitted for loading or discharging of IMDG class 1 cargoes. Yet, the consignment of such cargoes is not allowed at any ports or terminals. These two areas are located in the Yangon river and printed on nautical chart as shown in Figure 14.



Figure 14 Map of Yangon River Estuary

Source: MPA



### 3. Research methodology

This Chapter elaborates the broader details on the work process of this research which is divided into 4 (four) phases, namely: (1) preparation, (2) data collection, (3) analysis and (4) recommendations and suggestions. The time line for this work is depicted in Figure 15.



*Figure 15 Time Line*

Source: author

#### 3.1 Secondary data collection

The study process commenced with the gathering of secondary data covering the inventory of previous studies, references, updates, strategies, policies and plans of the various governments and other relevant secondary data. Secondary data collection was carried out in the involved private and public sectors. In this phase, the author scrutinized and reviewed the condition of the safe maritime transport of dangerous goods based on the secondary data collected. Secondary information was compiled from the documents of port operation and vessel operation. Moreover, those data were gathered from the Myanmar Port Authority, Myanmar Custom, Myanmar

Five Star Line Shipping Company, Ministry of Transport and Communications and Ministry of Industry (2).

### **3.2 Primary data collection**

Primary data was acquired through a questionnaire and interviews. The main purpose was to collect the data required for an analysis of the transport and handling of dangerous goods solely from the Myanmar maritime context. Primary data collection makes a significant contribution to this dissertation, and was conducted in the following ways:

- a) Interviews with key persons from marine administration, ports and terminals, maritime training centers and private freight forwarding companies in the national context.
- b) Questionnaire forms dispersed to the various stakeholders

### **3.3 The questionnaire**

A questionnaire was developed (see Appendix A) by the author in May 2018 and disseminated to key persons working actively in the Myanmar maritime industry via emails and Google Forms. Over 50 questionnaires were dispersed in late May and on completion of the study a total of 33 responses had been received. The set of questionnaires includes 22 questions comprised of multiple choice, scales and subjective questions. The objective questions are intended for quantitative data analysis and subjective questions meant for qualitative research. The collective data from the questionnaire included:

1. The training of the personnel involved in the handling of dangerous goods
2. The collaboration and interrelation of the involved stakeholders in the Myanmar maritime industry, especially for the transport of dangerous goods
3. The opinion on the existing framework and collaborative effort to be improved to meet the international and benchmark norms

### **3.4 Risk management in dangerous cargo operation and handling in Myanmar**

A risk analysis is based on the examination of the secondary and primary data collection outcomes. Moreover, this analysis identifies the balance between the risks and safety barriers when handling of dangerous goods in the ports of Myanmar and on-board Myanmar flagged vessels. It includes analyzing the risks pertaining to the stowage and segregation of dangerous cargoes in the port. An exploration was conducted on how the port authorities plan/prepare for emergencies or undesirable circumstances.

### **3.5 Recommendation**

The dissertation outcomes were used as the basis for the further development of the legal, administrative and operational framework for the safe maritime transport of dangerous goods in Myanmar.

#### 4. Analysis of questionnaire results and discussion

##### 4.1 Analysis of questionnaires responses

In total, 33 responses were received from 50 questionnaires distributed to the different stakeholders, including ship officers (deck and engine) at management level, instructors, marine administrators, shore-side officers, port managers and engineers. The majority of respondents were males, accounting for 96.6% in total. The questionnaire targeted various age groups, with the intent to eradicate the generation gap which is provided in Appendix A. Fourteen of the respondents are aged between 35 to 44 years old and seven are between 45 to 54 years old. A further five respondents represent the age group of 55 to 64 and another five are from the group of 25 to 34 years old. There are two respondents included whose age is over 65 years. The majority of participants are from the maritime administration and merchant ships. The people from Maritime Training Centers account for 18.2% and a detailed list can be seen in Figure 16.

#### Which organization/maritime sector are you working in?

33 responses

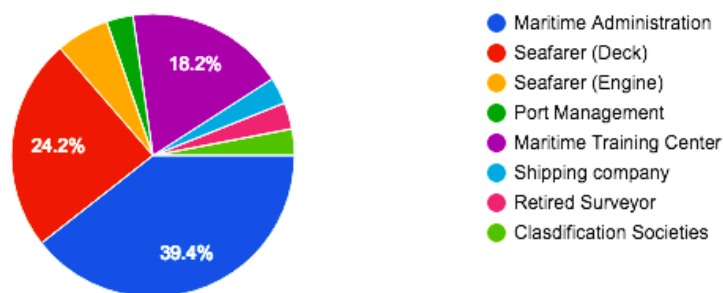


Figure 16 Question number 3

Source: author

The source of the responses are as follows:

- Maritime Administration 13
- Seafarer (Deck) 8
- Maritime Training Center 6
- Seafarer (Engine) 2
- Classification Society 1
- Shipping Company 1
- Port Management 1
- Retired ship's surveyor 1

Q. How well does the current legal framework for the carriage of dangerous goods fit the needs of your organization in Myanmar?

In the survey on the current legal framework in Myanmar conducted by the author, one instructor from the Maritime Training Center (MTC) replied that it is very bad, three instructors answered bad, two instructors thought neither good nor bad but nobody from the MTC replied that it was good. On the contrary, five marine administrators from the administration replied that the legal framework is good; another five marine administrators had the opinion that it was neither good nor bad, and three answered bad. Then, five ship officers thought it is neither good nor bad; one ship officers answered bad and two ship officers thought it was very bad. Only one ship officer thought it is good. One shore-side officer from a shipping company and one engineer from a classification society thought it was bad, but one manager from port management answered good. It is illustrated in graph Figure 17.

How well does the current legal framework for the carriage of dangerous goods fit the needs of your organization ...le from 1 (not at all) to 5 (very well).

34 responses

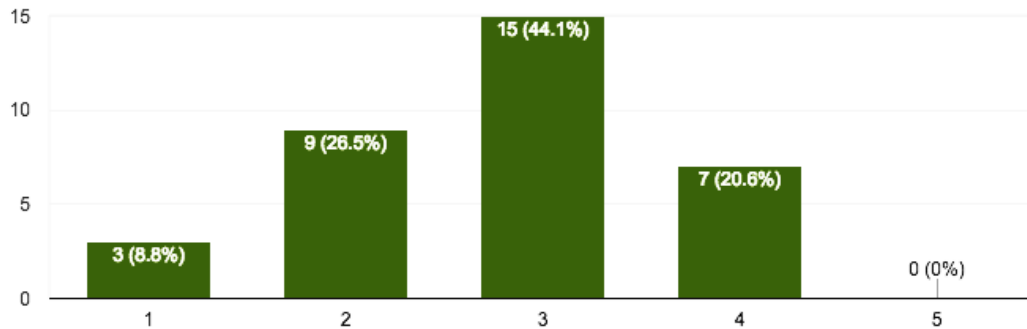


Figure 17 Question number 4

Source: author

Q. How well does the current administrative and operational framework for the carriage of dangerous goods fit the needs of your organization in Myanmar?

In the survey on the current administrative framework in Myanmar conducted by author, seven administrators from the Marine Administration similarly responded that it is bad; four thought it was neither good nor bad and two people answered good. Two instructors from MTC thought the framework was bad and three instructors answered neither good nor bad. Six ship officers, including deck and engine, thought it was neither good nor bad, and only one ship officer answered good. One retired surveyor answered good; one engineer from classification society gave an answer of bad, and one manager from the port replied neither good nor bad. It is shown in the bar graph of Figure 18.

How well does the current administrative framework for the carriage of dangerous goods fit the needs of your or...le from 1 (not at all) to 5 (very well).

33 responses

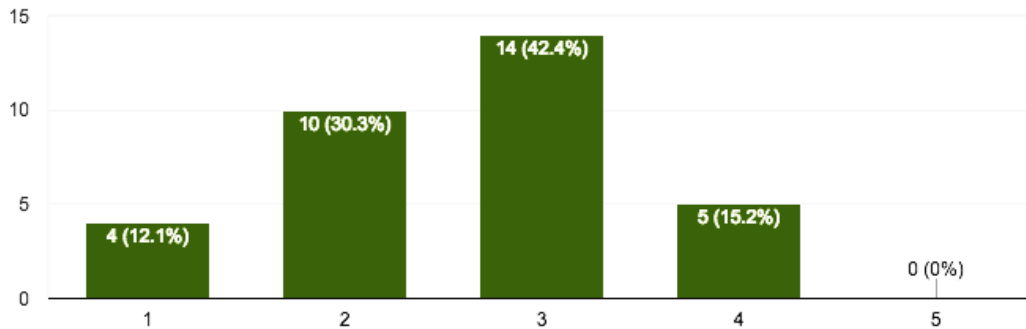


Figure 18 Question number 5

Source: author

Q. How well does the current operational framework for the carriage of dangerous goods fit the needs of your organization in Myanmar?

In the survey on the current operational framework in Myanmar conducted by author, five marine administrators thought it was bad but eight marine administrators answered neither good nor bad. Two instructors from MTC thought it was bad and another three answered neither good nor bad. Two ship officers thought it was bad and six ship officers thought it was neither good nor bad. One retired surveyor, one ship officer and one manager from port management thought it was good. However, one engineer working in a classification society thought it was bad and one shore-side officer from a private shipping company answered that it was totally bad. One chief engineer from a ship and one maritime instructor also thought that it was totally bad. It is shown in the bar graph of Figure 19.

How well does the current operational framework for the carriage of dangerous goods fit the needs of your or...le from 1 (not at all) to 5 (very well).

34 responses

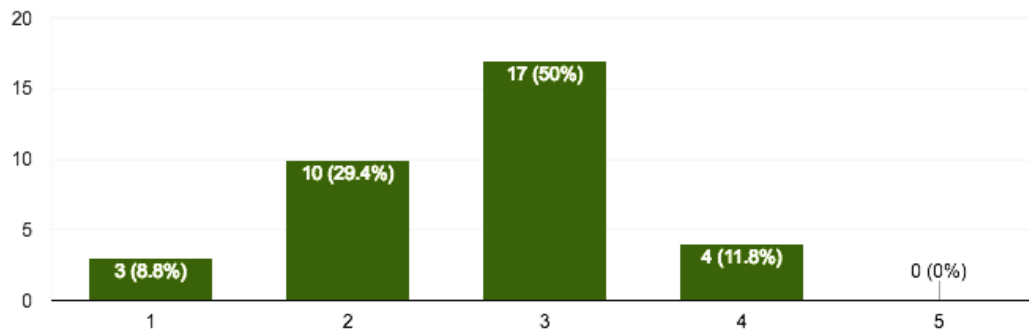


Figure 19 Question number 6

Source: author

Q. Do you think the tracking system for the movement of the dangerous goods is necessary to be established in Myanmar?

84.4% of respondents replied that they agreed with a tracking system for the movement of dangerous goods and only 3.1% were of the opinion that it was unnecessary and 12.5 % were unsure. It is depicted in Figure 20.

Do you think the tracking system for the movement of the dangerous goods is necessary to be established in Myanmar?

32 responses

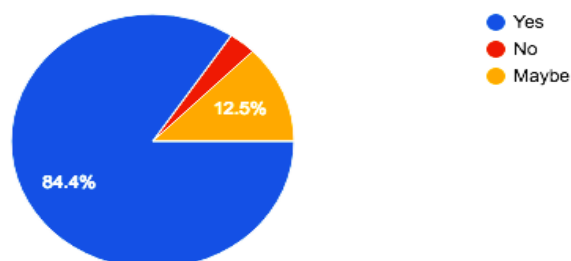


Figure 20 Question number 7

Source: author



Q. A National Container Inspection Program should be formed for the prevention of dangerous goods related accidents.

Totally, 91% of all respondents (strongly agree by 45.5% and agree by 45.5) replied that they agreed with the suggestion for the formation of a national container inspection program and merely 9.1% responded neither agree nor disagree which is illustrated in pie chart of Figure 21.

**A National Container Inspection Program should be formed for the prevention of dangerous goods related accidents.**

33 responses

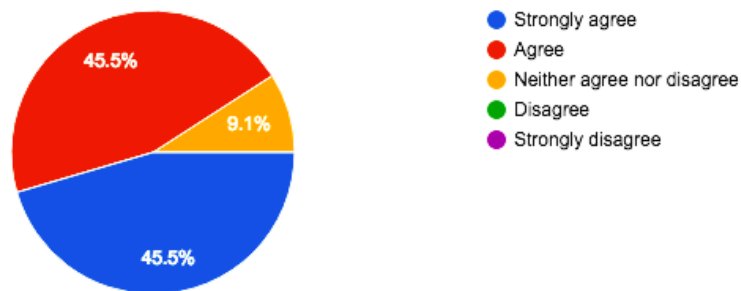


Figure 21 Question number 8

Source: author

Q. Which mode of transport, in your opinion, is the most dangerous for the carriage of dangerous goods?

42.4% of the total respondents thought that air transport was the most dangerous mode for carriage of dangerous goods, whereas other 30.3% considered sea transport to be the most dangerous. Moreover, only 27.3% answered road transport. They are illustrated in Figure 22.

## Which mode of transport, in your opinion, is the most dangerous for the carriage of dangerous goods?

33 responses

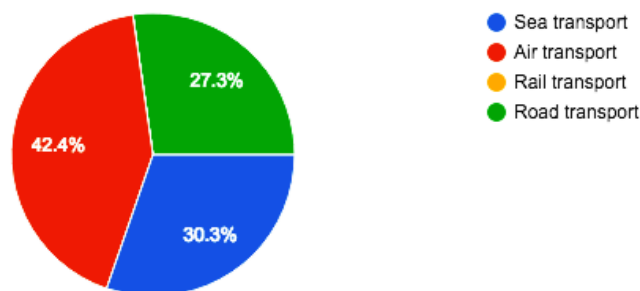


Figure 22 Question number 10

Source: author

According to the results received from the respondents, the majority of respondents have a good awareness of the public danger related to the transport of dangerous goods, accounting for 73.7% in total. 66.7% of respondents had attended Hazardous Cargo Training (HCT) and 36.4% of respondents were satisfied with the course but 18.2% were not satisfied with it and nearly half of them were neither satisfied nor dissatisfied. 63.6% of all responses supposed that the Hazardous Cargo Training was very critical for them and 21.2% answered that it was extremely important. 63.3% of respondents are not sure with regard to the presence of personnel, specialized for dangerous goods, at the port authority and the custom authorities.

Q. Have you encountered accidents related to dangerous goods?

28 responses were received and 23 of them replied that they had not encountered accidents. Only five of them had experience related to dangerous goods. The three answers regarding the causes of incidents were:

- Leaking compressed gas from DG tank container
- a huge explosion followed by fire occurring in Yangon in 2011
- a minor case with no severe personal injury or ship damage

Q. In your opinion, how likely are occurrences of accidents related to dangerous goods in Myanmar ports?

The author conducted a poll of 33 respondents across all ages and all professionals working in the shipping industry of Myanmar on the likelihood of accidents regarding dangerous goods. They were surveyed by questionnaire. The answer was contributed respectively by 6.1% (very likely), 27.3% (likely), 42.4% (neutral) and 24.2% (unlikely) as shown in Figure 23. 27.3% of respondents assumed that accidents related to dangerous goods in Myanmar ports are likely to occur, whereas 24.2% of them believed it was unlikely.

**In your opinion, how likely are occurrences of accidents related to dangerous goods in Myanmar ports?**

33 responses

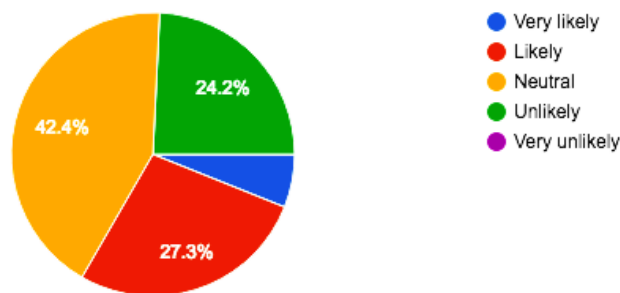


Figure 23 Question number 19

Source: author

Q. How effective, in your opinion, is the collaboration and interrelation of the involved stakeholders in the Myanmar maritime industry, especially for the transport of dangerous goods?

Only 18.2 % of respondents thought that the collaboration and interrelation of the involved stakeholders was very effective in Myanmar, especially for the transport of dangerous goods. Moreover, 36.4% of all respondents believed that it was not so effective, and nearly 45.5% of all respondents considered that it was somehow

effective. It can be seen in Figure 24.

How effective, in your opinion, is the collaboration and interrelation of the involved stakeholders in the Myanmar ...he transport of the dangerous goods?

33 responses

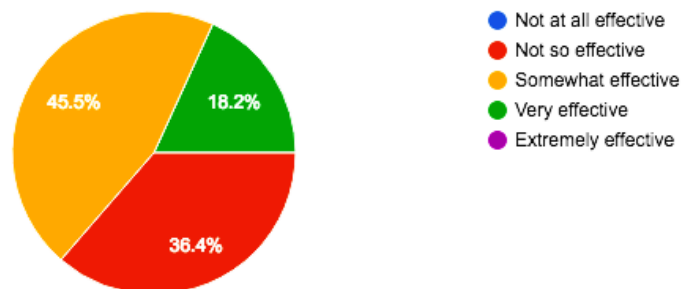


Figure 24 Question number 20

Source: author

Q. Can you kindly describe the relationships/collaboration between the different stakeholders and your reasons for your answer to the above question?

27 comments were received in relation to this question. The key issues raised by respondents were:

#### Training need

- lack of training for shore-based employees
- stakeholders need to be trained to raise the awareness of transportation, handling and storage of dangerous goods so that collaboration between the different stakeholders can be effective.
- require workshops and seminars
- education to public

### Stakeholder participation

- different stakeholders collaborate with each other on sharing information to improve efficiency and safety in the transportation of dangerous goods. Findings from different stakeholders on needs, benefits, challenges and incentives regarding information sharing may be one of the effective ways to optimize the safety of dangerous goods transportation.
- still require stakeholder mapping and gap analysis between each other
- all the stakeholders and administration shall initiate more steps and/or take more effort to ensure the safe carriage of D.G Cargoes.

### Law enforcement

- implement effectively national and international regulations to control and monitor the DG transportation of shipping industry
- strengthen law enforcement
- update current rules and regulations of MPA to the latest international requirements
- port authority is not so active as it should be

## **4.2 The volume of import and export of dangerous goods in Myanmar**

Yangon river ports and Kyauk Phyu deep-sea port are currently the main ports driving Myanmar's economy. Yangon ports are receiving container vessels, general cargo vessels, tankers and bulk carriers, whereas Kyauk Phyu deep-sea port is, so far, only accepting Very Large Crude Carrier (VLCC) tankers to forward oil to China by pipeline. The number of vessels calling to Yangon ports are presented in Table 7 and the table clearly shows the upward trend of country's trade. Oosterwegel (2018) predicted, "It is most likely that Myanmar remains a feeder market in the near future because competition with Singapore and Port Klang is not possible yet" (p.40).

Table 7

*Number of vessels calling Yangon ports*

Fiscal Year	Total number of vessels	Progression
2006-2007	1091	
2007-2008	1254	15%
2008-2009	1206	-4%
2009-2010	1372	14%
2010-2011	1461	6%
2011-2012	1505	38%
2012-2013	1793	18%
2013-2014	1891	6%
2014-2015	2002	6%
2015-2016	2332	16%

Source: MPA

Container handling throughput and general cargo handling statement in Yangon Ports are presented in Figure 25 and Figure 26. Imports and exports of TEU were almost the same in container handling, but imports of general cargo were much higher than exports. Both trade by container vessels and general cargo vessels in Yangon ports continues to grow, more than doubling over the period of ten years.



Figure 25 Container handling throughput in Yangon Ports (TEU)

Source: MPA

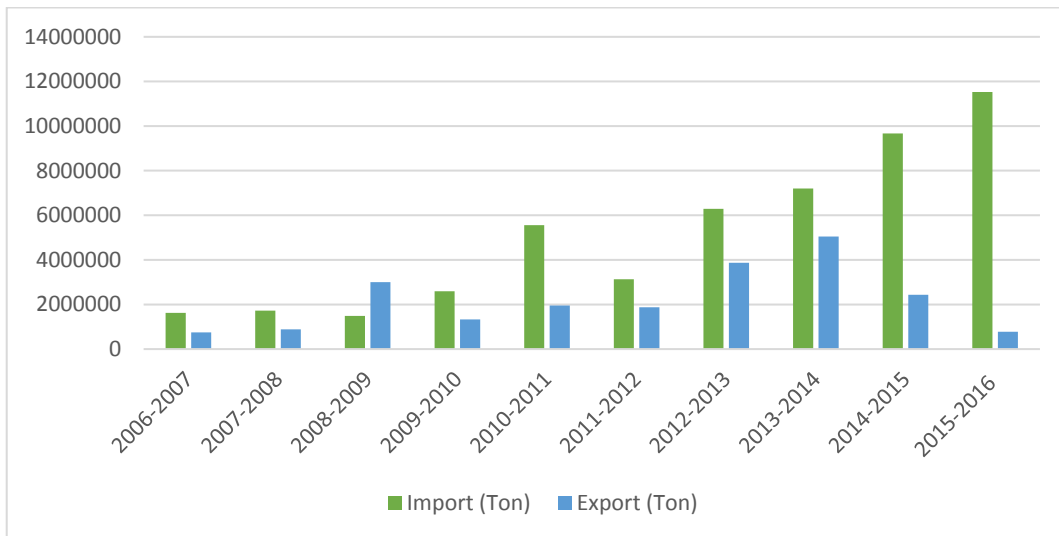


Figure 26 General cargo handling Statement in Yangon ports  
Source: MPA

In Myanmar, the out-shipment of chemicals including foreign and coastal seaborne trade was 23,850 tons and the in-shipment was 508,101 tons in 2015. Therefore, the imports of chemical were always much greater than the exports. The trade of chemicals continues to grow yearly as mentioned in Figure 27, which shows 5 years from 2011 to 2015.

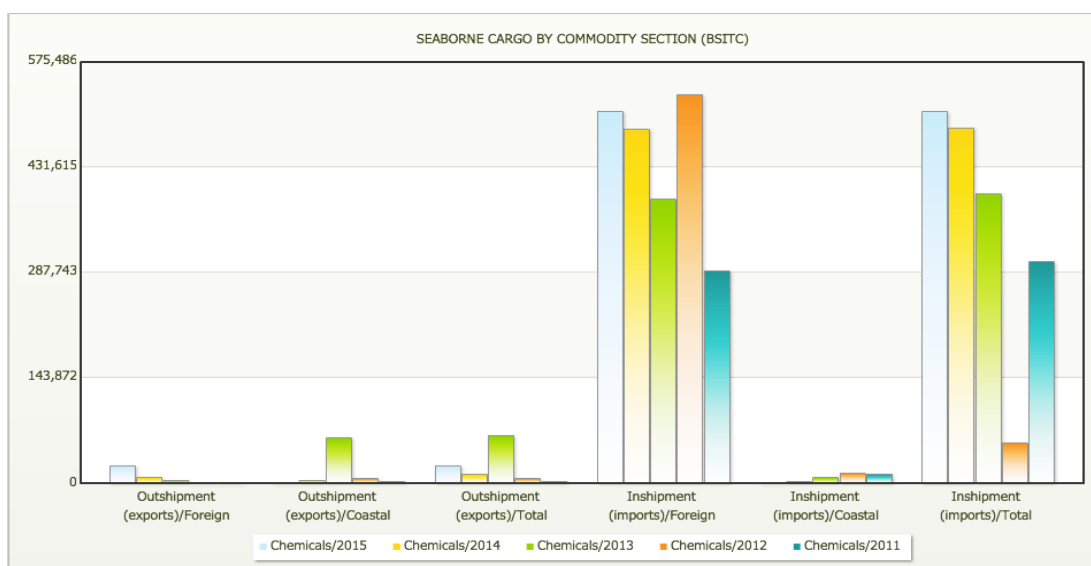


Figure 27 Chemicals export and import in Myanmar (Unit: Ton)  
Source: MPA via Myanmar Statistical Information Service

### 4.3 Risk management

Bernstein (1996) ,Khan and Burnes (2007) and Rao and Goldsby (2009) defined, “The word “risk” originates from the Italian word *risicare*, which means to dare”. With the growing trade of dangerous goods, the increased flow of shipping traffic and the handling of bigger vessels in Myanmar, related risks are inevitable in the maritime sector, and those related to dangerous cargoes can happen on shore or at sea due to the lengthy supply chain. In risk management, the probability of occurrence is the cause, whereas consequences are its effects. Thus, the probability is primarily important to be underlined in risk mitigation process for the prevention of the future accidents. RMSI (2001) provides a well-known formula to assess risk which is:

$$\text{Risks} = (\text{Frequency or probability of occurrence of the hazardous release events}) \times (\text{Estimated consequences of the hazardous release events})$$

In light of risk mitigation, it is imperative to widen the influences of a marine administration on the shipping lines, ports and foreign ships visiting to the country through the formation of safety barriers to prevent undesirable catastrophes. Safety barriers might be regulations, inspections, or container tracking systems. Sobral & Soares (2015) described that “safety barriers are usually applied to avoid the occurrence of undesired events or to mitigate or minimize their effects”. Safety barriers make minimize or eliminate the risks by reducing the probability of unwanted hazardous events to a negligible level or within the range of ALARP (As Low As Reasonably Practicable) by limiting catastrophic events. Talley (1996) stated that “unlicensed operators (versus licensed operators), and smaller ship sizes (versus large ship sizes) may contribute to the increase of risks and severity of cargo damage in container shipping”. The Swiss Cheese Model in Figure 28 depicts how the accidents can occur by passing through the safety barriers. In relation to this, the loopholes to let the accident happen always exist even when the layers of safety barriers are placed appropriately. Accident occurs every now and then by overcoming the organizational influences and unsafe supervisions. These are deemed as latent failures. Ninety-two accidents have been occurred in Myanmar within the previous five years period (2011~2016) as presented in Table 8.



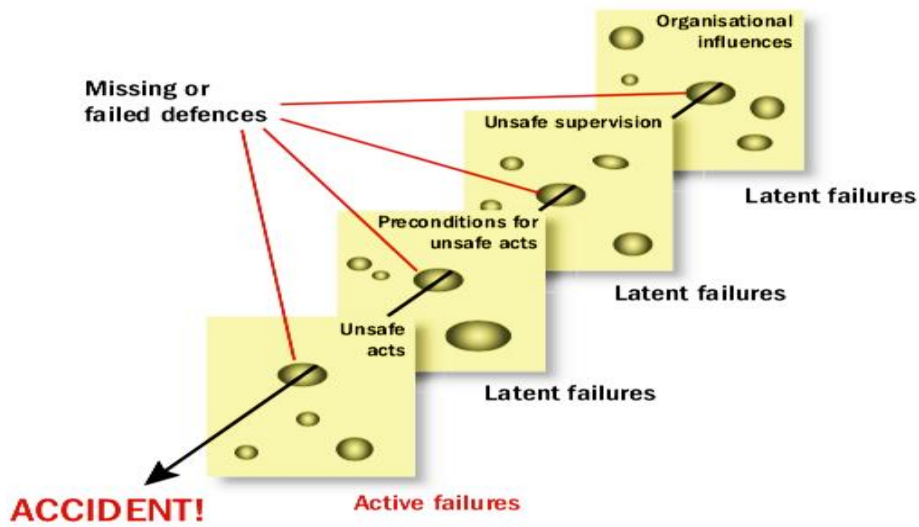


Figure 28 The Swiss Cheese Model

Source: Reason, 1998

Table 8

*Record of maritime accidents in Myanmar*

	Fire	MOB	Collision	Grounding	Overload	Stability	Flooding	Weather	Other	Total
2011	3	1	2	2		1	1	6	9	24
2012			6	1			1	3	1	15
2013	2	1	3	2				3	6	17
2014	1	1	7	2			3	2	2	18
2015	1		1	2			3	1	2	10
2016					1		2		5	8
										92

Source: DMA, 2016

The shipping industry ecosystem widens remarkably with multiple stakeholder involvements, so a comprehensive safety barrier analysis would be required to prevent marine accidents from happening. In Myanmar's Maritime Industry, there are key actors comprising both private and public entities such as DMA, MPA, Myanmar Maritime University (MMU), Myanmar Mercantile Marine College (MMMC), private

MTC and freight forwarders as mentioned in Figure 29, who contribute to addressing issues concerning new policy-making or the amendment of existing policies, maritime laws and regulations.

Batalden & Sydnnes (2013) stated that, "Of the causal factors coded to organizational influences, 64.7 % relate to organizational processes, of which 35.3 % concern oversight (poor procedural guidance, organizational training issues, and organizational risk management)". And then, he emphasized that "a total of 56.5 % of the causal factors under unsafe supervision are coded to shore-based management". The role of the competent authority is very important to ensure the proper packing of dangerous goods before safe movement. For example, the U.S. Coast Guard's National Container Inspection Program (NCIP) conducts the verification of compliance with regulation of containers according to MSC.1/Circ.1442 (2012). Seen from the perspective of risk management, such proactive action is very effective for the prevention of possible accidents related to mis-declared or undeclared dangerous goods.

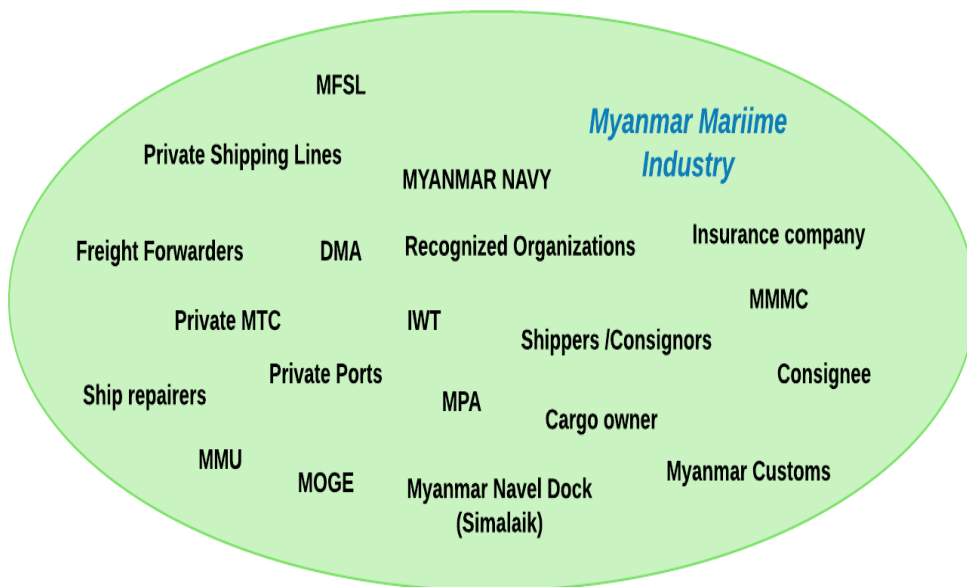


Figure 29 Key actors in Myanmar Maritime Industry

Source: author

As shown in Table 9, countries such as China and Germany conduct much fewer inspections than the United States; however, even the US is only able to inspect around 10% of all container cargoes currently. In 2014, only four IMO countries, US, Korea, Sweden and Belgium were able to provide year-end consolidated container inspection program reports. Myanmar still has no National Container Inspection Program making it necessary to spot check dangerous cargo containers and general cargo containers to determine if they have been misdeclared and undeclared. In the US, 50% of all DG containers and 50% of all general containers are searched for safety reasons.

Table 9

*Number of inspection on container in the top (10) countries*

No	Name of country	Total inspected	Total deficiencies
1	United States	55,661	3,667
2	China	4,982	705
3	Germany	1,129	89
4	Japan	753	41
5	Korea, Republic of	618	100
6	Belgium	575	51
7	Mexico	512	14
8	United Kingdom	510	38
9	Brazil	462	47
10	Taiwan	443	68

Source: CITAT, 2018

Both stowage and segregation of dangerous goods onboard and at port are critically important as they are related to many risky accidents. The tables for stowage and

segregation in port areas to avoid hazardous situations are shown in Appendix C. In case of emergency in a port, the following procedures shown in Figure 30 shall be complied with in Myanmar. As cited above, Tianjin blast reminds the shipping industry that the large-scale-man-made industrial catastrophe event do happen. (Swiss Re,2016). Since all Yangon ports are situated in downtown areas, the static risks, building and infrastructure within ports, and the mobile risks, ships and cargoes, have accumulated closely to the public areas. If something unexpected has happened, the consequences would be unpredictable as the extent of the Tianjin explosion expanded up to 3 km from the port.

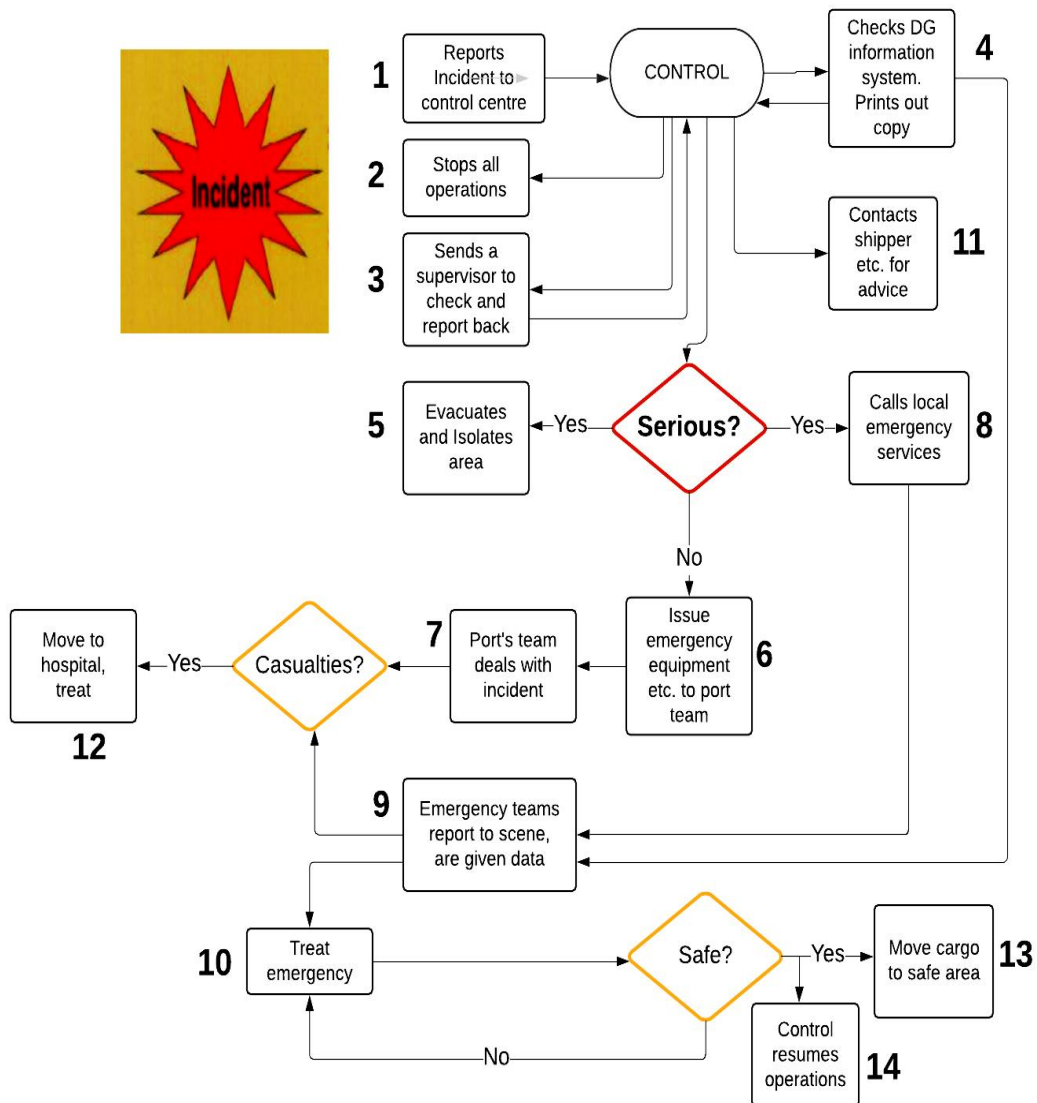


Figure 30 Emergency procedure in case a dangerous goods incident

Source: MPA

## **5. Recommendations and conclusion**

The author provides the following recommendations based on the insight gained by critically analyzing and evaluating the current conditions of both Myanmar and other well-organized successful nations.

### **5.1 Recommendation for legal framework**

#### **5.1.1 Legislation**

While DMA administers the transport of maritime dangerous goods, the road department ensures their safe road transport. Myanmar Port Authority deals with dangerous goods containers including loading, discharging and stowage for their shipment. However, there is no overall umbrella rule to fully cover over all modes of transport for dangerous goods. In this regard, the disaster in Tianjin called for a review of safety legislations for the stowage and segregation of dangerous goods. In China, State council: Decree 591 blankets all transport modes such as transport of dangerous goods by air, railways, waterways, and road, along with business licenses, licenses for purchase and road transportation of highly toxic chemicals and safety management of road transportation vehicles.

With regard to the legislation, the specific laws for dangerous goods are only some and deficient in Myanmar although there are many laws concerning the transport of goods which are written since long time ago. Accordingly, it is urgently needed to make more legislation and modify the outdated body of law. The findings generated from IMSAS pointed out that the Member States may not have established a system for a system to integrate the conventions and amendments into their national regulations and they may not have linked between their domestic legislation and relevant IMO provisions (IMO, 2017d). The author advocates that the legislation for

the safe maritime transport of dangerous goods should be written as a comprehensive legislation to be wide-ranging in terms of the roles and responsibilities of each government agency. If possible, road, rail, inland and sea transport should be combined under one umbrella legislation as they are enormously correlated in a single supply chain in intermodal or multimodal transportation. As mentioned above, Myanmar is a country that uses common law, which is a system that had its roots in medieval England. Donner (2015) expressed that “legislation is enacted law (statute law) and the ultimate legislator is Parliament”. In Myanmar, Hluttaw is similar to the parliament. Today, the executive and administrative agencies of government also promulgate a large body of law in the exercise of a limited legislative authority, which is similar in character to statutory law. The updated law and regulations should be issued in a timely manner, regarding the safe carriage of dangerous goods. Today IMO uses "tacit acceptance" procedures for adopting amendments by States to remedy long delays in bringing them into force. As an IMO Member State, Myanmar is under the obligation not to act contrary to standards necessarily determined by IMO. Again, the graph in Figure 31 shows 86 findings(38%) are related to initial actions (legislation) under Part I of the IMO Instruments Implementation (III) Code.

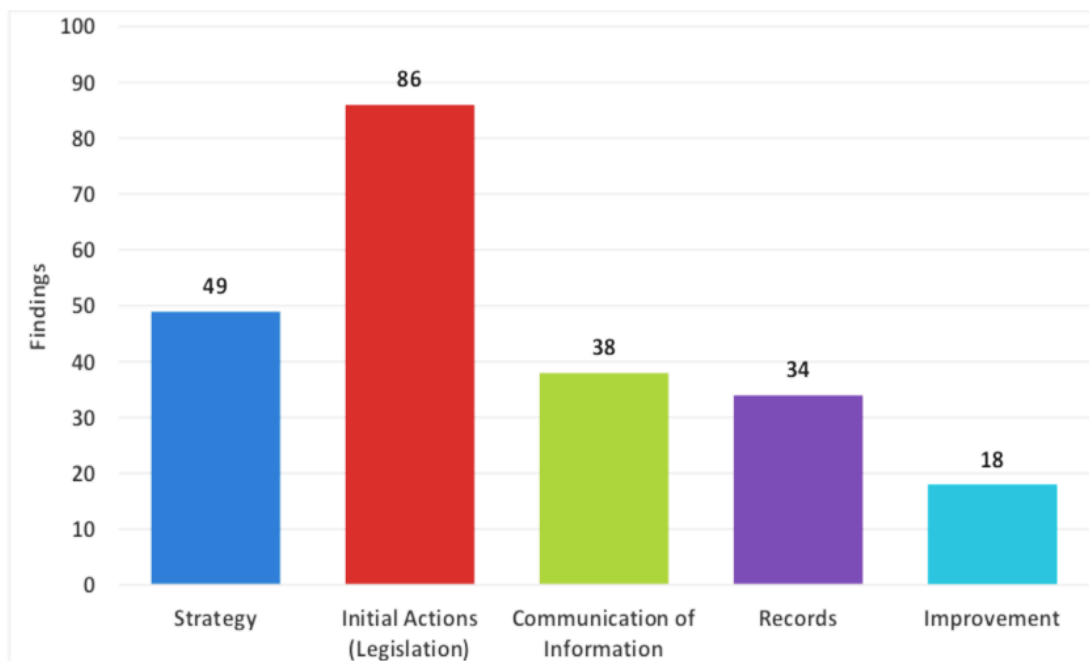


Figure 31 Number of findings under Part 1 of the III Code- Common Areas

Source: IMO, 2017d

### 5.1.2 Implementation and enforcement

Balkin (2000) mentioned, “IMO continues to provide technical co-operation, which is recognized as an increasingly important part of the work of IMO”. Myanmar is in the progression of its implementation with maximum pace. If national laws/ regulations are promulgated for the safe transport of dangerous goods, all stakeholders should implement effectively all requirements of laws/ regulations. Even though many procedures and laws have been written, they might actually be ineffective unless the proper implementation and enforcement are undertaken.

In relation to the implementation, IMO is responsible for maritime transport issues but it has no direct enforcement power as mentioned above. Enforcement is a direct responsibility of individual member states. The existing administrative framework can only be improved with compelling enforcement of coupled procedures. A long-term action plan should be prepared for the administration to ensure full enforcement abiding with the international norms and benchmarks. Nevertheless, the implementation of the safe transport of dangerous goods falls directly upon the maritime administration if the above provisions of the IMDG code are fully and deeply scrutinized.

## **5.2 Recommendation for administrative framework**

### 5.2.1 Monitoring

Proper monitoring and control of the transport of dangerous goods should be in place to avert accidents. All incidents, near miss cases and accidents should be investigated and records kept to get lessons learnt. The statistics are a key component in understanding the trend and likelihood and deciding on the feasible and reactive control measures. Besides, this can help the responsible organizations to pinpoint the weakness in the system. As stated above, Myanmar has been using the Port EDI system since October, 2017 which includes one function that is a Statistics Management System. The author strongly recommends to use it effectively because

communication and information management are extremely important in the transport of dangerous goods. Additionally, many respondents to the questionnaire believe that it is important that statistical data regarding the volume of import and export of the dangerous cargoes is recorded in Myanmar. It enables the declaration of dangerous goods digitally, which makes their reporting easier and more effective.

In order to assist the monitoring of cargo movement, some developed foreign ports have started operating Radio Frequency Identification (RFID) container tracking systems for Reefer containers to get real-time information on what is happening inside the container. To accomplish this, the container is fitted with simple technology including modem, GPS, wireless SIM Card and global satellite link, which makes the visibility of supply chain increase. Many Maersk Line vessels have been equipped with VSAT which transmits data gathered from the reefers to the satellite, enabling data monitoring of 270,00 Maersk Line reefer containers. The author strongly suggests the tracking system on the movement of dangerous goods containers in the future by using this kind of technology. As Department of Civil Aviation (DCA) is responsible for reporting to international, regional and national organizations regarding transport of dangerous goods by air, the author advises that DMA should take a key role in reporting the transport of DG by sea to IMO and other concerned organizations with the cooperation of Myanmar shipping lines and sea ports. IMO inaugurated the Member States an online reporting system called Global Integrated Shipping Information System (GISIS) in 2005 to access to the database compiled by the Secretariat which allows to enhance the monitoring process for the safety and environmental protection. An additional organization plan for the optimum implementation of dangerous goods legislation should be supplemented into the existing organizational structure of the Department of Marine Administration in Myanmar. For this regard, every vessel calling to Myanmar ports should report the dangerous goods information to the port tower of MPA from Very High Frequency (VHF) channel (16) and unfailingly update their status in Automatic Identification System (AIS) for this carriage of dangerous goods. Similarly, Vessel Traffic System (VTS) should be installed to monitor and safeguard the operation of vessels in Myanmar's coastal jurisdiction as many countries are undertaking for reduction of the maritime risks related to cargoes and ships in near shore areas.



### 5.2.2 Inspection

The author himself and many respondents are confident in saying that a National Container Inspection Program, as is established in the U.S, should be formed for the prevention of dangerous goods related accidents. An inspection team will need to be formed by the officials from maritime administrations to inspect the containers regularly and report their results to IMO. Cargo incidents, especially those involving dangerous goods (DG), threaten the public, mariners, port workers, and the environment, and can disrupt the marine transportation system. It is also important to monitor DG related activities to ensure compliance with national laws and rules at all times, beginning with spot checks. Thailand and some EU member countries established a Dangerous Goods Safety Advisory (DGSA) with experts from private sectors to support safety in shipping, logistic and freight forwarder companies. The author would like to encourage the development of a similar organization in Myanmar to enhance inspection and monitoring to safeguard the maritime industry. A capable workforce is required to inspect the containers, which might be challenging for the marine administration. The risk frequency can be analyzed for the probability as presented in Table 10. The manipulation of Frequency Index might help to determine the reasonably probable level in risk mitigation.

Table 10

*Frequency Index(FI)*

FI	FREQUENCY	DEFINITION	F (per ship year)
7	Frequent	Likely to occur once per month on one ship	10
5	Reasonably probable	Likely to occur once per year in a fleet of 10 ships, i.e. likely to occur a few times during the ship's life	0.1
3	Remote	Likely to occur once per year in a fleet of 1000 ships, i.e. likely to occur in the total life of several similar ships	$10^{-3}$
1	Extremely remote	Likely to occur once in the lifetime (20 years) of a world fleet of 5000 ships.	$10^{-5}$

Source: IMO, 2002

### 5.2.3 Stakeholders

The administrative style is likewise evolving continuously over time so that it is not possible to work solely by administration alone today. Working with other stakeholders together for the success, from national to international level, is required. The amount of time and effort needed for success depends on how effective the cooperation between internal departments is. Therefore, it is necessary to emphasize improvement in this area. In Myanmar, the drawback might be the need of the central government to focus on stimulating the maritime industry's development, which may be very difficult owing to its complexity of the control of safety. The message received from the present IMO SG is pertinent in this regard: "Maritime activity can both drive and support a growing national economy". The major challenges Myanmar currently faces might be cooperation, collaboration and coordination because every organization is acting vertically without unanimous decision. However, the author believes that the successful operation of maritime transport of dangerous goods can be achieved if two key actors, DMA and MPA, properly collaborate and cooperate with harmony.

In the opinion of the author, Korea maritime industry's policy being "Connecting all to one, sailing to the world" is most suitable to be imitated by Myanmar since Korea is greatly successful in the maritime industry although there are the 24 independent organizations and institutions such as Korea Marine Equipment Association (KOMEA), Korea Research Institute of Ships & Ocean Engineering (KRISO) and Korean Register (KR). For this purpose, Korea has fruitfully established the cooperation committee to organize and harmonize such 24 different bodies under one umbrella. The private companies, port authority, berth operator and the regulatory authorities are in need of close cooperation and collaboration to make sure safety and environmental protection in the Myanmar maritime transport sector. The desired goal cannot be obtained without the stakeholders' participation. Frequent meetings of the stakeholders can serve such important purposes by discussing current activities. For these purposes, information shall be sent to the stakeholders in advance in order to enable dialogues and exchange of ideas in the meeting for the purpose of revision of the current weaknesses and shortcomings. Currently, Myanmar's department of

marine administration is acting as a focal department for IMO, ASEAN Maritime Affairs and ASEAN Coast Guard Agency at the same time. Moreover, it collaborates internally with many agencies in the country as shown in Figure 32 so that its capabilities are extremely significant to be successful in implementation and enforcement of IMDG requirements. Cooperation makes us better.

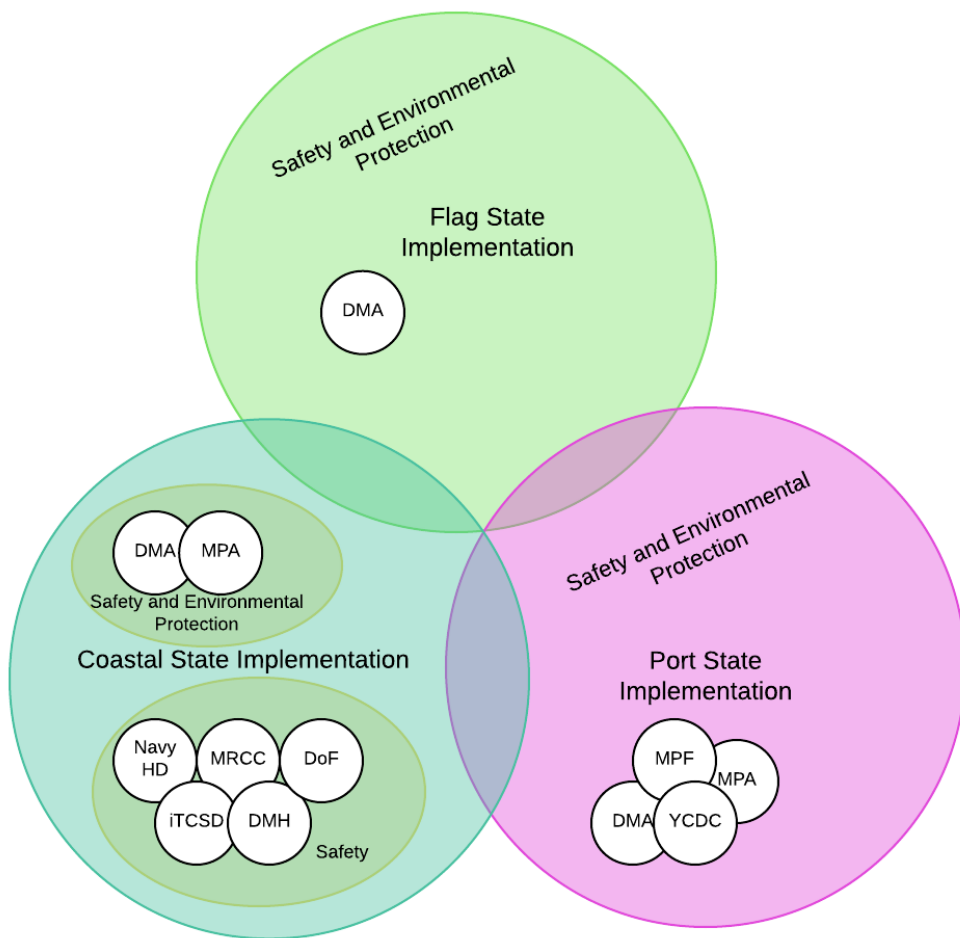


Figure 32 DMA and other related stakeholders

Source: DMA, 2017

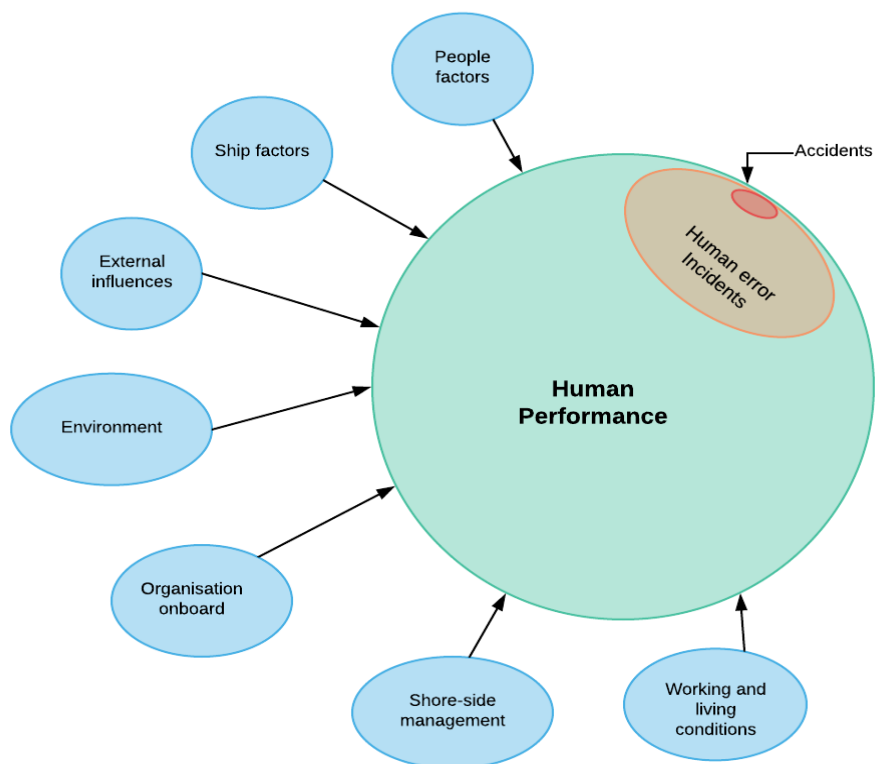
### **5.3 Recommendation for operational framework**

#### **5.3.1 Public awareness**

For this regard, public awareness can be fulfilled by the media (social media, TV broadcast, educational video, billboard). All persons performing in the various roles should be educated to act in accordance with the related rules and regulations to attain safe and clean transportation. Raising awareness at all levels is necessary. The owners or occupiers of dangerous goods are less aware of the regulations and the enforcement of law by the concerned authority is weak in Myanmar. Lack of knowledge and awareness can be addressed together with effective training. As good media management can help the situation, it can also worsen the circumstances so it is increasingly important to handle carefully nowadays.

#### **5.3.2 Training**

“Human Error” or “Human Failure” has contributed to marine accidents by the famous 80% figure. Figure 33 clearly mentions how human performance and accidents are interrelated in the shipping industry. It is depicted by the information and knowledge learnt from many accident investigations. For adequate administrative capacity for safe handling of dangerous goods, all trainers and administrative personnel should be trained under a sustainable training system. Both existing risks and introduced risks can be addressed by new technology or new methods of operation and management.



*Figure 33 Factors influencing human performance*

Source: MAIIF Investigation Manual

The dangerous cargo manifest may be incorrect, improperly filled out, missing, mis-declared or forged and there is always a risk. That may lead to a major catastrophe in the home country or aboard in the future so strict systematic control measures over this area are essential. Each level of handling DGs should understand proper handling/stowing and maintaining of DGs at his/her working/stowing areas. To ensure proper understanding of handling DGs, the application of PDCA (Plan, Do, Check, Act) circle should be used. The ocean voyage is no longer a self-contained journey but is just a link, albeit an important one, in the entire supply chain (Gard, 2016). As mentioned above, collaborative efforts be improved through knowledge sharing with the new rules and regulations for each department of different organizations by seminars, workshops and meetings. The marine administration should enforce upon seafarers and those ashore who are involved in DG operations to attend the updated

and compulsory training regularly. The superior officers and/or responsible persons should always observe new international standards and the best practices by attending international fora and conferences for discussion (open to all States, IGOs and NGOs), co-operating with international organizations, such as GIZ, and inviting experts into Myanmar to provide technical and administrative lectures for capacity building. Then, the administration should provide the approved certificates to attendees who have fruitfully joined the course and keep records of certifications. Only the qualified personnel who has held the required certificates should be appointed for the handling of dangerous goods.

#### **5.4 Conclusion**

As the dangerous goods transport keeps increasing in the world, these are impacted to Southeast Asia region and Myanmar. This implication demands the proper legislative and administrative measures to enhance the present working practices in the sector of transport of dangerous goods. For this regard, the maritime industry is similarly so risky as the aviation. Furthermore, coastal shipping, rail and road transport should not be underestimated. Today port management and logistics are very popular and booming with many interaction between regional and global market which is well known as globalization.

My dissertation aimed to bridge the shore side and ship side by letting the audiences knowing the different perspectives. Therefore, the ship and the seafarers are as important as the port and the port operator in the interface between the ship and port facilities. From the safety perspectives, the road vehicles and their drivers who are handling the dangerous containers should also not be overlooked for their important roles. The author encouraged to establish the statistics management system and the tracking technique to increase the visibility of the supply chain of dangerous goods movement.

The author also suggested to form the national container inspection program to investigate randomly the sealed containers for ensuring the control over the mis-declared and undeclared dangerous goods. The emergency response by port

personnel in case of incidents is critical to prevent undesired outcomes. The segregation of dangerous goods should be ensured in the port and on-board vessel. Moreover, the author recommended to upgrade the training system with the reliable certification. The recommendations are supported by the statistics gathered by interviews (on line and face to face) and survey questionnaire. The comparison between Myanmar and other selected countries in terms of the safe maritime transport of dangerous goods also provided the insight for the further improvement. The highlight on the risk management for Myanmar ports and Myanmar shipping lines was intended to remind the consequences of the catastrophes happened in the world. Finally, the author advocated that the regional seminar for technical capacity building should be regularly hosted in Myanmar for this regard to improve public awareness and high-level policy-maker participation.

Networks of inspectors together with the proper communication system may make the administration more effective and efficient in their enforcement. The enforcement of the law can be instigated with the detention of the container or the shipment by placing substantial monetary liabilities on the shipper. It can also be fulfilled through on-site inspection to companies that produce, import or sell dangerous products. As the shipping industry has been approaching digitalization for a long time, information technology should also be considered for the safe operation of dangerous goods. As discussed above, the maritime transport sector needs far-reaching public awareness, a high-level of commitment by policymakers and collaboration by other relevant key stakeholders in this regard. Finally, the legal, administrative and operation frameworks need to be properly monitored, modified as necessary and continuously updated by the State with regard to the safe maritime transport of hazardous materials. The author would like to conclude this dissertation here by saying that all stakeholders should work together to safeguard people, cargo, assets, infrastructure and environment from the inherent risk of dangerous cargoes.

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## **Appendices**

### **Appendix A**

#### **THE LEGAL, ADMINISTRATIVE AND OPERATIONAL FRAMEWORKS OF THE SAFE MARITIME TRANSPORT OF DANGEROUS GOODS: MYANMAR AS A CASE STUDY**

##### Research Information Sheet

Thank you for participating in this survey! The goal is to collect data on the maritime transport of dangerous goods in Myanmar to identify and analyze opinions about the current legal, administrative and operational framework governing such transport. This research is being undertaken in partial fulfillment of the requirements of a Master of Science degree at the World Maritime University. The outcome is expected to help further the development of Myanmar in the maritime sector.

The Legal Framework includes the body of law adopted or framed to control the maritime transport of dangerous goods in Myanmar, for instance, The Burma Code (Myanmar Code) Volume VII and the IMO conventions that the Government of the Union of Myanmar has already ratified, acceded to or accepted.

The Administrative Framework of the maritime transport of dangerous goods encompasses the administrative processes governing the performance of the port state, coastal state and flag state in fulfilling the State's obligations in accordance with the mandatory conventions, codes and guidelines such as the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Dangerous Goods Code (IMDG Code), etc.

The Operational Framework of the maritime transport of dangerous goods covers the packaging, the detailed inspection, tracking, monitoring, the essential shipboard and

shore-based procedures relating to the prevention of pollution by harmful substances, the training of shore-based personal and seafarers, documentation and labelling, contingency plans onboard and on shore, etc.

This survey is expected to take 10 ~15 minutes to complete.

Please note that all data will be held in the strictest confidence and stored securely in the computer drive. At the end of this research all the data collected will be disposed of on 30th November 2018. Strict confidentiality will be observed and your data will not be shared with anyone else.

Your participation in this research is highly appreciated. If you have any issues or questions, please contact to the email, w1701715@wmu.se or the phone number, +46764526721.

Regards

.....

1. What is your gender?

- Female
- Male

2. What is your age?

- 18 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- 55 to 64
- 65 to 74
- 75 or older

3. Which organization/maritime sector are you working in?

- Maritime Administration
- Seafarer (Deck)
- Seafarer (Engine)
- Port Management
- Maritime Training Center
- Shipping company
- Other (please specify)

4. How well does the current legal framework for the carriage of dangerous goods fit the needs of your organization in Myanmar? Please answer on a scale from 1 (not at all) to 5 (very well).

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. How well does the current administrative framework for the carriage of dangerous goods fit the needs of your organization in Myanmar? Please

answer on a scale from 1 (not at all) to 5 (very well).

1                      2                      3                      4                      5

6. How well does the current operational framework for the carriage of dangerous goods fit the needs of your organization in Myanmar? Please answer on a scale from 1 (not at all) to 5 (very well).

1                      2                      3                      4                      5

7. Do you think the tracking system for the movement of the dangerous goods is necessary to be established in Myanmar?

- Yes
- No

8. A National Container Inspection Program should be formed for the prevention of dangerous goods related accidents.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

9. How will you rate your awareness of the public danger related to the transport of dangerous goods?

- Extremely aware
- Very aware
- Somewhat aware
- Not so aware
- Not at all aware

10. Which mode of transport, in your opinion, is the most dangerous for the carriage of dangerous goods?

- Sea transport

- Air transport
  - Rail transport
  - Road transport
11. Does your organization have a statistical reporting system for the transport of the dangerous goods?
- Yes
  - No
12. As far as you know, do the relevant authorities in Myanmar keep a record of the nature of dangerous goods in packaged form imported/exported into the country? Please indicate your agreement/disagreement with the following statement: It is important that statistical data regarding the volume of import and export of the dangerous cargoes is recorded in Myanmar.
- Strongly agree
  - Agree
  - Neither agree nor disagree
  - Disagree
  - Strongly disagree
13. Please indicate your satisfaction with how well the current training for hazardous cargoes handling delivered in Myanmar meets the international standards?
- Very satisfied
  - Satisfied
  - Neither satisfied nor dissatisfied
  - Dissatisfied
  - Very dissatisfied
14. Are there personnel, specialized for dangerous goods, at the port authority?
- Yes
  - No
  - Maybe



15. Are there personnel, specialized for dangerous goods, at the customs authorities?
- Yes
  - No
  - Maybe
16. Have you attended the Hazardous Cargo Training?
- I have already attended
  - I haven't attended yet
  - I have a plan to attend
  - I have no intention to attend
  - It is not necessary to attend
17. To what extent is Hazardous Cargo Training important for you?
- Extremely important
  - Very important
  - Somewhat important
  - Not so important
  - Not at all important
18. Have you encountered the accidents which were related to the dangerous goods?

19. In your opinion, how likely are occurrences of accidents related to dangerous goods in Myanmar ports?
- Very likely

- Likely
- Neutral
- Unlikely
- Very unlikely

20. How effective, in your opinion, is the collaboration and interrelation of the involved stakeholders in the Myanmar maritime industry, especially for the transport of the dangerous goods?

- Not at all effective
- Not so effective
- Somewhat effective
- Very effective
- Extremely effective

21. Can you kindly, describe the relationships/collaboration between the different stakeholders and your reasons for your answer in the above question [20].

22. How can the existing framework and collaborative effort be improved to meet the international and benchmark norms?

## Appendix B

New IMO FAL Form 7 to be effective from 1 January 2018

### IMO DANGEROUS GOODS MANIFEST

(IMO FAL Form 7)

(As required by SOLAS 74, chapter VII, regulations 4.5 and 7-2.2, MARPOL 73/78, Annex III, regulation 4.3 and chapter 5.4, paragraph 5.4.3.1 of the IMDG Code)

1.1 Name of ship										1.2 IMO number		1.3 Call sign		Page Number
1.4 Voyage number			2. Flag State of ship			3. Port of loading			4. Port of discharge					
5. Booking/ Reference Number	6. Marks & Numbers Container Id. No(s) Vehicle Reg. No(s)	7. Number and kind of packages	8. Proper Shipping Name	9. Class	10. UN No.	11. Packing Group	12. Subsidiary Risk(s)	13. Flashpoint (in °C.c.c.)	14. Marine Pollutant	15. Mass (kg) Gross/Net	16. EmS	17. Stowage position on board		
Additional information														
18.1 Name of master										19.1 Shipping Agent				
18.2 Place and date										19.2 Place and date				
Signature of master										Signature of Agent				

## Appendix C

MSC.1/Circ.1216  
ANNEX  
Page 44

**TABLE 1 – SEGREGATION TABLE FOR DANGEROUS CARGOES IN PORT AREAS**

Classes	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	8	9
Flammable gases	2.1	0	0	0	s	a	s	0	s	0	a	0
Non-toxic, non-flammable gases	2.2	0	0	0	a	0	a	0	0	0	0	0
Toxic gases	2.3	0	0	0	s	0	s	0	0	s	0	0
Flammable liquids	3	s	a	s	0	0	s	a	s	0	0	0
Flammable solids, self-reactive substances and desensitized explosives	4.1	a	0	0	0	0	a	0	a	s	0	0
Spontaneously combustible substances	4.2	s	a	s	s	a	0	a	s	s	a	0
Substances which, in contact with water, emit flammable gases	4.3	0	0	0	a	0	a	0	s	s	0	0
Oxidizing substances	5.1	s	0	0	s	a	s	s	0	s	a	0
Organic peroxides	5.2	s	a	s	s	s	s	s	0	a	s	0
Toxic substances (liquid and solids)	6.1	0	0	0	0	0	a	0	a	0	0	0
Corrosives (liquid and solids)	8	a	0	0	0	a	a	a	s	s	0	0
Miscellaneous dangerous substances and articles	9	0	0	0	0	0	0	0	0	0	0	0

Note for the segregation table

Cargoes of classes 1 (except division 1.4S), 6.2 and 7 should normally be allowed into the port area for direct shipment or delivery only. These classes have not been included in the table. However, if, through unforeseen circumstances, these cargoes have to be temporarily kept, it should be in designated areas. Segregation requirements of the individual class as stipulated in the IMDG Code should be considered by the port authority when establishing specific requirements.

**NOTE TO TABLE 1**

**SEGREGATION ADVICE FOR THE TEMPORARY KEEPING OF DANGEROUS CARGOES IN PORT AREAS**

1 The reception and keeping of dangerous cargoes of classes 1 (other than division 1.4S), 6.2 and 7 should be subject to special rules for each port as the handling facilities at each terminal or berth vary considerably. The rules should be agreed with the authorities responsible for the safety of the port.

2 All dangerous cargoes delivered to the port area should be marked, documented, packaged, labelled or placarded in accordance with the IMDG Code.

3 The segregation of dangerous cargoes should be in accordance with chapter 7.2 of the IMDG Code as follows:

3.1 Packages/IBCs/trailers/flat racks or platform containers

- 0 = no segregation necessary unless required by the individual schedules
- a = away from – minimum 3 m separation required
- s = separated from – in open areas, minimum 6 m separation required in sheds or warehouses, minimum 12 m separation required unless separated by an approved fire wall

3.2 Closed containers/portable tanks/closed road vehicles

- 0 = no segregation necessary
- a = away from – no segregation necessary
- s = separated from – in open areas, longitudinally and laterally, minimum 3 m separation required, in sheds or warehouses longitudinally and laterally, minimum 6 m separation required unless separated by an approved fire wall

3.3 Open road vehicles/railway freight wagons/open-top containers

- 0 = no segregation necessary
- a = away from – minimum 3 m separation required
- s = separated from – in open areas, longitudinally and laterally, minimum 6 m separation required, in sheds or warehouses longitudinally and laterally, minimum 12 m separation required unless separated by an approved fire wall

Notes:

1 For freight containers, portable tanks, lorries, flat racks or platform containers or rail wagons a distance of 3 m is equal to the width of a standard 20-foot container, or one rail track, one trailer lane or, in the case of successive rail wagons, the longitudinal buffer space.

2 The segregation table shown uses "0" to indicate that no general segregation is required but those individual requirements of the Dangerous Goods List of the IMDG Code shall be consulted. The IMDG Code's general segregation table (7.2.1.16), however, uses an "X" instead of the "0" used in these Recommendations. The difference is intentional, to emphasize the difference in the use of the segregation tables.

3 "Closed type unit" means a unit in which dangerous goods are totally enclosed by sufficiently strong boundaries, such as a freight container, a tank or a vehicle. Units with fabric sides or tops are not closed type units.

4 General

4.1 For dangerous cargoes with a secondary hazard, the segregation requirement for the secondary hazard should be applied when it is the more stringent. For cargo transport units containing dangerous cargoes of more than one class, the most stringent segregation requirement should be applied.

4.2 Dangerous cargoes in packaged non-containerized form, belonging to different classes, should not be stowed directly above each other. This applies to packaged dangerous cargoes belonging to one class but having different secondary hazards and also to certain cargoes of class 8.

## Appendix D

### Intermodal Container Inspection Report (USCG)

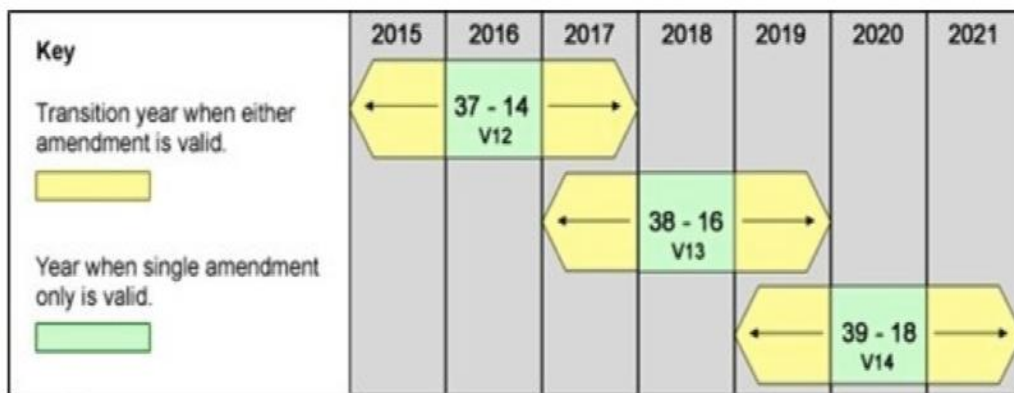
DEPARTMENT OF HOMELAND SECURITY <b>U.S. Coast Guard</b> <b>INTERMODAL CONTAINER INSPECTION REPORT</b>		MISLE Activity Number 690344
1. Container Number: SUDU1234567		2. Country of Origin: Peru
3. Container Type: FREIGHT		4. Date of Inspection: 08 Apr 14
5. Inspection Location: MPA Seagirt Marine Terminal		6. Time of Inspection: 1430
7.	Involved Party: Stepan Company	8. COTP Zone: BALTIMORE
	U.S. DOT Hazmat Registration Number: 053012001010UW	9. Original Seal Number: 01230321
	Address: 22500 W. Millsdale Rd Elwood, IL 60421	10. Replacement Seal Number: CG08041790
		11. ACEP Number: N/A
		12. CSC ID Number: D-HH 1155/GL 2246
		13. Shipment Prepared By: <input type="checkbox"/> 49 CFR <input checked="" type="checkbox"/> IMDG Code
14. Inspection conducted as part of Multi-Agency Strike Force Operation? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
15. Nature of Deficiency:		
No.	Description	Cite (Convention) Action Taken
1	Shipping description not in required sequence.	49 CFR 172.202,IMDG Code 5.4.1.4.2 Corrected on the spot.
2	Container condition an obvious risk to safety.	49 CFR 453.1(b) See additional instructions.
	No further discrepancies noted. DHS.	
Additional Instructions: Compliance order. Repair required prior to further movement of container - damage to front left corner post exceeds permissible standards. Contact the COTP at (XXX) XXX-XXX upon remedy.		
16. Control Action Taken:		
<input checked="" type="checkbox"/>	Container Detained	HAZMAT UN ID#S 2258
<input type="checkbox"/>	Shipment Detained	HAZMAT Class(es) 8(3)
<input checked="" type="checkbox"/>	Repair Required	
<input type="checkbox"/>	Re-Inspection Required	
17. Authorities cited to support actions (check applicable): <input checked="" type="checkbox"/> 49CFR 453.1 <input checked="" type="checkbox"/> 33 CFR 160.109 <input type="checkbox"/> 33 CFR 6.04-7		
Copy delivered to: Robert Smith, Terminal Manager (Shipper/Agent/Custodian - Printed Name) _____ (Shipper/Agent/Custodian - Signature)		
CG COTP Representative: MST1 Douglas H. Shueb (Printed Name) _____ (CG COTP Representative - Signature)		
This deficiency report constitutes written notice of discrepancies discovered, order for detention, and/or corrective action required. <u>Separate notice will be given if penalty action is initiated.</u>		

CG-5577 (04/14)

Page 1 of 1

## Appendix E

### IMDG Code Amendment cycle 2015 - 2021



## Appendix F

### Criteria for the identification of harmful substances in packaged form

Title	MARPOL 2014 Amend (66th) / Annex III / Appendix
Effective Date	3/1/2016

#### APPENDIX

<i>Criteria for the identification of harmful substances in packaged form</i>	
For the purpose of this Annex, substances, other than radioactive materials*, identified by any one of the following criteria are harmful substances* .	
<b>KR</b> : Amended by Res.MEPC.257(67))	
* Refer to class 7, as defined in chapter 2.7 of the IMDG Code	
** The criteria are based on those developed by the United Nations Globally Harmonized System of Classification and Labelling of Chemicals (GHS), as amended. For definitions of acronyms or terms used in this appendix, refer to the relevant paragraphs of the IMDG Code.	
(a) Acute (short-term) aquatic hazard	
Category: Acute 1	
96 hr LC <sub>50</sub> (for fish)	≤1mg/l and/or
48 hr EC <sub>50</sub> (for crustacea)	≤1mg/l and/or
72 or 96 hr ErC <sub>50</sub> (for algae or other aquatic plants)	≤1mg/l
(b) Long-term aquatic hazard	
(i) Non-rapidly degradable substances for which there are adequate chronic toxicity data available	
Category Chronic 1:	
Chronic NOEC or ECx (for fish)	≤0.1mg/l and/or
Chronic NOEC or ECx (for crustacea)	≤0.1mg/l and/or
Chronic NOEC or ECx (for algae or other aquatic plants)	≤0.1mg/l
Category Chronic 2:	
Chronic NOEC or ECx (for fish)	≤1mg/l and/or
Chronic NOEC or ECx (for crustacea)	≤1mg/l and/or
Chronic NOEC or ECx (for algae or other aquatic plants)	≤1mg/l
(ii) Rapidly degradable substances for which there are adequate chronic toxicity data available	
Category Chronic 1:	
Chronic NOEC or ECx (for fish)	≤0.01mg/l and/or
Chronic NOEC or ECx (for crustacea)	≤0.01mg/l and/or
Chronic NOEC or ECx (for algae or other aquatic plants)	≤0.01mg/l
Category Chronic 2:	
Chronic NOEC or ECx (for fish)	≤0.1mg/l and/or
Chronic NOEC or ECx (for crustacea)	≤0.1mg/l and/or
Chronic NOEC or ECx (for algae or other aquatic plants)	≤0.1mg/l
(iii) Substances for which adequate chronic toxicity data are not available	



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**Category : Chronic 1**

96 hr LC50 (for fish)  $\leq 1 \text{ mg/l}$  and/or

48 hr EC50 (for crustacea)  $\leq 1 \text{ mg/l}$  and/or

72 or 96 hr ErC50 (for algae or other aquatic plants)  $\leq 1 \text{ mg/l}$

and the substance is not rapidly degradable and/or the experimentally determined BCF  $\geq 500$  (or, if absent, the log KOW  $\geq 4$ ).

**Category : Chronic 2**

96 hr LC50 (for fish)  $> 1 \text{ mg/l}$  but  $\leq 10 \text{ mg/l}$  and/or

48 hr EC50 (for crustacea)  $> 1 \text{ mg/l}$  but  $\leq 10 \text{ mg/l}$  and/or

72 or 96 hr ErC50 (for algae or other aquatic plants)  $> 1 \text{ mg/l}$  but  $\leq 10 \text{ mg/l}$

and the substance is not rapidly degradable and/or the experimentally determined BCF  $\geq 500$  (or, if absent, the log KOW  $\geq 4$ ).

Additional guidance on the classification process for substances and mixtures is included in the IMDG Code.

## Appendix G

Example of dangerous goods marking and labeling



- |                                |                       |   |
|--------------------------------|-----------------------|---|
| ① Orientation label (optional) | ② Primary class label | ③ Standardized UN certification (according to standard) |
| ④ Shipping name                | ⑤ UN number           | ⑥ Subsidiary class label                                |

Source:LP (2016)