Response to technology advancement in maritime education and training: a case study of the South African national maritime institutes

Lihle Amanda Ngcobo

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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: ………. …………………

Date: …18 September 2018……………….

Supervised by: Dr. Johan Bolmsten

World Maritime University

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Institution/organization:

Co-assessor:

Institution/organization:
ACKNOWLEDGEMENTS

Let’s go to the King, we don’t have much to bring
Our hearts are torn in pieces, It’s our offering
Let’s go to the King

Truth is we tired, Options are few
We trying to pray, but where are YOU?
We all churched out, Hurt and abused
We can’t fake, What’s left to do?

Truth is we weak, No strength to fight
No tears to cry, even if we tried
But still our souls, Refuses to die
One touch-will change-our lives

Let’s go to the King, we don’t have much to bring
Our heart’s torn into pieces, It’s our offering
Lay us at the Throne, Leave us there alone
To gaze upon YOUR Glory, and sing to YOU this song
Please let’s go to the King

Truth is it’s time, To stop playing these games
South Africa needs a WORD, For the people’s pain
So GOD speak right now, let it fall like rain
We’re desperate, We’re chasing after YOU

No rules, no religion
We’ve made this decision
To run to YOU, The Healer that we need

Let’s go to the King, we don’t have much to bring
Our heart's torn to pieces, It's our offering
Lay us at the Throne, Leave us there alone
To gaze upon YOUR glory, and to sing to YOU this song

GOD we're in the way, we keep making mistakes
Glory is not for us, It’s all for YOU

Let's go to the King, we don't have much to bring
Our heart's torn to pieces, It's our offering
Lay us at the Throne, Leave us there alone
To gaze upon your glory, and sing to YOU this song

Take US to the KING…. Take US to the KING…. Take US to the KING…. 

Take Me to The King - by Tamela Mann (Amended by Author)

Songwriter: Kirk Franklin

Above everything, my sincere and heartfelt gratitude goes to the Almighty God. It was He who touched the hearts of the people that approved my application to study at WMU. Truly and honestly all Glory goes to Him and Him alone, and it is He who has sustained me and given me the strength to complete this work.

I would like to thank my dearest mother (T.P. Kwela), who means more to me than life itself. Thank you for all your prayers of encouragement, your support and for loving me unconditionally. I would like to thank my father (B.P. Kwela) for having been there and loving us the best way he knew how. Thank you.

I express deep appreciation to my family (Ngcobo, Mcunu, Kwela and Maphumulo). Thank you for the prayers and support during this time; without you, life would have no meaning. Immense appreciation goes to my extended family (Mlisana, Sibisi, Ngcobo and Mpunzana), you have been the pillars of my childhood. Thank you.
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Thank you and God bless
ABSTRACT

Title of Dissertation: **Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutes.**

Degree: **Master of Science**

The most important function of maritime education and training cannot exist in its true sense, without the mention of seafarers. Maritime education institutions are tasked with the responsibility of equipping seafarers with relevant knowledge, skills and competences in accordance with the STCW Convention. In addition, the training should incorporate all techniques and technologies available on-board modern ships, and the management thereof. Lastly, the seafarer should be prepared for the development of global shipping as a whole.

Technological advancements in the shipping industry has influenced competitiveness that requires seafarers to not only be knowledgeable on the theoretical aspect of technology, but the technological aspect as well. In order for seafarers to successfully compete in the job market, they need to be well trained and that is where MET institution comes in.

This study examines whether the South African MET institutions have been able to adapt to changes of technology within the public universities, using the triangulation research methods. The study found that South African MET institutions are not competitively technologically equipped or even ready to adopt the various technology equipment available in the market compared to the other nations studied. SA should focus on building capacity and infrastructure, and then look into investing more in MET, after the country has built its human resource capacity. South Africa has a potential to play a meaningful role in producing seafarers for Africa and the world.

**KEYWORDS:** Technology, technological advancement, maritime education and training, maritime industry, universities, seafarers.
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<tbody>
<tr>
<td>ARPA</td>
<td>Automatic Radar Plotting Aid</td>
</tr>
<tr>
<td>BSc</td>
<td>Bachelor of Science</td>
</tr>
<tr>
<td>CBT</td>
<td>Computer-Based Training</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>Compact Disc Read-Only Memory</td>
</tr>
<tr>
<td>CMTP</td>
<td>Comprehensive Maritime Transport Policy</td>
</tr>
<tr>
<td>CoC</td>
<td>Certificate of Competency</td>
</tr>
<tr>
<td>CPUT</td>
<td>Cape Peninsula University of Technology</td>
</tr>
<tr>
<td>DUT</td>
<td>Durban University of Technology</td>
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<tr>
<td>E-Learning</td>
<td>Electronic Learning</td>
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<tr>
<td>ECDIS</td>
<td>Electronic Charts Displaying and Information System</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GMDSS</td>
<td>Global Maritime Distress and Safety System</td>
</tr>
<tr>
<td>HOD</td>
<td>Head of Department</td>
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<tr>
<td>HRDC</td>
<td>Human Resource Development Council</td>
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<td>IMO</td>
<td>International Maritime Organisation</td>
</tr>
<tr>
<td>MET</td>
<td>Maritime Education and Training</td>
</tr>
<tr>
<td>NQF</td>
<td>National Qualification Framework</td>
</tr>
<tr>
<td>Rand</td>
<td>Rand (South African Currency)</td>
</tr>
<tr>
<td>RADAR</td>
<td>Radio Detection and Ranging</td>
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<tr>
<td>SA</td>
<td>South Africa</td>
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<tr>
<td>SAIMI</td>
<td>South African International Maritime Institute</td>
</tr>
<tr>
<td>SAMSA</td>
<td>South African Maritime Safety Authority</td>
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<tr>
<td>SAQA</td>
<td>South African Qualification Authority</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>STCW</td>
<td>International Convention on Standards of Training, Certification and Watch-keeping for Seafarers</td>
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<td>TETA</td>
<td>Transport Education Training Authority</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<td>USD</td>
<td>United States Dollar</td>
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<td>USN</td>
<td>University of Southeast Norway</td>
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<td>World Maritime University</td>
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1 CHAPTER ONE: INTRODUCTION

1.1 Introduction

Globalization and technology have made a remarkable and crucial shift in the shipping industry. In both labour and equity, the world’s maritime industry has borne witness to this shift since the 1960s (Alderton, 2004). The rapid developments of global shipping came with internationalized vessel ownership and seafarer recruitment (Alderton et al., 2004), all for the purpose of importation and exportation of goods by sea. Slack (2001) described shipping as the sector at the core of logistics; which without; global transportation across oceans would cease to exist. Over the past few decades, the scale of international trade through shipping has undoubtedly increased due to technological developments and industry demands (DeSombre, 2006), and with this change presents a need for adequate and competent seafarers.

It is indisputable that technological innovation has globally contributed in sustaining the shipping industry (Tang & Sampson, 2011). It is also true, however, that with the improvements of technology, challenges to upgrade the skills component of seafarers emerge (Rogers 2003). The maritime technology advancements are changing and evolving at an expeditious pace, and since seafaring is a global industry, this study particularly focuses on how South African maritime institutions respond to technological advancements, specifically in the area of maritime education and training (MET) pertaining to seafarers, in relation to other identified countries.

South Africa (SA) is an example of a rapidly developing country attempting to improve in the maritime space, and is currently undertaking developments to shape its educational systems. The aim of this dissertation is to investigate how South Africa
responds to the technological advancements related to maritime studies, and how the public maritime institutions adapt to the technological training methods and tools available in the international market for student competitiveness. The dissertation will, in addition, take a look at how the United Kingdom (UK), Norway and the Philippines respond to technological advancements as a benchmark to how South Africa is responding.

1.2 Background

In pursuit of being a global seafarer supplier (DoT, 2017), the South African government attempted to fast-track the development of the maritime sector by initiating the Operation Phakisa project, which was in line with the South African 2030 National Development Plan. The South African former president, President Jacob Zuma, estimated that the country’s blue economy has the potential of contributing up to R177 billion (USD 15.13 billion) to the South African GDP by 2033 compared to the R54 billion (USD 4.62 billion) it contributed in 2010 (Operation Phakisa, 2014).

The South African blue economy is underutilized, as a result, contributing less than it ought to due to underdeveloped systems. Technology plays a huge role in maritime development and the more technology advances, the more pressure is put on industry to embrace those advances on a global scale for the effective operations of the industry. The global digital revolution will impact South Africa severely (Moyo, 2017), and for the country to survive any turn technology takes, the country should be ready and well trained so that it can absorb the change easily.

Hildebrand and Schröder-Hinrichs (2014) suggested that when looking into maritime research, one has to look into finding technology and innovative solutions that will improve the use of ocean resources related to human activity. This is particularly important for the seafarers because of the nature of their industry. Seafaring is largely an international career for many and it is important for the South African cadets to be globally competitive, and equipped with current and relevant technological skills to better understand the different vessels operating in the maritime industry.
As a developing country attempting to make its mark in the maritime sphere, South Africa can learn from countries that are more advanced in maritime technology training, and take advantage of their educational systems for the country to improve. A prime example of this is the Philippines as it is also a developing country with similar economic, political and social dynamics, and is one of the world’s leading supplier of seafarers. The United Kingdom and Norway are as well one of the leading countries in maritime technological training and advancements, and are known for their cutting-edge and unique training techniques, and this study will visit these MET systems to create a benchmark of a model South Africa can implement to improve MET in relation to technology.

The South African Operation Phakisa initiative identifies four priority sectors as new growth areas in the ocean economy, and amongst these four is the transport and manufacturing sector, of which South Africa hopes to grow to derive value from, for the purpose of the economy (UNECA, 2016). One of the outcomes intended for the Operation Phakisa initiative is job creation, and the shipping industry is an ideal industry for many developing countries struggling with a high unemployment rate. Figure 1 reflects on the country’s unemployment rate for the past ten years, and as the graph indicates, the country has been struggling to improve the numbers of unemployed citizens, with the rate steadily increasing over the years.
Problem Statement and Motivation

Bonnin and Wood (2002) found that there is insufficient training berths for students that graduate from MET institutions in South Africa, making potential seafarers unable to make use of their qualifications in the seafarer market. The study further discovered that the decline of seafarer training berths is attributed to the global economic crisis and technological advancement in shipping, amongst other reasons.

In the midst of the global economic crisis and the country’s maritime struggles, the Operation Phakisa further promised considerable benefits and job creation to South Africans and in the process created expectations that have not been met (Claassen, Funke & Nortje, 2017). This problem continues to rise and affect the South African seafarers; hence South Africa needs to find ways to help the cadets if the country is to be successful as a shipping and seafarer supplying nation.

The seafarer industry is an ideal industry that can provide work for a number of the country’s citizens and alleviate some pressure from the government by absorbing these citizens for international employment. Because the shipping industry is international, so is the competition for the employment. For South Africa to be the preferred supplier
of seafarers, the country’s MET system must be trusted globally by ship-owners and ship agencies that employ seafarers. It is important, therefore, for the cadets to have a technological familiarity and awareness of the technologies adapted in the shipping industry for them to remain competitive and relevant in the market.

Furthermore, Pourzanjani (2017) states that the next generation of seafarers have to be fluent in using technology and that South Africa and the African MET institutions need to meet the global maritime industry that has already embraced digitalisation. He further adds that South Africa needs to go beyond the current standards of its qualified cadets, by providing simulator-based competency training and assessments to improve the confidence of the cadets so that they can compete in the international maritime job market. If South Africa fails to improve the technology aspect of training in the country’s MET institutions, it might run the risk of producing seafarers that are redundant in the global market and remain with an increasing problem of unemployment and wasted resources for inadequate training.

1.4 Significance of the study

The South African government is currently investing in a number of maritime transport projects and MET is one of the important sectors identified as it links to job creation. Maritime infrastructure is capital intensive in nature, and many universities if not assisted with additional external funding, cannot afford MET technology. This study will therefore aim to shed light on the importance of South Africa securing additional funding for its MET institutions as a collective (public and private sector as maritime cuts across many sectors), for South African seafarers to be internationally competitive.

1.5 Aims and objectives of the study

The aim of this study is to assess South Africa’s response to technological advancements in the maritime education and training sector by the two main public maritime universities when compared to other country’s universities. The study looks
at how Durban University of Technology (DUT) and Cape Peninsula University of Technology (CPUT) adapt technologically when compared to universities in the Philippines, the United Kingdom, Norway and the Netherlands. The study then evaluates the level technology incorporation to MET and finds areas of improvement that the South African universities can focus on.

The specific objectives of this research will be to:

a. Assess the key technology tools used to educate and train SA cadets in relation to the STCW Convention requirements.

b. Identify key methods used in educating and training MET students.

c. Evaluate how technology assists in MET in SA, with reference to the practices of other countries.

1.6 Research Questions

In order to answer this core research question, the following five sub-questions were posed to navigate this study and identify the specific areas for investigation. The study generated the three questions below:

1. What are the technology tools used to educate and train SA cadets in relation to the STCW Convention requirements?

2. What are the key methods used to educate and train MET students?

3. How can technology assist in South African MET institutions, with reference to the practices of other countries?

1.7 Research methodology

The study reviews literature related to MET technology and technological advancements, which will serve as secondary source data. This provides the
background information of the study which will include information from academic journals, reviews, articles, policies, reports, documents, books and desktop research.

A survey of questionnaire samples and interviews was conducted. The questionnaire was sent to the MET institutions’ students and academic staff to get their perspective, and the industry experts were also interviewed to get their point of view in the matter. This forms part of the study as primary data.

The study uses qualitative and quantitative analysis, of which together with other data collect techniques will make up a triangulation method of data findings.

1.8 Research Assumption

The study assumes that the demand for seafarers will increase and that the global shortage supply or demand for seafarers will be filled by South Africans. There will be a need for digitally-ready and competent seafarers who will fill the gap; therefore, South Africa will benefit tremendously. The study assumes that South Africa is not responsive to the technology developments in the maritime industry and this is affecting the cadets in the labour market as the shipping industry becomes more digital in nature.

The study also assumes that technology tools plays a huge role in maritime education and training. Therefore, South Africa can learn from international maritime institutions in order for it to become an important player in supplying quality and competent seafarers in this global competitive industry. Operation Phakisa Ocean Economy presents an opportunity to encourage the government to invest by resourcing maritime universities with advanced relevant technology that will meet the international standard as the study will confirm.

1.9 Research Outline

This study consists of 6 chapters and each chapter focuses on its own important component of the research. Below is a brief summary of what each chapter presents:
Chapter one introduces the study by providing an overview and background. It covers the problem statement and motivation; looks at the significance, and the aim and objective of the study. It also highlights the research questions, research methodology, research assumptions, as well as the research structure of this chapter.

Chapter two is the literature review of the study. The chapter begins with a review of technology in MET. It further looks at the impacts of technology in MET, and the simulator training minimum requirements under the STCW Convention. Then lastly highlights the South African maritime governance and MET systems.

Chapter three provides details on the methods used on the research framework. The triangulation methodology was used in this study, covering the literature review, electronic questionnaires, electronic interviews and observations from country visits.

Chapter four reviews the findings of the methodology techniques used in chapter three. The chapter reveals what was found through the literature review, electronic questionnaires, electronic interviews and the observation from the visited countries.

Chapter five analyses and discusses the findings from chapter four. It looks into each method technique used, analyses and discusses the methods by answering the research questions and the aims and objectives of the study.

Chapter six, in conclusion, gives recommendations for the gaps that were found in the study and summarizes what was found. The chapter concludes by highlighting what was most significant that was found and gives recommendations for further possible studies that can be undertaken in the future.
2 CHAPTER TWO: LITERATURE REVIEW

2.1 Purpose and outline

This chapter of the research reviews the available literature in order to assess what has been studied in relation to MET technology. It looks at both the global and the South African context of MET developments in technology, covers technologies used in the MET industry and institutions, as well as attempting to investigate the South African maritime system with the aim of identifying challenges. The literature analyses the different technologies commonly used by various MET institutions from different parts of the world, and looks into how South Africa incorporates these technology developments for the purpose of training maritime professionals.

2.2 Technology in MET

Maritime education and training is defined as the acquisition of the knowledge and skills related to subjects in the maritime field that enhance competence in the maritime context (Cunningham, 2015). Technological advancement, on the other hand, is described as an attempt to extend or further understand the underlying science used to develop current materials, devices, products or processes (Enduro, 2014).

MET cannot exist in its true sense without the mentioning of seafarers. MET institutions are tasked with the responsibility of equipping seafarers to acquire relevant knowledge, skills and competences in accordance with the STCW Convention. In addition, the training should be in relation to the techniques and technologies required on-board the modern ships and the management thereof, to prepare the seafarer for the development of global shipping as a whole. Technological advancements have
influenced the evolution of MET competency training, assisting seafarers to handle increasingly demanding and complex ship management tasks. It is just as important to continuously update and upgrade the seafarers even after they have left the higher education institutions, as technology keeps changing and evolving, and the regulations get amended as well.

Ibrahim and Tawfik (2015) urge that maritime education is a vocational study and that during the training of students, the conditions set should match the environment the students will work in. They maintain that students should be prepared to work in unfavourable, unfriendly, strict and sometimes hostile environments, and that the instructors should do this in a proficient and competent method. This method is an ideal that is not always possible for various reasons (mostly financial and lack of infrastructure and capacity), but can be substituted with a mix of practical training and theoretical education methods.

There are a number of technologies that can assist in MET training, technologies that are used in many universities around the world, including the universities that are studied in conjunction with the SA universities. Table 1 shows the commonly used technological tools and equipment in the market.

Table 1: Common Technological Tools used in the MET and on-board Ship

| Electronic learning | Electronic learning, better known as e-learning is defined by Ward (2002) as "learning that is supported by information and communication technologies", and "may encompass multiple formats and hybrid methodologies, in particular, the use of software, Internet, CD-ROM, online learning or any other electronic and interactive media." Guri-Rosenblit (2005) further defined e-learning as the use of electronic media for a variety of learning purposes that range from add-on functions in conventional classrooms to full substitution for the face-to-face meetings by online encounters. It has been alluded that learning methods are successful when they give added-value to learners and proves through assessing that learning outcome have indeed been achieved (Ibrahim & Tawfik, 2015). E-learning can be used as an additional method to |
Complement the conventional teaching methods to help students better understand the theory; as well as be used as a continuous learning method for when the university alumni students need to improve and develop their knowledge further.

**Computer-Based Training**

Many have referred to computer based training (CBT) as the simplest and primary form of e-learning and the most commonly used in the maritime field (Ibrahim & Tawfik, 2015). Dumbleton (2001) describes computer-based training (CBT) as “a broad generic term to describe how computer-run software can be used in support of training applications” while Williams & Zahed (1996) defines CBT as “a technique of instruction which involves defining what is to be learned, breaking the learning into component elements, and sequencing these elements via computer.” The reason for CBT’s popularity is because of its mobility and independency, and the fact that universities can take advantage of this and include laptops as a tool of instruction, install the module courses software on the laptops and students can learn and practice at any time and any place. The software can be updated easily while giving the student an added advantage of familiarizing themselves with technological tools that will assist them in more ways than one. Students, particularly from disadvantaged backgrounds, that may have trouble with technology can easily familiarize themselves slowly and have more time to practice than they would if the computers were at the university. It is important to note, however, that CBT is better for knowledge-based learning, rather than competence-based.

**Simulator-based training**

A simulator is a maritime training tool able to generate realistic situations for vessel training, providing the user an opportunity to acquire the required skills, as specified in the STCW Convention. Hensen (1999) defined the simulator as a device built to mimic real situations for the purpose of the operator to practice and eventually demonstrate the competence in a controlled environment. Furthermore, Hensen (1999) added that the maritime universities and training institutions use simulation technology for the training of nautical studies in order to imitate a certain situation. According to Mourik & Braadbaart (2003), there are several types of advanced
marine simulators manufactured or offered by many well-known companies worldwide with service centres to maintain those devices. Among these types are the bridge simulators, the LNG simulators, crane simulators, heavy lift simulators, and engine room simulators, all specializing in specific fields in the shipping industry.

Simulator-based training is found to be one of the key tools in many MET institutions because of the growing environmental pressures that have led to insufficient availability of berths. Cross (2011) further stipulates that the simulation environment prepares and trains the student skills and competencies that would normally take a longer time to acquire. The simulator can create a condition and situation that the cadet may take time to encounter; if they ever do; but the exercise prepares the cadet for all situations that are important to learn and creates an experience as close to real life as possible. This experience is becoming more advantages to the market because of its benefits. As the cadet trains and make mistakes, it is not costly because the instructor simply starts the simulation exercise again until the cadet is competent; while if the accident happens in real life; the consequences would be dare.

| Electronic chart display and information systems | Electronic Chart Display and Information System (ECDIS) is a complex navigation tool developed “to assist the mariner in route planning and route monitoring, and if required display additional navigation-related information if required”, as specified in the Performance Standards for ECDIS (Acomi, 2016). ECDIS is a real-time navigation system provided to assist the seafarer with information that will increase navigation safety and enhance operational efficiency. The maritime and shipping industry have been rather slow and sceptical of adopting ECDIS over the traditional paper charts because of the electronic charts complexities (as well as considering the risk of transferring from a well understood paper charts which was until recently still an approved method of navigation), to the misunderstood electronic charts (Acomi, 2016). Many studies have claimed that with the proper understanding of ECDIS its use increases navigational safety, but of equal importance is that if ECDIS is incorrectly used, this complex tool can increase risk at sea. It has also been discovered by some studies that ECDIS is one of the most |
complex tools for students to understand, it is therefore advisable for the cadets start with ECDIS training as soon as possible, in preparation for the workplace.

### Global Maritime Distress and Safety System

The Global Maritime Distress and Safety System (GMDSS) basically is described to be a worldwide network of automated emergency communications for vessels at sea. Every sea-going vessel that is 300 gross tonnage and above is obliged to have a radio equipment system for distress alerts, conforming to the required international standard so that the vessel can alarm search and rescue authorities and surrounding vessels should an emergency situation occur (IMO, 1999). The GMDSS is an IMO initiative representing the safety and importance of communication at sea, and came into effect on February 1, 1999. The Canadian Coast Guard (2014) state that the primary purpose of GMDSS is to save lives by increasing the chances of a distress call reaching its destination, increasing the possibility of the vessel and survivors being found and helped with any kind of information that will save their lives.

### Shipboard Radar

The radio detection and ranging (Radar) is a shipboard measuring device which not only measures the time it takes for a pulsed signal to be reflected back from an object but also its bearing relative to your position. The radar is the only electronic device that is able to provide information and detect surrounding objects around the vessel. World War II brought about the development of the radar, but today, the device is available for all types of vessels in the market. The radar is an excellent tool for navigational safety which informs the seafarer everything around the vessel at all times, avoiding the chances of a collision occurring at all times and conditions of the day.

### Impact of Technology in MET

Technology in MET is becoming increasingly important as the shipping industry becomes more digitized. Seafarer competitiveness is increasingly relying on digital
understanding and performance more than the conventional theoretical understanding, so it is important to understand what technology is and what benefits it can bring.

Technology consists of two primary components. The first is a physical component which comprises items such as products, tooling, equipment, blueprints, techniques, and processes; and the second is the informational component which consists of the know-how in management, marketing, production, quality control, reliability, skilled labour and functional areas (Kumar et. al, 1999).

Maritime education can be explained as a set of interdependent processes such as teaching, learning, researching and resources including human, material and information that function harmoniously to achieve specified educational objectives (Asyali, 2003). The existence of technological infrastructures in maritime educational facilities and universities have not developed at the same rapid rate as the broad maritime technology era has in the past few decades. In order for the university to satisfy the demands and new expectations that the industry requires from the modern seafarer, the university must consider advanced technological and educational programmes to better position their cadets on a global scale and competitive industry.

Cicek et. al (2002) states that the most effective and practical way of training cadets is by using ships to provide the experience students need, over and above the education. This is currently supported with the use of simulators, which aid with the familiarity of ship equipment before the cadets join on board the vessel. As a matter of fact, due to technological advancements and automation, the equipment’s function on the vessel is no longer visible, nor are the officers’ mental activities (Asyali, 2003), so to bridge this gap for cadets, the use of simulators at training institutions need to be considered because the emergence of innovative technologies is unlikely to disappear (Chan et al. 2006).
2.4 Simulator training under STCW

Technology is covered under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), as amended in 2010. The STCW provides the minimum standards of competence, for the training of seafarers, including training using technological tools and equipment. Traditionally the convention catered to educate individuals to become certified seafarers capable of demonstrating their competencies in order to receive their “Certificate of Competency” (CoC) issued by authorized organizations. This task may only be achieved through adequate education, coupled with practical training and work experience (IMO, 2010).

The STCW Convention, as amended 2010, represents a legal framework with technical standards through its articles and annex. Part A of the STCW Code is mandatory, and stipulates minimum standards of competence for the seafarers, whereas Part B only provides for recommendations.

2.4.1 Mandatory STCW simulation training

When it comes to STCW mandatory simulation training, the only compulsory training has been that relating to the use of RADAR and ARPA. The 2010-amended STCW also makes use of simulators for training in electronic chart display and information systems (ECDIS) a mandatory requirement during training. These simulators are used only as methods acceptable for the demonstration of the relevant competencies, otherwise in all other cases, approved simulator training and assessment are not mandatory but just one of the methods accepted by the convention for training and demonstrating competence. Although not all simulators are mandatory, they all still need to comply with the STCW prescribed standards (IMO, 2010).

2.4.2 STCW Regulation A-I/6

In regulation A-I/6, the section addresses the training and assessment of the seafarers and states that each party shall ensure that all training and assessment of seafarers for certification under the Convention are firstly “structured in accordance with written
programmes, including such methods and media of delivery, procedures, and course material as are necessary to achieve the prescribed standard of competence” and secondly that they are “conducted, monitored, evaluated and supported by persons qualified in accordance with paragraphs 4, 5 and 6.” The second part of the section requests that “persons conducting in-service training or assessment on board ship shall only do so when such training or assessment will not adversely affect the normal operation of the ship and they can dedicate their time and attention to training or assessment,” (IMO, 2010)

2.4.3 STCW Regulation A-I/12

Regulation A-I/12, the standards governing the use of simulators section address two parts. The first part is the performance standards, which provide the general performance standards for simulators used in training, as well as the general performance standards for simulators used in assessment of competence. The second part speaks of other provisions that address simulator training objectives, training procedures, assessment procedures and finally qualifications of the instructors and assessors (IMO, 2010).

Below are examples of different kinds of simulators; from the small desktop simulator, to the full mission simulator on motion platform.
Figure 2: Different types of simulators equipment.

Source: The image of Kongsberg Maritime Simulators (Setcorp, n.d.)

2.5 South African Maritime Education and Training System

The Durban University of Technology (DUT) in Durban, KwaZulu-Natal and the Cape Peninsula University of Technology (CPUT) in Cape Town, Western Cape are the only two universities of technology in South African offering undergraduate studies for cadetship training (DoT, 2014). This study will analyse how DUT and CPUT respond to the technological advancements of the shipping industry with respect to maritime education and training, when compared to some of the leading maritime nations around the globe.

It is important to note that South Africa is part of the IMO “so called” White List which distinguishes the countries that are in full compliance with the STCW-95 Convention and Code. In South Africa, SAMSA is responsible for the maintenance of the MET compliance system and that the country does not go below the minimum STCW required standards to remain being on the White List. Although the STCW
requirements are only the minimum requirements to be maintained, many countries cannot afford to go over the bare minimum that is required.

Seafarer development is a long term investment that will bear fruit that will cascade back into the sector (Claassen, Funke & Nortje, 2017). Even though the investment might be high, the benefits are plenty and South Africa needs to find ways of securing funding for the education of maritime professionals and seafarers to build the country’s capacity in the maritime sector. Emad and Oxford (2008) stated that maritime training in institutions is primarily based on conventional and formal schooling, which is originally designed to provide the knowledge and understanding required by students to perform their future tasks on the job. Similarly, even though the main purpose of the formal education is to give the students the theoretical background and the knowledge that they require on-board ships, practically the system is not successful in achieving this goal.

DUT and CPUT offer nautical studies for seagoing cadetship training and shipping and logistics studies for land based shipping professionals. The seafarer training and certification accreditation general standards are done by the Department of Higher Education and Training, of which the International Maritime Organization (IMO) sets the minimum standards through the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, as amended (STCW), and then the South African Maritime Safety Authority (SAMSA) regulates the training and certification for the country. Likewise, for all South African training institutions to be recognised for their training, be it public or private institutions, need to be accredited by SAMSA, who is also in turn accredited by the IMO.

In the same light, there is the South African International Maritime Institute (SAIMI), which was established in response to the maritime sector demands for the coordination of the maritime skills development, training, education and research. SAIMI manages the National Cadetship Programme, which is an in-service training programme funded by the South African Government to assist the South African cadets obtain on-board
work experience. The cadet programme is supported by a dedicated training vessel SA Agulhas I and other South African government-owned vessels (InvestSA, n.d.).

Figure 3 illustrates a deck or engine cadetship training programme respectively.

*Figure 3: Cadetship Training Programme for Deck and Engine.*

![Diagram of Cadetship Training Programme](image)

*Source: The image of the Cadetship Training Programme (SAMSA, 2013)*

### 2.6 South African Maritime Policy Direction

SAMSA is a public entity under the Ministry of Transport; and the South African Ministry recently launched the Comprehensive Maritime Transport Policy (CMTP), (DoT, 2017) which aims to embody the Government’s commitment to give direction and develop the maritime transport sector of the country to its full potential. The CMTP includes the guidelines on maritime education and training and highlights the
importance of maritime awareness from basic primary school level, through secondary school and into tertiary level education.

Furthermore, there are numerous maritime technological tools and equipment available in the market that can assist in equipping maritime students into professionals that can be competent and confident to compete amongst the world’s best. One of the CMTP goals is to develop and maintain an International Maritime Centre in Africa which will serve a complex maritime supply chain system and in order for this goal to be achieved, South Africa needs to investigate how the country responds to the current maritime technological advancements, because technology comprehension is exactly what this goal will require.

The CMTP was launched after the country realized that the transport policy needs to incorporate the maritime goals and agendas to develop the maritime industry for the betterment of the country’s economy. This was done after the former President Jacob Zuma’s speech regarding the government initiative called Operation Phakisa, which intends to unlock the ocean economic potential and create employment for the citizens of South Africa. The objective of the CMTP is to facilitate the maritime development movement into a direction that will transform the industry and give proper governance and protection for the South African waters, and furthermore explains how the education aspect of the maritime will be conducted.

2.7 MET Challenges in South Africa

South Africa has faced challenges within the maritime space for many years, and this is what spurred the development of the CMTP. The maritime and transport policy was developed for the purpose of forming direction in the South African maritime industry, in order for the industry to grow and take shape. Table 2 highlights the challenges faced by MET in South Africa.
Table 2: Maritime Challenges in South Africa

<table>
<thead>
<tr>
<th>Challenges</th>
<th>The South African Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>The South African labour market decline.</td>
<td>The South African seafarer industry was at its all-time high in the 1970’s with approximately 7000 ratings and officers combined, employed in the merchant maritime sector (Ruggunan, Ghosh &amp; Bowles, n.d.). The seafarer labour supply has since been declining and has never been able to recover back to those numbers, more especially with officers.</td>
</tr>
<tr>
<td>Lack of training berth availability.</td>
<td>Ruggunan, Ghosh &amp; Bowles (n.d.), suggest that of the 240 South African cadets that graduate every year, many struggle to secure training berths needed to acquire their final accreditation with SAMSA, making it difficult to find employment in the global labour market. This lack of training berths is affecting the growth of cadet production in South Africa, and will continue to haunt the country with more students being trained. As a matter of fact, this berth placement issue is not a unique issue to South Africa (Ruggunan, Ghosh &amp; Bowles n.d.) which is even more of a reason for the country to produce quality and competitive seafarers.</td>
</tr>
<tr>
<td>Shortage of sufficiently skilled lecturers and limited capacity to train cadets to officers.</td>
<td>DUT and CPUT are accredited to train undergraduate cadets and both institutions face serious human resource constraints when training cadets (DOT, 2011). Among these constraints are factors much as poor physical infrastructure that the institutions are based in; a lack of sufficiently skilled lecturers to teach on maritime programmes; and the expectations of the broader university management for lecturers to publish, conduct extensive administration, and participate in the institutional life of the university” (Ruggunan, Ghosh &amp; Bowles n.d.).</td>
</tr>
</tbody>
</table>
As South Africa forges on in maritime developments, it is important to identity the challenges the country faces in order to improve areas that need improvement, for the country’s economy to grow. It can be assumed that the decline of seafarers labour supply in South Africa is a result of the country’s unattractive seafarers in the global demand market, and there could be many reasons for this, which could include internal and external factors. The same can be said for the lack of training berths availability and the shortage of sufficiently skilled lecturers. The challenges interlink with each other, and it may again be assumed that by fixing one challenge, it poses potential to fix the other problem.
3 CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Purpose and outline

The overall aim and purpose of this chapter is to discuss how the research was conducted from the sample selection to data analysis. This chapter looks into the methods and tools used to look at how South Africa responds to technological advancement in MET and considers lessons from other countries. The research data collection includes literature review, electronic questionnaires, electronic interviews and observations from country visits as research techniques.

3.2 Selection of Participants

The purposive sampling and random survey method were used in this study in selecting participants (Lunenburg & Irby, 2008). The sampling was purposive in that it is specific to what universities and what countries are to participate in the survey, but is random in that any student from the specific universities is allowed to participate, so long as they are studying maritime subjects. In the same manner, any member of the faculty staff is welcome to complete the questionnaire, provided they are working in the maritime department. The study is a case study for South Africa and the primary respondents are those from South Africa. Other countries are chosen based on their advancement in maritime technology and MET to observe and measure the differences between some of these leading countries and South Africa.
3.3 **Data Collection Methods**

The study used primary and secondary data sources for the purpose of this research. Hollensen (2007) defines primary data as information gathered by a researcher from a direct and original source, usually customized to answer research questions undertaken by a particular researcher, for a specific topic in mind. Equally, he explains secondary data as the act of collecting information that has previously been obtained through another study by another researcher for a different objective. In most cases, the secondary data assists in defining research problems through which primary data collection can be based on.

Primary data serves as first-hand information, while secondary data is obtained from related studies by other researchers in the relevant field. The data obtained will then be analysed and presented to answer the three aims and objectives, as well as the research questions of the study.

In order to systematically understand the collected data, the study codes the data using an open-coding approach for the qualitative data collection, based on overarching themes and concepts identified during the collection. The themes are presented in chapter four based on observation, and the recurrence or emphasis of specific statements by the respondents to the questionnaires. The quantitative data collection is analysed on Google Form graphs and pie-charts and presented in numbers and percentages, based on the number of the participants that participated in the Google Forms.

### 3.3.1 Primary Source of data

The primary data for this study was collected through electronic questionnaires, which were forwarded to the two public South African MET universities. A selection of universities from the United Kingdom, Norway, and the Philippines were also asked some questions during field study visits and the IMO meeting in London. In addition, electronic interviews were distributed to a number of industry experts across the globe in the MET and the shipping industry to gather different views and recommendations.
on the topic of technology. Four countries were visited during the study as an observer-participant, and data were collected during the question and answer section in the universities mentioned and the organizations visited during the study. Below are research tools used.

### 3.3.1.1 Field Observation

In this study, observation recorded in a notebook and pictures captured on cameras, enabled the researcher to get a first-hand account and to see and interpret the current situation and practices at the MET institutions studied, as the basis for a combined study. Observation has the capability to produce detailed, qualitative descriptions of human behaviour that illuminate social meanings (Sapsford & Jupp, 1998). The visits to the different countries allowed for first-hand experience, where observed data was collected and recorded on various devices like notebooks, mobile phones and cameras. The data was later presented as is in chapter dealing with findings and discussed in the chapter on analysis and discussion based on the information presented. Recommendations were made in chapter six from what was found, analysed and discussed in chapter four and five. The observation method best answered all three of the research questions and the aims and objective, and was complemented with the questionnaire survey forwarded to South African university participants.

### 3.3.1.2 Observations Results

Patton (2015) affirms that purposeful sampling, normally used in qualitative research, aims at deliberately selecting information-rich cases to analyse them for the intention of eliciting vital facts. Accordingly, the observation techniques were purposefully chosen as a method that would give the researcher first-hand experience of the universities chosen to study and the country’s economic state these universities are at. This gave the researcher vital and valid facts that will make the study more meaningful.

For the observer-participant, the components were based on what was observed during the field study and these components answered the research questions and objectives of the thesis. There were three components observed that look into the availability of
tools and technology, the university infrastructure, as well as adequate human resource availability. All the universities visited were assessed according to these components.

3.3.1.3 **Electronic Questionnaire**

The electronic questionnaire was convenient because of its accessibility, with no geographical limitation in collecting data from the university students and staff because the questionnaire was completed and submitted electronically and this was convenient for both the participant and the researcher. The questionnaire was designed in two parts, i.e., a two-fold one designed specifically for students and the other for academic staff. This was the most practical method purely because the participants are spread out across the globe and the internet is the best way to bridge the geographical gap between the researcher and participants. As a result, the electronic questionnaire was used as a data collection instrument for its convenience and cost-effectiveness (Bart, Philbrick, & Smith, 2010), and similarly, Gillham (2008) recommended this method by outlining its advantages in data collection for research purposes.

The electronic questionnaire aimed to assess how the students train at the various universities, in comparison to their future competitors. The study looked into the various methods used by the university to educate and train their maritime students and cadets. The students and university staff were asked on technology tools used to educate, train and assess seafarers in relation to the STCW Convention requirements. Lastly, a question was posed on how technology could assist in MET training to assist South Africa improve on the challenges faced regarding technology adaptation.

3.3.1.4 **Electronic Interviews**

The purpose of the electronic interviews was to collect expert views from industry players in the shipping industry, academia and training industry, for the purpose of answering the last question (3) and objective (c). Because of geographical reasons, the five interview questions were conducted electronically. Instead of face-to-face
interviews, the questions were formulated on an electronic document and forwarded to the relevant participants because of distance and time factors. The electronic questions were sent out to industry experts from around the globe, and the experts included seafarers, lecturers and seafarer training professionals around the world. The interview form was then sent to the World Maritime University (WMU) professionals, the industry experts met at the IMO and the visited countries, and lastly the form was sent to other professionals from South Africa as well.

3.3.2 Secondary Sources of Data

The secondary data were collected using the WMU Library (physical and online library portal) and through desktop research.

3.3.2.1 Literature and Desktop Research

The secondary sources of data included the review of policies, journals, books, academic articles, reports (DoT, SAMSA, TETA, SAIMI sponsored), research, the STCW Convention, as amended in 2010, and the IMO Conventions.

3.4 The use of Triangulation

Numerous research techniques were used in this study for the purpose of answering the dissertation research questions and objectives. This technique is called the triangulation method and is utilized by researchers that need to complement their research with different techniques to reinforce their findings (Denzin 1978). Correspondingly, Kane (1990) affirms this method of using different types of complementing techniques to assist the researcher in analysing the data for more accurate and precise finding.

Figure 4 identifies the multiple research techniques that this study will conduct in order to receive valid results.
3.5 Data Analysis Methods

This study uses qualitative data collection for the observation, questionnaire and interviews, while quantitative data collection is also applied in some portions of the student questionnaires for analysis. Qualitative method refers to non-numerical data collection while the quantitative method refers to statistical data collection. According to Creswell (2014), qualitative data deal with open-ended questions which do not have fixed answers; while quantitative data tend to have closed-ended questions with predetermined responses.

Qualitative Data Analysis (QDA) consists of three parts: Noticing, Collecting and Thinking about interesting things, and is used in this study to analyze and code observation and questionnaire findings (Khandkar, n.d.). The QDA process happens simultaneously as the three components are experienced generally at the same time. As the three components occur and the individual continues to collect information, new information or items may be noticed and need to be considered, so the analytical process starts again.
The Workflow of Qualitative Data Analysis in general, means taking notes of certain things for (generally) research purposes based on, for example, observation, recording events or interviews and gathering documents. (Khandkar, n.d.). In the analysis phase, the research may code the information by adding descriptive words or “codes” to put the information in perspective.

Since the study uses the triangulation method, the data findings are presented in multiple forms using different techniques of analysis.

The techniques used are firstly the literature review, then the observations from field study visits at different universities and organizations, the third are the questionnaire surveys to the university faculty staff and students, and the last technique was the interviews to industry professionals and experts. All four techniques together make up the methodological triangulation validation method used in the dissertation, and the observation and questionnaire methods are analysed according to the open-coding approach with identifies commonalities in the responses given by participants. The study first presents the findings separately in chapter four based on the techniques and the research questions and aims and objectives stated in chapter one, then in the
discussion chapter (5) considers all the methods together and analysis the findings as a collective, triangulating all of the techniques from the findings.

3.6 Limitation of Data Collection

The data collection was limited because of geographical dispersions of the participants of the study. The study includes universities from across the globe, as well as industry experts from around the world. The geographical distance is one of the main reasons why the use of electronic questionnaires and interviews are used as a tool to collect data for this study.

In addition to this, there are some respondents that the survey was sent to that did not respond in time for the data to be captured in the study. Some were not willing to share information or participate, and others requesting anonymity.

Furthermore, the difficulty of internet access, especially to the students that do not have smartphones or other means of connectivity beside the charges at internet cafes. This proved to be an issue when it came to answering the questionnaire and sending back the consent form because of printer and scanner issues, but all issues were overcome in the end.

Finally, the delayed responses from the participants is another issue which resulted in a shorter time to analyse the data fully. Other participants forgot and had to be followed-up by emails. With this said, it was evident that the follow-up task is critical, if the researcher is to submit the study in time, considering the limited time allocated for this paper.

3.7 Ethical Considerations

Drew, Hardman and Hosp (2008) puts forward the view that “ethics has become a cornerstone for conducting effective and meaningful research.” The World Health Organization (2013) report also stated that “research involving human participants must be conducted in a manner that respects the dignity, safety, and rights of research
participants”. Ethical considerations were considered when undertaking this study as per the requirements of the World Maritime University Academic Committee to ensure protection toward the participants at all times. Drew et al. (2008) further note that “every researcher has a responsibility to protect the participants in an investigation,” and that “it is of paramount importance that educational researchers respect the rights, privacy, dignity, and sensitivities of their research populations and also the integrity of the institutions within which the research occurs.”

The research process and all the research instruments used were, therefore, approved by the Ethics Committee of WMU before the data collection commenced. The study was conducted in a professional manner, and approval requested from the participants by including a consent form with every survey sent out to the participating candidates.

The next chapter presents the findings that are in line with the methods described in this chapter.
4 CHAPTER FOUR: FINDINGS AND ANALYSIS

4.1 Purpose and outline

This study looks at two MET universities in South Africa to understand how these universities respond to technology advancements in their training activities. The two South African universities are compared with other universities from the UK, Norway and the Philippines, on different field studies of visits to the various universities to the named countries during the course of the year. The study includes observations from these university and organizations studied, and highlights on a global perspective from maritime shipping professionals and maritime lecturers and training consultants, for South Africa to draw some lessons and perhaps establish a benchmark for improvement. The methodology chapter presented the steps taken to collect data, and this chapter presents the findings and how the data was analysed in a systematic way. The findings are presented in a way that responds to the research questions and objectives stated in chapter one.

The findings triangulate and complement each other by eliciting key points from the four methods used. First, the literature review in chapter two draws attention to the popular technology tools commonly used in the MET training centres and universities. Second, the observation study in this chapter provides an overview of what technologies the studied universities incorporate into the teaching methods. The third method, being the questionnaires reveal how the South African MET lecturers and learners use technology tools and equipment and sheds light on how the technologies assist with their competency learning. The fourth and final electronic interview method is a global industry perspective of what the industry professionals and experts have to
say about technology, the future of MET and how technology in MET will affect South African MET institutions.

4.2 Findings from field observations at MET institutes

The findings from the field observations carried out at the Fleetwood Nautical Campus MET institute, The University of Southeast Norway, Maritime Academy of Asia and Pacific (MAAP), and the Durban University of Technology (DUT), assisted the observer-participant to understand and gain a holistic picture of how the universities carry out their MET system. The findings indicate lessons that can be learned to improve the MET practices at the South African’s MET institutes, and compare how other universities from other parts of the world carry out MET training. DUT was the only SA university that was visited during the observation study, but the questionnaire study form was sent to both DUT and CPUT for the two perspectives.

The field observation section presents key findings by looking into what tools and equipment are available in the four universities visited, then ascertains what methods are being used at the various universities, and finally determines the human resource capacity of the university. The observer-participant will look at the United Kingdom, then Norway, then the Philippines and conclude the observations and findings with South Africa.

4.2.1 United Kingdom

The Fleetwood Nautical Campus maritime education and training institute in the United Kingdom was observed during a July 2018 field study. Fleetwood Nautical Campus is an all-encompassing maritime institution providing a wide range of courses to educate and train cadets for the shipping and maritime industry.
4.2.1.1 Availability of Tools and Equipment

Fleetwood Nautical Campus is a dedicated MET institution that trains cadets for the shipping industry competencies and the competitive global market. The key finding for the tools and equipment availability is that the institution is equipped with five full mission ship bridge simulators, an engine room simulator, and a marine engineering workshop. The institution has, in addition, a specially built enclosed training lake by the beach where lifeboat drills, seamanship training and rescue trainings are conducted. There is an environmental survival tank and a fire-fighting training centre, and the institution has its own swimming pool with a wave-generating machine with an underwater helicopter evacuating facilities for the purpose of efficient and effective training of students, and all these tools need specific knowledge and competence that the instructor needs to have before giving the training. The instructor competency requirements can be seen in Appendix B and Appendix C.

4.2.1.2 Training Methods used in MET

The Fleetwood Nautical Campus incorporates all the training tools and equipment mentioned and blends them into the course curriculum. A key finding was the numerous ways of educating and training students the institution combined to develop a state of the art MET training method. The campus has traditional classrooms for lecture room teaching where the students and lecturer discuss matters in class. Classroom lectures are further purposefully combined with training methods that allow for competence-based training, like the lake and pool additional tools that are not technical but useful. This combination of traditional classroom lectures and demonstrative teaching for competency training is key for how Fleetwood Nautical Campus positions themselves as a state of the art MET institution. Even though the focus of the UK MET institutions appears not to approach their teaching methods towards research developments, their approach is geared to serve a different purpose. The UK approaches MET purely on the basis of competent and competitive seafarers that will be ready for the shipping industry, and separates innovative research from MET institutions.
4.2.1.3 Adequate Human Resource

Another key observation at the Fleetwood Nautical Campus was how staff was recruited, supported, and educated to keep up with the rapid development in general and the technology development in the maritime industry in specific. It was mentioned during the presentations from the staff members that a number of the institution’s staff are alumni that have studied at Fleetwood Nautical Campus. The alumni work in the shipping industry collecting valuable experience and once they are qualified and ready to take up lecturing positions, the institution has a clear recruiting policy to take them on and the institute encourages the lecturers to go in between seafaring and lecturing to keep abreast with what is happening in the industry. This is an excellent way of keeping current and providing cadets with knowledge that is fresh and relevant in their times.

Another interesting observation was a system called the e-tracker database, which is used to monitor the students’ training. This means that the instructor can observe which students need assistance and how these students can be assisted to improve their academic performance. This database is accessible to both the instructors/staff and the student, making the academic record transparent and the cadets aware of their academic standing and remarks from instructors.

4.2.2 Norway

The University of Southeast Norway (USN), was visited in June 2018, and is a conventional university, with the maritime faculty separate from the larger university but a short walking distance from the main university. The university’s maritime faculty offers Bachelor of Science, Master’s and Doctoral studies in science and the students are all sponsored by the university which is also sponsored by various stakeholders (public and private).
4.2.2.1 Availability of Tools and Equipment

The USN University is government sponsored with Kongsberg equipment, Kongsberg being one of the world leading suppliers in maritime training equipment. The Kongsberg simulator, specifically, is a division that focuses on digital maritime training equipment for the maritime industry and maritime institutions. Kongsberg manufactures many of the equipment found in shipping vessels as well as the training simulator equipment found in many institutions that have simulators. The department provides a new generation of ship’s bridge simulators, specially designed for optimum user experience to ensure maximum realism in exercises, an important element for grooming competency and giving the students a real-life scenario.

The equipment found at USN includes the 360 degree wall projector simulator and other full-scale simulator training facilities for the students. USN categorizes its simulators into two functions, simulators for the training of students and another set of special simulators for research purposes. USN, as was mentioned by one of the facilitators during the visit, focuses on much more than training cadets, but includes research and training and the MET technology provided are specifically for that.

4.2.2.2 Training Methods used in MET

A key finding at the USN was how competence-based training and education is combined with research and industry collaboration to equip the students with cutting-edge skills about the technological development in the maritime industry. It was clear how the close collaboration with Kongsberg has given the university forefront capabilities to educate and train the students using the latest maritime industry technologies and simulations tools.

Furthermore, it was interesting to observe how the university combined classroom education and training with a research invention focused education, allowing students to acquire innovative skills and have the understanding about the development of maritime technologies and be in a position where they can be innovative and creative in their career. During the Norwegian field study visit to USN, an autonomous ferry
vessel model reportedly built from scratch by a group of students demonstrated the kind of projects the students are involved in. It is, therefore, clear that as much as USN teaching methods involve class lecturing, they focus more on demonstration of competency, research and development.

4.2.2.3 Adequate Human Resource

The campus offers science degrees lectured by highly qualified lecturers. The lecturers are qualified in their own respective fields and the university’s maritime department especially needs qualified lecturers because of the equipment that the department holds. Kongberg equipment needs specialized lecturers that will understand the equipment. One thing that stood out was how the lectures combined a research focus, and industry connection to develop their cutting edge competencies, and this is one of the most important elements of shipping, the ability to combine theory to practical industry practices.

4.2.3 Philippines

The Maritime Academy of Asia and Pacific (MAAP), the Philippine university was visited in April 2018. The MAAP University is owned and operated by the Associated Marine Officers’ and Seamen’s Union of the Philippines (AMOSUP).

4.2.3.1 Availability of Tools and Equipment

One of MAAP’s key findings was that it is a dedicated and sponsored maritime university with numerous education and training facilities on 122 hectares of property. The MAAP campus is technologically equipped with a full mission simulator on a motion platform, navigation and engine room simulators, vessel training centre, hybrid chemical and product tanker simulator and an LNG-Membrane type cargo handling simulator, amounting to a total of 62 simulators. The facilities include a helicopter,
underwater escape training, fire-fighting centre and the centre for advanced maritime studies, and these are all sponsored by various public and private sponsors.

4.2.3.2 Training Methods used in MET

One of MAAP’s key finding was how technology and infrastructures enabled the university to create a method and environment that can mimic life at sea to better educate and train their cadets. MAAP is an isolated cadetship training boarding campus and all the students of MAAP stay on campus. This method trains cadets on being away from home. The large hectares of property allow for the instructors to add physical training for the cadets to learn the importance of fitness. The lecturers, in addition, include a 24-hour work shift in the learning activities where students learn the responsibility of manning a ship on shifts. This method trains cadet’s emotional, physical and professional discipline. MAAP further uses classroom discussions, simulator training and other training tools as methods of training the university’s cadets and all these methods use a combination of traditional and demonstrative methods of training.

4.2.3.3 Adequate Human Resource

The lecturers at MAAP are previous seafarers with sufficient experience at sea. The Philippines is one of the world’s leading maritime nations and are extremely maritime cultured. Finding an experienced seafarer is not as difficult as it is in South Africa because the country has numerous seafarers of all ranks, and qualifications. The Philippines produces seafarers with BSc degrees and the lecturers are also qualified to train the cadets in a way that will ensure that they are competent, with all the necessary tools and equipment at their disposal.

4.2.4 South Africa

Finally, DUT, one of the two universities the study focuses on in South Africa was visited in May 2018. During this visit, a tour around the maritime faculty was given.
DUT (like CPUT – the second studied public technical university) offers maritime
deck and engine cadetship diplomas and shipping and logistics diplomas and is South
Africa’s main maritime cadetship training institutions.

4.2.4.1 Availability of Tools and Equipment

The key finding was the lack of sufficient and industry competitive technology tools
and equipment in the maritime department. The university has a general lack when it
comes to technology availability compared to the other MET institutions studied. The
department has 30 desktop simulators for student CBT, and plans to purchase another
30 desktop simulators as soon as funds become available from the government, and
these were all the technological tools and equipment DUT had. The university could
do with more demonstrative technology training tools like the institutions in the UK,
Norway and the Philippines.

4.2.4.2 Training Methods used in MET

The key finding at DUT was the limited variety of training methods used to educate
and train cadets. The visit to the university was fortunately during a lecture day with
students in their respective classes which presented an opportunity to observe the
teaching session. The tour around the department’s facilities included a view of the
lecture halls and the desktop simulators where lectures and class discussions take
place. The maritime department as observed was fairly small with a maximum capacity
of 120 students. One way for the university to maximize on the courses offered and
train more cadets is through the introduction of e-learning, and this can be beneficial
for seafarer lifelong learning and DUT can offer various courses online. One key
observation was that the lecture halls are relatively small with the desks closely lined
up in rows against each other and there is not much demonstrative teaching and
learning within the current infrastructure.
4.2.4.3 Adequate Human Resource

Key findings regarding the human resources were the insufficiency of adequate lectures at DUT. The department lacked lecturers and had vacant posts that the university has been trying to fill for some time. The HOD added that university has had difficulties attracting and retaining appropriately qualified lecturers, and that this was a huge problem with regards to the courses the university can offer. Even though the department is well staffed, there is still a need for more qualified staff to lecture other courses that the university offers.

4.2.5 Field Observation Summary of key Findings

The field observations’ key findings from the UK was the variety of technology tools incorporated in the course curriculum, and the Norwegian was their cutting edge training approach using technology research. The Philippines holistic training approach mimicking life at sea in their technology training and career development was something to be recommended and that SA can learn from. These finding are the key when developing a successful MET institution and producing marketable cadets for international supplier demands of seafarers.

4.3 Findings from Questionnaires

The answers from the questionnaire distributed to faculty and students at DUT and CPUT in South Africa triangulate with the findings from the observation with respect to the observed benefits and challenges of the South African MET institutes. The observer-participant gives an outsider perspective of the SA MET institutions, while the questionnaire provides the inside perspective the MET system.

Below is the summary of the results gathered through the questionnaire and a brief discussion of the findings for both faculty and students.
4.3.1 Faculty Staff Member Questionnaire Results

The DUT and CPUT maritime faculties are small departments with few faculty members in the department. As a result, three (3) responses were received from DUT and another five (5) from CPUT making a total of eight (8) electronic responses. All of the 8 questionnaire responses were eligible and answered by the relevant faculty members requested to answer by certain positions within the department. The respondents from DUT who answered were three (3) - one (1) head of department (HOD), one (1) lecturer, and one (1) associate professor. CPUT on the other hand, for the same questionnaire, had five (5) responses from the faculty. One (1) head of programme (marine engineering), one (1) HOD of maritime studies and survival centre, one (1) lecturer, one (1) lecturer and curriculum officer and one (1) senior maritime instructor.

All eight (8) responses were considered for the analysis of the findings and below are critical questions and their respective answers in summary.

4.3.1.1 Technology tools used to educate and train MET students – First research question and objective

**Question:** What are the maritime technology training tools or equipment(s) used to educate and train the students?

Of the three DUT respondents one (1) member affirmed that the engine room simulator and GMDSS simulator as tools and equipment used to educate and train the students, two (2) confirming the electronic chart display and information systems (ECDIS) simulator and shipboard radar/ARPA unit and all three (3) in agreement of the bridge simulator. In CPUT, four (4) confirmed the bridge simulator, three (3) confirmed the GMDSS simulator, one (1) said the shipboard radar/ARPA, another saying none of the options were applicable and did not mention to provide any information.
**Question:** What are the maritime technology training tools or equipment(s) used to assess the students?

DUT responded with three (3) confirming that the use of bridge simulators to train and assess the students are in use, two (2) confirming the use of the electronic chart display and information systems (ECDIS) simulator and the shipboard radar/ARPA unit, and 1 confirming the GMDSS simulator and the engine room simulators. CPUT 5 staff members similarly responded and 3 confirmed that the university uses the bridge simulator, another 3 confirming the use of GMDSS simulator, 1 confirming shipboard radar/ARPA and 1 confirming the use of small boats and pool drills, and 2 saying that none of the options provided were applicable.

**Question:** Who is responsible for the maintenance of the maritime technology training tools or equipment(s)?

Respondents in this question were given a leeway to answer by providing more explanation. DUT, again had different answers for this question: one (1) suggesting that the service provider is responsible for the maintenance of the maritime technology training tools or equipment, another 1 suggesting the department (not sure whether the schools department or a government department) and the last member suggesting that it is the university and maritime studies department’s responsibility. CPUT members on the other hand all suggested that it was essentially the university’s responsibility, with 1 saying it is the university, another saying the university pays a service provider to maintain, usually the licence holder, the third one saying it is the technician’s responsibility, the fourth saying it is the lecturer and the last one suggesting that it is the survival centre’s responsibility and that he/she is responsible for that role.

**Question:** Would you say your maritime technology training tools or equipment(s) are old or new?
The attempt was to find out whether the technology equipment are old or new and gave a scale of 1 - 10, one (1) being “very old” and ten (10) being “brand new.” One person from DUT rated the equipment 3 out of 10, another rating the equipment 4 out of 10, the last one rating the equipment 5 out of 10; none going over into the category of the equipment being new. At CPUT, the majority of the members suggested that the equipment are old, one (1) giving a 1 out of 10, another one (1) giving a 1 out of 10, two (2) members agreeing that the equipment deserve a rating of 4 out of 10 and the last one (1) member getting into the new category with a 6 out of 10 rating.

**Question:** Are there any plans to acquire new maritime technology training tools/equipment(s) or dispose of the old ones?

DUT was in full agreement, with all three (3) members confirming that there are plans of buying new maritime technology training tools/equipment for the department. At CPUT, two (2) are under the assumption that the university will buy new tools and/or equipment for the department, another two (2) assume the university will update the software of the existing tools and/or equipment and the last person adding that there a plans to invest in some new simulators for practical training (lifeboat simulator).

**Question:** Has the maritime technology training tools/equipment(s) helped in improving the training of maritime professionals?

This question attempted to know whether the maritime technology training tools/equipment have helped in improving the training of maritime professionals. The scale of 1 - 10 was given with one (1) being “not helpful at all” and 10 being “extremely helpful”.

At DUT, one (1) member was extremely pleased with the technology giving it a 10, the other two (2) on average giving the technology training tools/equipment a four (4) and another a six (6). Two (2) members elaborated on their scoring suggesting that the “simulation provides an environment that is as
close as we can get to navigation operations on board” and the other staff member responding by saying that “it simulates working environment on board a ship and help students to understand better the subject they are learning about”. There is one member that did not elaborate on to the answer but the elaborating question was not mandatory.

At CPUT, two (2) members were on the extreme side, rating the maritime technology training tools/ equipment a 9 out of 10, and rest around the average zone with one (1) rating the maritime technology training tools/ equipment a 6 out of 10, another one (1) a 4 out of 10 and the last member rating it a 3 out of 10. Four justified their responses and explained that “it is important to train students by using training tools in order to prepare students to real life”. Another staff member suggesting that “new equipment is required to improve the skills of graduate to prepare them for the workplace/new technology on vessels”. One explained that “a lifeboat would benefit all students as it is not dependent on conditions we can also simulate night time conditions which no one else does,” and the last staff member explaining that there is “too little time for program, too many students, too few simulators” as a current restriction and limitation of the university.

4.3.1.2 Methods used to educate and train MET students – Second research question and objective

**Question:** What are the teaching methods used to educate and train maritime students in your institution?

All the staff faculty respondents from DUT and CPUT confirmed that the university covers the basics and uses the interactive lecture hall set-up and simulator as teaching methods. A few responses affirmed online lessons as a teaching method that was recently introduced by the universities.

**Question:** What are the methods and tools used to assess maritime students in your institution?
All the staff faculty respondents from DUT and CPUT agreed that written test(s) and examinations, practical simulation assessments, as well as individual written assessment(s) are used to assess student competence. Some staff members suggested the use of group assignment(s), individual presentation(s), group presentation(s) and online assessment(s) as additional methods used to assess. In CPUT, one faculty staff member adding a few more components of the assessment methods which are group projects, service learning projects, and creating videos.

**Question:** What informs your institution's MET teaching methods used in the maritime department?

Only one (1) of the three (3) faculty member from DUT selected research and industry influence, with one member adding compliance with accreditation requirements. Two (2) out of three members selected digital era influence, academic quality reasons and university policy influence. No staff member selected government influence. CPUT members selected all of the options, with one member adding academic program aligned to maritime authority requirements and the accreditation body, SAMSA. One (1) member added the predetermined research answer, two (2) selecting digital era influence, three (3) selecting industry and government influence and four (4) selecting academic quality reasons and university policy influence.

### 4.3.1.3 Technology assist in South African MET institutions – Third research question and objective

**Question:** Please may you share your opinion about the maritime developments happening in the maritime industry, preferably in MET in light of the national or global technology advancements?
At DUT, the first respondent answered by saying “South Africa is lagging behind the rest of the world. Universities require extensive capital input to bring its infrastructure to international standards,” another said “MET providers need to lobby for funding from the private sector as well as government because the technology needed for simulators and other equipment is expensive, and that it is also difficult to find teaching personnel with the appropriate work experience and competence.” The same respondent further suggested that “an initiative that will bear fruit is the monitoring and guidance of ex-students to become lecturers.” Another participants suggested that “it is on the road to become more and more automated and that ships are going to become autonomous with the crew numbers reducing, and eventually the ships will be steered from land.”

CPUT responded by saying the “Maritime Authority is too restrictive to accommodate new teaching methodologies and distance learning practices. Maritime Authority staff are not equipped academically to understand the needs and capabilities of the maritime industry and institutions with regards to technological and teaching methods advancements” and another one saying that “With new programmes which we are currently developing we have an opportunity to upskill and improve in line with technology changes with the sector. It's exciting but I'm also concerned about technology in the industry replacing people with robots. In port areas many people have lost jobs as machinery no longer required humans and also experimentation currently have vessels without any humans on-board; this I find unacceptable as technology does not create jobs it reduces the number.” The last two faculty members were short and straight to the point, saying “South African MET institutions should invest more to upgrade teaching facilities” and finally the last concluding with that “South Africa is far behind the international standard, and that this is due to outdated facilities.”
Question: Please may you share your opinion on where the university/ institution could improve in terms of maritime education and training using technology tools/ equipment(s) or/and what the university/ institution is doing right?

The faculty from DUT responded with suggesting that improvement is needed in terms of better “infrastructure, equipment, larger premise, more lecturers.” Another responded with commending the “decision to remove the sea-time component from the curriculum was a positive step that assisted the Department to become economically viable. The material of instruction in the newly developed Diploma programme is aligned with current industry requirements.” The last member of the DUT faculty suggested that the university needs to invest for in research work, and that “there are few independent research attempts, but there is not enough strong support for the researchers and their experimental work. Focus is still on teaching, but it should be primarily on research.”

CPUT faculty put forth funding concerns and that the university is burdened with political issues, based on the fact that the university is a public university. Others suggesting that there are many plans in the pipeline and that there are engagements with industries. The final member suggesting that the university requires updated facilities.

4.3.1.4. Summary of Staff Faculty Questionnaire Perspective

The South African MET staff faculty from DUT and CPUT in general all agreed that both universities could use an upgrade of technological tools and equipment availability. The SA MET staff recommended that the universities invest more on demonstrative teaching and learning tools and equipment for the benefit of the students to familiarize themselves with technology equipment.

Table 2 shows the summary of the students’ responses from the questionnaire.
Table 2: Staff Questionnaire Perspective

<table>
<thead>
<tr>
<th>Rating Scale:</th>
<th>Poor</th>
<th>Below Average</th>
<th>Average</th>
<th>Above Average</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments</td>
<td>Methods used to educate and train MET students</td>
<td>Technology tools used to educate and train MET students</td>
<td>Technology assist in South African MET institutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUT</td>
<td>Below Average</td>
<td>Insufficient tools and equipment</td>
<td>Current lack of technology assistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPUT</td>
<td>Below Average</td>
<td>Insufficient tools and equipment</td>
<td>Current lack of technology assistance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3.2 Student Questionnaire Results

There are 29 responses received from DUT and 23 from CPUT making a total of 52 electronic responses. All of the 52 questionnaire responses were eligible and considered in the study, and the response results triangulate with the faculty questionnaire and the observer-participant’s observations. The respondents were all from DUT and CPUT and the majority of the students ranged from 19 – 22 years of age. Three quarters of the students were male and the other quarter female, with eighty-three (83) percent of the students studying the seagoing Nautical Studies Diploma, and the other seventeen (17) percent studying land-based logistics. The majority of the students were funded by scholarships and bursaries, others by parents, and some by university bursaries. Most of the respondents were from first and second year with only ten (10) percent from the third year.

4.3.3 Technology tools used to educate and train MET students - First research question and objective

4.3.3.1 DUT Respondents

Question: Does the course involve the use of maritime technological tools or equipment for training of competence?
- 55.2% said no, while the other 44.8% of the total 29 respondents saying yes. The next question asked the students what maritime technological tools or equipment were used in their course. Eleven (11) students responded by saying
that none of the suggested options were used as training tools, another six (6) said that the use of video conference lecturing was used, four (4) students said that bridge simulators were used, another three (3) confirmed the use of shipboard radar/ARPA unit and only one (1) saying that the course involved the use of GMDSS simulator as a tool to educate and train the students.

4.3.3.2 CPUT Respondents

Does the course involve the use of maritime technological tools or equipment(s) for training of competence?

23 responses

![Pie chart showing 60.9% Yes and 39.1% No]

*Figure 8: CPUT Question 10 - Part A from Student Questionnaire.*
*Source: Author (2018)*

If yes, please tick the maritime technological tools or equipment(s) that your institution uses? (Tick all that apply)

19 responses

![Bar chart showing Bridge simulator 9 (47.4%), GMDSS simulator 6 (31.6%), Shipboard Radar/ARPA Unit 7 (36.0%), Engine room simulators 1 (5.3%), Video conference lecturing 1 (5.3%), None of the above 10 (52.6%)]

*Figure 9: CPUT Question 10 - Part B from Student Questionnaire.*
*Source: Author (2018)*
60.9% said no, while the other 39.1% of the total 23 respondents saying yes. The next question asked the students if maritime technological tools or equipment were used in their course. Ten (10) students responded by saying that none of the suggested options were used as training tools, nine (9) saying bridge simulators, seven (7) saying confirmed the use of shipboard radar/ARPA unit, six (6) saying GMDSS simulator, and saying engine room and another the use of video conference lecturing were used.

4.3.4 Technology assistance in South African MET institutions – Third research question and objective

4.3.4.1 DUT Respondents

**Question:** On a scale of 1 to 10, is technology based training more helpful in understanding and demonstrating your confidence than the traditional training methods?

![Bar chart showing responses to the question](image)

Figure 10: DUT Question 14 from Student Questionnaire.

*Source: Author (2018)*
**Figure 11: CPUT Question 14 from Student Questionnaire.**  
*Source: Author (2018)*

**Response:**

The students responded with some suggesting that technology based training is easier to understand and remember, and that technology will help with their competence level in the workplace. Other students suggested that technology gives more insight on the subject, especially since the maritime industry is a digitalized industry and is constantly evolving in technology. Students agreed that some subjects are understood better with visual and practical aid. Many students suggested that using technology will help them understand some subjects better, as well as give them a picture of what to expect in the workplace before going to work at sea, instead of just doing theory based learning. Maybe students appeared to prefer the option of being trained in using technological tools and equipment rather than being told about it.
There was a set of students that admitted to not knowing much about some of the technology tools given on the survey and appreciated the awareness and commitment to doing more research on what else is available out there in the market. Some students believed that they were introduced to technology late and that they should have started using the simulators earlier, while others confirmed that they had not started using them at all. Some suggested that it would be more fun and experimental to use technological tools and provide practical experiences to the theory they are learning. Other students believed that it is better to get a good understanding of the theoretical knowledge before one can expect technological training, while others opposed this and suggested that it is better do both theory and practical at the same time than the two being separated, and one saying that they did not have any maritime technological tools on campus.

Students from CPUT raised the same suggestions; many showing appreciation for technology based training. Many confirmed that technology based training helps with better understanding on the theory learnt, improves confidence and keeps the learner relevant and up to date with what industry is looking for in terms of competence. Other students said they are more hands on students than theory understanding and some said they learn by seeing (visual), which makes technology much better to understand. Some said that technology is better because it gives you a chance to make mistakes before you get to the real vessel. Others said that technological learning involves more practical learning which is more efficient for the new generation because of its practical knowledge.

There were some students that were opposed to technology saying that the traditional methods are more efficient than technological method because they have been used longer than technological methods; thus they are more accurate. Some say for students that do not have prior sea-time experience, technology is helpful. Same said that because the institutions lacked technological practice,
cadets with certificate of competence still make mistakes and that a mixture of
theory and practical training is better.

4.3.4.2 Student Questionnaire Key Findings Summary

The South African MET students from DUT and CPUT in general were satisfied with
the universities’ services, but suggested some improvements in the components from
the research questions and aims and objectives. The majority of the students confirmed
that the institutions could improve on the tools and equipment availability. The
students from both DUT and CPUT recommended that the universities should invest
more in demonstrative teaching and learning tools and equipment, for better
understanding and competency. The students put forward that there was a lack of tools
and equipment and some even admitting that they did not even know about some of
the technologies available or being used in the MET industry.

4.4 Findings from Interviews

The interviews worked well to triangulate and complement the data collected during
field observation study and questionnaires. Five questions were randomly asked to the
participants and the participants were from all over the globe.

Table 6 represents the demographic data of the experts and professionals sampled. The
data gives an overview of where the participants were located, what their nationality
was, and their professional titles, as well as how many years’ experience they have in
the industry.
The interview consisted of five (5) main questions that attempted to answer research question 3 and the third objective. The interview looked at methods, technology tools used and the impact of technology on a global scale to educated and train cadets according to the STCW requirements. It then sought to understand what a developing country like South Africa can do to improve their status in MET training and education. Below are the results in summary.

### 4.4.1 Experts and Professionals Interview Results.

**Question:** What are the key methods and technology tools used to educate, train and assess seafarers in relation to the IMO's STCW International Convention requirements?

**Response:**

<table>
<thead>
<tr>
<th>Table 2: Demographic Data.</th>
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</thead>
<tbody>
<tr>
<td><strong>Geographic Location of the Industry Professionals and Experts Workplace</strong></td>
</tr>
<tr>
<td>9 – South Africa</td>
</tr>
<tr>
<td>1 – Malaysia</td>
</tr>
<tr>
<td>1 – Norway</td>
</tr>
<tr>
<td>1 – Taiwan</td>
</tr>
</tbody>
</table>

| **Industry Professionals and Experts Nationality** |
| South African | Filipino | Dutch | British |
| Burmese | Swedish | Norwegian | Singaporean |
| Indian | |

| **Professionals and Experts** |
| 5 – Captains | 3 – Chief Engineer |
| 4 – Ratings | 9 – Lecturers / Training Consultants |

| **Numbers of years of experience in Industry** |
| 8 experts with over 30 years | 7 experts with between 20 - 30 years |
| 8 professionals with between 10 – 20 years | 4 professionals with under 10 years |
Simulators are the key technology tools and equipment being the most commonly mentioned for seafarer training. Other common tools and equipment mentioned are e-learning, laboratory equipment, computer based training, engineering equipment, safety equipment, ECDIS, GMDSS, RADA/ARPA, BRM and videos.

**Question:** What is the impact of technology in maritime education and training, concerning the maritime professionals and seafarers?

**Response:**

The industry professionals and experts were of the opinion that technology is an undeniable contributor to MET training, ie one cannot think of cadet training and not think of technology. Many stated that technology is the key component that equips seafarers to reach the competency that is required in today’s shipping and future shipping. Some MET professors shared that the training professionals in shipping, like the lecturers, are not teaching current developments (but teaching their era knowledge) because they are not exposed to current shipping at the time of training. The rate of change in current technology is high and multidimensional, and professors need to update their knowledge consistently and continuously. Many professionals and experts mentioned autonomous and unmanned sailing that lies ahead, posing a challenge to the future knowledge needed by seafarers, questioning what the new curriculum should be to accommodate the future of shipping. Some shared that there is too much focus on technology but no emphasis on basic seamanship. The majority of the professionals shared their views of the importance of technology and that it is essential for competency and vital for ship and navigational safety.

**Question:** What is the best way forward and key in terms of MET developments, for a developing country like South Africa that wants to globally compete on supplying seafarers?

**Response:**
Training for global competition and ultimate competency is the way forward for any country, including South Africa, to pursue. Some professionals mentioned South Africa’s geographic location and that the country should take full advantage of this by training seafarers. Some mentioned sending lecturers on an apprenticeship on board of modern ships to see how things are done. Some mentioned South Africa is increasing its ship registry and investing in the national fleet. South African should invest in high quality education and continuously improve in MET.
5 CHAPTER FIVE: DATA ANALYSIS AND DISCUSSION

5.1 Purpose and outline

This chapter discusses and highlights important findings from the primary and secondary data presented in chapter four, in the context of the literature review. The discussion and analysis presented in this chapter is structured to follow the three research questions and objectives.

5.2 Discussion and Analysis of the Findings

This chapter highlights key findings in a way that responds to the three research questions and the three objectives by drawing comparisons to South Africa and other countries studied in the dissertation. The first critical areas highlighted are tools and equipment used to educate and train the students. The second critical area looked at is the educating and training method of instruction adopted aspect. The final area looks into is the sufficiency and adequacy of human resource capacity to train on the tools and incorporate the different methods of instruction in the course for students’ better understanding. The availability of infrastructure also forms an important part this chapter, and mentioned in the key findings at different times because of its influence on the three key areas this study has focused on.

The findings in chapter four highlight the United Kingdom’s approach to MET technology as being integrated in the curriculum, producing well-rounded competitive seafarers. The Norwegian’s approach to MET being technology based and cutting edge, producing creative and innovative seafarers. The Philippines, being the last country of comparison and a developing country like South Africa, is the most realistic
comparison and can be the most practical country for South Africa to learn from. Given these points, South Africa can learn from all of the mentioned countries, not necessarily to implement, but to learn on what would best serve South Africa.

5.2.1 The technology tools used to educate and train seafarers in relation to the STCW Convention requirements

This section attempts to answer or fulfil the first research question and the first objective of this study. DUT and CPUT have 30 desktop simulators in one lecture hall for simulator practice required for training according to the STCW Convention, and there are plans to buy an additional 30 desktop simulator. This is by no means sufficient, but a step in the right direction to complement the current technologies in the market. In reality, South Africa is not at par with the world’s best when compared to current world leading suppliers of seafarers, and the institutions would have to improve many components to compete with the best. The based on what was observed the South African MET universities infrastructure could do with some improvements to accommodate more technological training tools. The staff members commented on the lack of available human resource capacity to teach on the technical subjects that require seafarer experience. The institutions have the bare minimum of what the STCW requires, which is good but does not put South Africa on a competitive edge. Similarly, a number of students confirmed that the use of maritime technological tools or equipment is not incorporated in the course, which means the technological tools are being used by a certain group, which the faculty confirmed to be third year students.

The United Kingdom, Norway and the Philippines are competitively advanced in term of the technology tools used to educate and train cadets; but continue to search for ways to develop, improve and evolve, for the betterment of the students to keep current and relevant in the market. South Africa’s counterparts go over and above the standard minimum STCW Convention requirements and invest in technology tools that will put their institutions in the global map. The Philippines is a developing country like South Africa but has managed built a culture that makes the country a seafarer supplier of
choice, as well as worked to convince investors (shopping companies) that the Philippines is a country to invest in. As a result, MAAP has every technological tool a maritime institution needs and the country continues to find ways to keep the title of being the world’s leading seafarer supplier. Since the country has lot of islands, the country uses ferries as transport systems to move people around islands and there is a culture of fishing. This presents an opportunity to provide berths for training unlike South Africa with a shortage of berths (HRDC, 2014). Without a strong ship registry and ship ownership, the country needs to find practical solutions this challenge.

5.2.2 Methods used to educate and train seafarers

This section attempts to respond to the second research question and to fulfil the second objective of the study. The United Kingdom’s technology integrated and tools incorporated approach is the best way of producing the most competitive seafarers, out of all of the other approaches from the other universities studied. The English train their cadets holistically, using traditional academic theory classroom discussion and group work learning and teaching the traditional way, while incorporating technological based learning with other tools like the lake training and fire drill training for all-round knowledge of the seafarer. South Africa can find an approach that would best suit South African conditions and attempt to train cadets in a holist way. South Africa is a coastal country with both the MET universities in coastal cities, more demonstrative training can be incorporated in some way to familiarise the cadets with the sea, instead of limiting learning by conducting indoor based class activities that do not include the practical skills training of competencies that will be expected in the job market.

The Norwegian cutting edge technology teaching approach grooms cadets to be innovators and game changers instead of students that will follow trends set by others, and a close industry collaboration was visible between the school and the maritime industry. South Africa can find what works for them and specialize in a particular skill that the country can be known for. The Norwegian approach is more centred on
innovative maritime research training, including training of seafarers and the Norwegian universities balance the two quite well, which is why the country is so successful when it comes to technology advancements. Norway is the most adaptive country, in comparison to the other universities studied, in terms of technology culture and innovative thinking. Technology and innovation is the Norwegians’ strong key point, South Africa needs to finds its own strong key point that the country can be known for and use methods that will practically demonstrate this strength for the country to gain trust in the international market.

This is exactly what the Philippines did, by finding their place and strength in the international market and pushed until they were one of the world’s leaders in seafarer supply. The Philippines holistic approach is a recommended approach for South Africa as the Philippines is also a developing country that developed the country into one of the leading seafarer suppliers. The Philippines does not only use technology and the traditional method of learning, but trains cadets holistically, training on physical fitness, attitude and life at sea, so that the cadets are not surprised once the course is complete and start their professional careers.

South Africa aims to be an International Maritime Centre in Africa and one of the leading suppliers of seafarers (DoT, 2017), and one of the ways to achieve this is by ensuring that the country produces marketable and well trained maritime professionals and systems that will assure the world of the country’s competence. For an internationally competitive seafarer industry, the methods of instruction used at a maritime institutions need to match what the industry is looking for. The literature shows that the shipping industry is increasingly becoming more digital and new technologies enter the shipping and MET sector at a rapid pace. South African MET institutions need to adapt to these changes and respond to the technological advancements faster, if the country is to have relevant seafarers. The SA universities are lacking a variety of methods that demonstrate practical teaching and learning of the students. The desktop simulators and online lessons are a great start, but more
technology tools must be invested in, if the DUT and CPUT cadets are to stand a chance in the international market.

5.2.3 Technology in South African maritime education and training institution -

This section relates to research question three and therefore fulfils objective three. The data collected correctly alluded that the country is lagging behind in terms of technology, and that the two key MET universities require extensive capital to improve the infrastructures to international standards. This speaks to the universities response to technological advancements in respect to MET, suggesting that the institution is nowhere close to international standard in comparison to other countries they are competing with. Equally, others speak of the need for investors, and the importance of MET providers lobbying for funding from the private sectors and government. Essentially; the shipping industry is an international industry which benefits the private and public sector; it makes sense for both to contribute, including international investors because shipping serves multiple purposes and stakeholders. Unfortunately, before international investors can invest, the investors need to be certain that the investment will not go to waste and currently, South Africa is not in a position that can convince investors to invest in the country’s maritime developments. This was equally confirmed by the institutions suggesting that the maritime authorities are restrictive and do not accommodating other means of teaching and evolving and that the staff itself is inadequately trained with insufficient academic qualifications to carry out the work that needs to be done. For technology to even begin to assist South African MET institutions and improve the quality of professionals the country produces, South Africa needs to first resolve its capacity issues. The country needs to work on capacity building, before it can aim to be a leader in anything. International partnership with other MET institutions could be a solution to this challenge.

It was suggested by one of the institutions that the universities can hire past students that have had experience in the shipping seafarer industry, to return to the university
to lecturer and assist with the required skill that is lacking in the universities. This is one way that the university can develop the necessary capacity, but in addition to this, the institution needs not just hire a seafarer because of only experience but it must be coupled with a balance of academic qualifications as well. The disconnect of this crisis is that even though a seafarer might be a Master Mariner or a Chief Engineer, the industry’s seafarer certificates of competence are not the same as the academic qualification certificates that universities require when hiring for academic or lecturing positions. South Africa can then develop a strategy on how to merge the two requirements to insure that this insufficient capacity issue of is revolved.

5.2.4 South African MET institutions with reference to other countries

This part relates to all the questions and all the objectives of this study which sought to draw lessons for South Africa.

Before South African institutions can improve MET using technology to the level of other universities studied in this study, the institutions should procure qualified lecturers that can operate the modern technology equipment. Drawing from the findings at DUT, where the faculty mentioned a problem the university is experiencing with securing qualified lecturers and that there are vacancies which have not been filled for a while because no qualified personnel has been found. Apparently this has been an ongoing problem. It is only once critical problems like this are solved that the university can solve the lack of MET technology and equipment issue. Another important element could the collaboration between the two universities or the establishment of one or two dedicated Maritime Universities to order to focus all resources and investment and to attract sponsors. Like it was discovered from the literature that most of MET institutions rely more on sponsorship and that most of the countries that are playing a leading role in supplying seafarers have stand-alone maritime academies.

It became clear from responses from questionnaires that the students from both DUT and CPUT appreciate using the little technology provided and find it beneficial in their
learning, this appreciation would develop into motivation if the different stakeholders can be encouraged to invest more in the technology tools and equipment. The students further mentioned how technology based training gives insight on what to expect in the vessel and that it is much easier to use and understand. Some students understand practical work better through visual aid and simulation, other students add, and it is for this very reason why the use of technology is the future for maritime training.

Interestingly, a handful number of students did not see the need for better facilities and believed that the university is providing all it needs to prove and that there is nothing better the school could provide. This shows that some students do not know what other technologies are out in the market except the desktop simulators provided by the university. It is clear that these students are not aware of the various technology tools that are out there and only know of what has been provided by the university, and there was lack of motivation from others knowing that the university can do better and expressed their concerns on what awaits them after their qualifications. This reveals the culture South Africa has on technology, as well as the awareness the students have, which is why the students need to be introduced to technology as early as possible. Even if the technology is not in the university, but they need to experience a vessel as early as possible to be aware of its different components and this is where the national cadet programme vessel will come to good us. The vessel presents a perfect opportunity for students to familiarise themselves with the vessel. Every maritime students should have the opportunity to experience a vessel before graduating so that when the student are familiar with a vessel the course is complete.

One of the findings highlighted the United Kingdom’s approach to MET technology as being integrated in the curriculum, producing well-rounded competitive seafarers. The Norwegian’s approach being cutting edge technology, producing creative and innovative seafarers which incorporates research and innovation. The Philippines being a developing country like South Africa, sponsored by various investors, can be the best country for South Africa to learn from. South Africa can learn from all of these
countries, not necessarily to implement, but to learn on what would best serve South Africa.

Against the discussion in this chapter, the next chapter presents recommendations containing actionable tasks for the South African maritime education and training sector.
6  CHAPTER SIX: RECOMMENDATION AND CONCLUSION

6.1  Purpose and outline

The is a final chapter which provides the recommendations made based the study and finally gives a conclusion of what the thesis was about and its achievement. This chapter rounds and looks back and reflects on what the study touched on by highlighting key findings.

6.2  Recommendations

Based on the key findings and analysis, the table below presents recommendations that were formulated containing practical investigation and implementation actions:

*Table 3: Recommendations for South Africa*

| 1. Conducting maritime skills audit to establish available skills and seafarers | South Africa’s focus in maritime is a recent inspiration. Talks of maritime before the past decade was something unheard of. It can be suggested that a maritime skills audit be done before huge investments are put into the institutions. The SAMSA and HRDC (2014) Maritime Skills Review was not detail and did not provide the baseline in terms of seafarer’s figures hence to produce a database of maritime graduates, professionals versus the available maritime jobs in South Africa and international. This will avoid a situation where maritime graduates are stranded without jobs. It can be that South Africa is not ready to take a certain direction in maritime, but ready for another sector or division. Maritime has many sectors and divisions that the country can easily finds more lucrative and possibly more comfortably than the others. Once a comprehensive skills audit is completed, and the country knows exactly what skills are required to move forward and where more focus can be given, South Africa can |
then decide what is the best move for MET. This will further assist in establishing what will be feasible and what will not. Only after this audit can the country attempt to do proper maritime developments. The audit study should establish what skills are there and where these skills can be fitted to develop the maritime industry as effortlessly and as natural as possible, while attempts to develop the larger scale of the maritime are planned into strategy - long term goals.

| 2. Building capacity and training resources in terms MET technology equipment and infrastructure | South Africa’s vision is to be globally recognised as a maritime nation by 2030 (Claassen, Funke & Nortje, 2017) and have produced more than 7000 seafarers by 2019 (InvestSA, n.d.). Reviewing subsequent and more recent literature, it is unfortunate that this vision and figures have had little success to show. The general panorama is that South Africa has subsided instead of develop into the vision and promises the country foreshore. One of the reasons for this has been the evident lack of competitive infrastructure in the two main government maritime universities. Drawing from the findings of this study, it is evident that South Africa is not at par with many of the leading seafarer supplying nations in terms of infrastructure and technology advancements. What is also clear is the country’s lack of investment into the institutions. The country’s vision in maritime education and training development is good but it is not supported by action. The ambition to produce seafarers is commendable, but the lack of capacity for such ambitions need to be addressed. Most of the industry development budget is directed to other activities such as workshops, conferences and festivals; losing sight of the fact that once the word is out, the institutions need to be well equipped and ready for the students in the best of ways and not with the bare minimum the institutions can offer. With the current infrastructure, there is no way of producing quality seafarers of worldly standards; but before the institutions gets to that place, there needs to be adequate infrastructure and human capital that will move the vision forward and convince ship-owners to employ our seafarers. |
| 3. Poaching university alumni students for Human Resource capacity building | Referring back to the faculty staff questionnaire, one member made the suggestion that the university needs to hire alumni students that have collected seafarers of worldly standards; but before the institutions gets to that place, there needs to be adequate infrastructure and human capital that will move the vision forward and convince ship-owners to employ our seafarers. |
hire. This suggestion can be further analyzed and government (or investors) can sponsor interested seafarers at sea to pursue university masters and doctoral degrees for there to be a balance of experience and academically qualified human capital. The approach can alleviate the countries lack of appropriate skills that are needed to operate the technological tools and equipment to train the students accordingly. The National Cadetship Programme can further assist the students after graduating with the technological equipment experience, and the students can gain more confidence in operating the ship with both simulator and vessel experience. The students will be encouraged to pursue maritime studies when the developments are in place and the international ship-owners and agencies will have more confidences in South African cadets from the new systems in place. It is therefore recommended that the government or various stakeholders invest more in building capacity that will be skilled to work the MET technology equipment before investing in the various tools that the institution’s needs

<table>
<thead>
<tr>
<th>4. More beneficial Partnership Agreements with international MET institutions and the shipping industry</th>
<th>One of the challenges noted during the study is the lack of training berths for SA students. Partner agreements with other international universities and companies will assist the South African MET students become exposed to the global industry of shipping easily. If SA universities could partner with international universities and shipping companies to arrange student exchange programmes and seatime. This would assist students and expose them to other elements that they might not be aware of and work experience. This will also train students on being away from home, and on being on-board the vessel while studying hence to expose them to latest technology and equipment. The students from SA would appreciate and benefit from such exposure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. The Government MET budget</td>
<td>It is important to note that most of the South African maritime budget is allocated to various sectors, very little of those funds are spared for MET institutions. The vision as seen by the establishment of Operation Phakisa and SAIMI, as well as the R235 million that was announced to have been allocated to SAIMI is not utilized to resource the MET industry as one would have imagined. Since these funds never reached the MET universities, a recommendation would be that the funds be used to do research and capacitate MET institutions. Study the</td>
</tr>
</tbody>
</table>
current status of maritime within the country, study the global trends and industry predictions, and then establish what South Africa is feasibly capable of accomplishing, since the main focus of SAIMI is related to research innovation and development (SAIMI, 2018)

6. Building a new country’s dedicated Maritime University

MET technology or equipment is costly, and housing MET under a conventional university will prove difficult to find sponsorship. MET needs more funds to deliver quality and competitive education and if housed in a conventional university, other departments or faculties will as a result suffer. It is recommended that South Africa consolidates the maritime universities, similar to MAAP in the Philippines, in order to avoid the division of funds directed to multiple institutions. This will create answerability to the progress the country makes, with one dedicated institution driving the MET development. Because of the costs of running any MET related affairs are so high, the country’s maritime stakeholders should agree on what is feasible to develop, focus on that one component of development and develop it in one place.

The establishment of a dedicated MET institution will require industry support and stakeholder buy-in. A proper study is required to access its feasibility and whether it will be able to attract students from the country and the rest of Africa, and how these students will get berths after completion of their qualification. Until this study is done, for it the findings will determine what next step South Africa needs to take when it comes to a dedicated MET institution.

6.3 Conclusion

In conclusion, looking back at the study, an introduction was presented of what the study will focus on by providing an overview and background of the thesis. The problem statement was provided highlighting the issues and challenges the thesis will attempt to tackle and answer. The chapter additionally motivated the reasons for the study by looking at the significance, and the aim and objective of the study, and addressed these issues in the chapters of the thesis. It also highlighted the research
questions that the study centred on and answered, using the triangulation research methodology, to answer the research questions that were stated, as well as the assumptions given at the beginning of the study.

The dissertation was centred around three research question and three aims and objectives. These questions and objectives were answered and achieved through the use of three research methods that were identified, and together they formed a triangulation method. The literature review gave background knowledge of the South African MET system and the global overview understanding of technology in MET was necessary to understand past studies that covered maritime training, to understand the attempts previously tried to fill possible gaps in the MET domain. Past literature shed light on the continuous developments of technology, specifically in the maritime domain, and the need for the shipping industry professionals to acquire and update their skills and knowledge, to remain relevant in the shipping industry. The study also highlighted on the few challenges that also touch on the research questions and objectives, expanding on the research problems to be answered by the study. For South Africa to be regarded as a maritime nation or a leader in seafarer supply, these challenges in the MET sector will have to be affected in a researched and systematic way.

The findings confirm the assumption made at the beginning of the paper that there is a lack of digitally ready cadets in the South African institutions that will be ready to take its place in the international labour market. The findings also found that there is a lack of competent lecturers so a recommendation was given for the country to organize its skills supply and work on getting the fundamentals in order, in terms of what is possible within the timeframes allocated in the South Africa maritime projects. Once the necessary feasibility study has been complete, the country can then train the necessary individuals and lecturers. South Africa is not yet ready to invest in certain maritime tools and equipment because that country does not have adequate human resource to use that equipment. South Africa is struggling to find suitable maritime trainers and lecturers, any technology invested over and above what the institutions
have would be wasted investment, until the country has the relevant adequate human resource for the job.

The study was important and critical for South African as it forge ahead with exploring the oceans economy. The dissertation successfully accesses the status of the South African MET institutions technology and the ability to respond to technological advancement, in comparison to other parts of the world, namely the United Kingdom, Norway and the Philippines.
7 REFERENCES


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8 APPENDIXES

Appendix 1 – Consent Form to Participants

Consent Form

NB: Participants are to sign the consent form before participating in the interviews. You may sign electronically or online by submitting your questionnaire or electronic interview to the researcher.

Project Title: Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutions.

Researcher Name: Lihle Amanda Ngcobo
MSc. in Maritime Affairs specializing in Maritime Education and Training
World Maritime University
211 57 Malmö, Sweden
E-mail:w1701380@wmu.se

Dear Participant,
Thank you for taking the time to answer the attached questionnaire. The questionnaire will take approximately 10 - 15 minutes to complete, and upon completion, you may press send and the questionnaire will automatically be sent to me through Google Forms.
The purpose of the questionnaire is to collect data for a Master’s of Science Dissertation research paper at the World Maritime University (WMU) about the “Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutions.” The World Maritime University (WMU) is a post-graduate institution and belongs to the International Maritime Organization (IMO) under the United Nations (UN).
Data derived from this questionnaire is only for the purpose of the dissertation, complete confidentiality is assured and there will be no names requested on the questionnaire. Furthermore, once the responses to the questionnaire have been processed, the originals will be destroyed by the 30th of November 2018. Your participation is highly appreciated and will be extremely helpful in conducting a comprehensive research study with well-informed findings.
Please Tick Box

1. I confirm that I have read and understood the information above and give my consent to use my data that I will give on the questionnaire.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.

3. I agree to take part in the above study.

*Tick the statements if appropriate*

4. I agree to the interview / consultation being audio recorded

5. I agree to the interview / consultation being video recorded.

6. All data collected will be deleted upon completion of the research as stated in the research guidelines

**Consent**

Your signature below indicates that you have decided to participate voluntarily to this study and that you have read and understood the information provided above. You will be given a copy of this form to keep.

Signature of Participant: ______________________________

Date________________

Name of Participant (PLEASEPRINT): ______________________________
Appendix 2 – STCW Convention, 1978, as amended, Regulation I/6: Training and Assessment

Section A-I/6

Training and assessment

1. Each Party shall ensure that all training and assessment of seafarers for certification under the Convention is:

   .1 structured in accordance with written programmes, including such methods and media of delivery, procedures, and course material as are necessary to achieve the prescribed standard of competence; and

   .2 conducted, monitored, evaluated and supported by persons qualified in accordance with paragraphs 4, 5 and 6.

2. Persons conducting in-service training or assessment on board ship shall only do so when such training or assessment will not adversely affect the normal operation of the ship and they can dedicate their time and attention to training or assessment.
Appendix 3 – STCW Convention, 1978, as amended, Regulation I/12: Standards governing the use of simulators

Section A-I/12
Standards governing the use of simulators

PART 1 – PERFORMANCE STANDARDS
General performance standards for simulators used in training 1 Each Party shall ensure that any simulator used for mandatory simulator-based training shall: .1 be suitable for the selected objectives and training tasks; .2 be capable of simulating the operating capabilities of shipboard equipment concerned, to a level of physical realism appropriate to training objectives, and include the capabilities, limitations and possible errors of such equipment; .3 have sufficient behavioural realism to allow a trainee to acquire the skills appropriate to the training objectives; .4 provide a controlled operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relevant to the training objectives; .5 provide an interface through which a trainee can interact with the equipment, the simulated environment and, as appropriate, the instructor; and .6 permit an instructor to control, monitor and record exercises for the effective debriefing of trainees.

General performance standards for simulators used in assessment of competence required under the Convention or for any demonstration of continued proficiency so required shall: .1 be capable of satisfying the specified assessment objectives; .2 be capable of simulating the operational capabilities of the shipboard equipment concerned to a level of physical realism appropriate to the assessment objectives, and include the capabilities, limitations and possible errors of such equipment; .3 have sufficient behavioural realism to allow a candidate to exhibit the skills appropriate to the assessment objectives; .4 provide an interface through which a candidate can interact with the equipment and simulated environment; .5 provide a controlled
operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relevant to assessment objectives; and - 27 - STCW/CONF.2/34 I:\CONF\STCW\2\34.DOC .6 permit an assessor to control, monitor and record exercises for the effective assessment of the performance of candidates. Additional performance standards 3 In addition to meeting the basic requirements set out in paragraphs 1 and 2, simulation equipment to which this section applies shall meet the performance standards given hereunder in accordance with their specific type. Radar simulation 4 Radar simulation equipment shall be capable of simulating the operational capabilities of navigational radar equipment which meets all applicable performance standards adopted by the Organization* and incorporate facilities to: .1 operate in the stabilized relative-motion mode and sea- and ground-stabilized true-motion modes; .2 model weather, tidal streams, current, shadow sectors, spurious echoes and other propagation effects, and generate coastlines, navigational buoys and search and rescue transponders; and .3 create a real-time operating environment incorporating at least two own-ship stations with ability to change own ship’s course and speed, and include parameters for at least 20 target ships and appropriate communication facilities. Automatic Radar Plotting Aid (ARPA) simulation 5 ARPA simulation equipment shall be capable of simulating the operational capabilities of ARPAs which meet all applicable performance standards adopted by the Organization* , and shall incorporate the facilities for: .1 manual and automatic target acquisition; .2 past track information; .3 use of exclusion areas; .4 vector/graphic time-scale and data display; and .5 trial manoeuvres. PART 2 – OTHER PROVISIONS Simulator training objectives 6 Each Party shall ensure that the aims and objectives of simulator-based training are defined within an overall training programme and that specific training objectives and tasks are selected so as to relate as closely as possible to shipboard tasks and practices. * See relevant/appropriate performance standards adopted by the Organization. STCW/CONF.2/34 - 28 - I:\CONF\STCW\2\34.doc Training procedures 7 In conducting mandatory simulator-based training, instructors shall ensure that: .1 trainees are adequately briefed beforehand on the exercise objectives and tasks and are given sufficient planning time
before the exercise starts; .2 trainees have adequate familiarization time on the simulator and with its equipment before any training or assessment exercise commences; .3 guidance given and exercise stimuli are appropriate to the selected exercise objectives and tasks and to the level of trainee experience; .4 exercises are effectively monitored, supported as appropriate by audio and visual observation of trainee activity and pre- and post-exercise evaluation reports; .5 trainees are effectively debriefed to ensure that training objectives have been met and that operational skills demonstrated are of an acceptable standard; .6 the use of peer assessment during debriefing is encouraged; and .7 simulator exercises are designed and tested so as to ensure their suitability for the specified training objectives. Assessment procedures

Where simulators are used to assess the ability of candidates to demonstrate levels of competency, assessors shall ensure that: .1 performance criteria are identified clearly and explicitly and are valid and available to the candidates; .2 assessment criteria are established clearly and are explicit to ensure reliability and uniformity of assessment and to optimize objective measurement and evaluation, so that subjective judgements are kept to the minimum; .3 candidates are briefed clearly on the tasks and/or skills to be assessed and on the tasks and performance criteria by which their competency will be determined; .4 assessment of performance takes into account normal operating procedures and any behavioural interaction with other candidates on the simulator or with simulator staff; .5 scoring or grading methods to assess performance are used with caution until they have been validated; and .6 the prime criterion is that a candidate demonstrates the ability to carry out a task safely and effectively to the satisfaction of the assessor. 

Each Party shall ensure that instructors and assessors are appropriately qualified and experienced for the particular types and levels of training and corresponding assessment of competence as specified in regulation I/6 and section A-I/6.
Appendix 4 – Faculty Staff Member Questionnaire Form (DUT & CPUT)

DUT - Faculty Staff Member Questionnaire Form

Greetings,

Thank you for participating on this survey. This is a voluntary questionnaire regarding a research topic on the "Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutions." The purpose of this questionnaire is to collect information from the maritime institution faculties and will only be answered by the maritime faculty staff within the maritime institution mentioned on the questionnaire. The results of the survey will be used in a Master's thesis at World Maritime University, and will only serve as a part of the master's thesis. All participants will answer anonymously. The survey consists of 30 questions (10 from each section), it will take approximately 10 to 15 minutes to complete, and once the responses have been processed, the originals will be destroyed. Because of the inconvenience of printing and scanning of the attached Consent Form, by submitting this questionnaire you will be giving your consent for the researcher to use the information provided for the purpose of the study. Your participation is highly appreciated and will be extremely helpful in conducting a comprehensive research study with well-informed findings. Thanking you for your assistance in advance. *

Required

Maritime Education and Training (MET) Ship Berth Placement Questions

Part 1:

1. Please fill in this questionnaire if you are a staff member from Durban University of Technology / Cape Peninsula University of Technology:

2. What is your position in the institution?

3. How many students does the maritime university or the maritime faculty have in total? (Please indicate approximate number) *
4. Does the institution guarantee cadetship berths after completing the course? * Mark only one oval. Yes No Not sure Other:

5. Does the institution assist with cadetship berths after completing the course? * Mark only one oval. Yes No Not sure Not Applicable Other:

6. With each graduating academic class, how many cadets secure cadetship training within the first 6 months of completing their course/qualification? (Please indicate approximate percentage) * Mark only one oval. 0 - 10% 11 - 20% 21 - 30% 31 - 40% 41 - 50% 51 - 60% 61 - 70% 71 - 80% 81 - 90% 91 - 100%

7. What options are available for your students to get sea-time training? (Tick all that apply) * Check all that apply. National training vessel Commercial Fleet from National Ship Registry Agreements in place with other government Other:

8. Does the country have its own fleet of vessels that can be used to provide berths for training? * Mark only one oval. Yes No Not sure Other:

9. Does the country have any vessels under its ship registry that can take on the students after their course? * Mark only one oval. Yes No Not sure Other:

10. Are there any possibilities or discussions of your country considering doing an open registry? * Mark only one oval. Yes No Maybe

Maritime Education and Training Tools and Equipment(s) Part 2:

11. What are the teaching methods used to educate and train maritime students in your institution? (Tick all that apply) * Check all that apply. Classroom/ Lecture Hall Interaction Distance Learning On-line Lessons Simulator Other:

12. What are the methods and tools used to assess maritime students in your institution? (Tick all that apply) * Check all that apply. Written test(s) and examination(s) Individual written assignment(s) Group assignment(s) Individual presentation(s) Group presentation(s) On-line assessment(s) Practical simulation assessment(s) Other:
13. What informs your institution's MET teaching methods used in no. 11? (Tick all that apply) * Check all that apply. Research Industry influence Digital era influence Academic quality reasons Government influence University policy influence Other:

14. What are the maritime technology training tools or equipment(s) used to educate and train the students? (Tick all that apply) * Check all that apply. Electronic chart display and information systems (ECDIS) simulator Bridge simulator GMDSS simulator Shipboard Radar/ARPA Unit LNG simulators Crane simulators Heavy lift simulators Engine room simulators Auxiliary machinery and propulsion training None of the above Other:

15. What are the maritime technology training tools or equipment(s) used to assess the students? (Tick all that apply) * Check all that apply. Electronic chart display and information systems (ECDIS) simulator Bridge simulator GMDSS simulator Shipboard Radar/ARPA Unit LNG simulators Crane simulators Heavy lift simulators Engine room simulators Auxiliary machinery and propulsion training None of the above Other:

16. Did the university buy the maritime technology training tools or equipment(s) the institution uses or were they sponsored? * Mark only one oval. University bought some University bought all Some were sponsored All were sponsored 50% sponsored and 50% bought

17. Who is responsible for the maintenance of the maritime technology training tools or equipment(s)? *

18. Would you say your maritime technology training tools or equipment(s) are old or new? * Mark only one oval.

1 2 3 4 5 6 7 8 9 10

Very old

Brand new
19. Are there any plans to acquire new maritime technology training tools/equipment(s) or dispose of the old ones? * Mark only one oval. Buy new tools and/or equipment(s) dispose of old tools and/or equipment(s) Upgrade software on existing tools and/or equipment(s) Other:

20. Has the maritime technology training tools/equipment(s) helped in improving the training of maritime professionals? * Mark only one oval.

1 2 3 4 5 6 7 8 9 10

Not helpful at all
Extremely helpful

Please explain in detail your opinion on number 20:

Maritime Faculty Student Matters Part 3:

21. Please provide an approximate number of applications that the university receives for the maritime faculty each year, on average? (Example: 1000/year)? *

22. Please provide an approximate percentage of qualifying applicants per year, on average? (Example: 50% of the 1000) *

23. Please provide an approximate number of students that the university takes for the maritime faculty as a whole? (Example: Maritime Studies Faculty or the entire university if it is a specialized maritime institute) *

24. Please provide an approximate number of students that each course has on average? (Example: Nautical Studies/Marine Transportation Department) *

25. Please provide an approximate number of students that each class has per course, on average? (Example 50/class) *

26. Please provide an approximate number of lecturers that teach your specific course, including all the course subjects/modules? (Example: 5/course) *
27. Please provide an approximate pass rate/ year, on average, in percentage(s)? (Example: 85%) *

28. Please provide an approximate dropout rate/ year, on average, in percentage(s)? (Example: 10%) *

29. Please may you share your opinion about the maritime developments happening in the maritime industry, preferably in MET in light of the national or global technology advancements?

30. Please may you share your opinion on where the university/ institution could improve in terms of maritime education and training using technology tools/ equipment(s) or/and what the university/ institution is doing right?

Thank you very much for your participation.
Appendix 5 – Student Questionnaire Form (DUT & CPUT)

Student Questionnaire Form

Greetings,

Thank you for participating on this survey. This is a voluntary questionnaire regarding a research topic on the "Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutions." The purpose of this questionnaire is to collect information from the maritime institution faculties and will only be answered by the maritime students within the maritime institution mentioned on the questionnaire. The results of the survey will be used in a Master's thesis at World Maritime University, and will only serve as a part of the master's thesis. All participants will answer anonymously. The survey consists of 15 questions, it will take approximately 5 to 10 minutes to complete, and once the responses have been processed, the originals will be destroyed. Because of the inconvenience of printing and scanning of the attached Consent Form, by submitting this questionnaire you will be giving your consent for the researcher to use the information provided for the purpose of the study. Your participation is highly appreciated and will be extremely helpful in conducting a comprehensive research study with well-informed findings. Thanking you for your assistance in advance. *

Required

1. Please fill in this questionnaire if you are a student from Durban University of Technology / Cape Peninsula University of Technology:

2. What is your age range? * Mark only one oval. 18 or less 19 - 20 21 - 22 23 - 24 25 - 29 30 - 35 36 - 39 40 - 45 46 - 50 51 or more

3. What is your gender/ sex (according to your identity document)? * Mark only one oval. Male Female Other:

4. What qualification are you studying for? * Mark only one oval. Certificate Diploma Degree Other:
5. Under which specialization does your enrolled course fall under? * Mark only one oval. Nautical Studies / Marine Transportation (Sea-going: Deck) Marine Engineering (Sea-going: Engine) Shipping and Logistics Studies (Land-based: Freight and Logistics) Trainee in culinary (Cooking and catering studies) Other:

6. Who is funding your tuition fees? (Tick all that apply) * Check all that apply. Parents/ Guardian University Bursary/ Scholarship Other Bursary/ Scholarship Other:

7. Did you have any sea-time experience before enrolling at the maritime institution? * Mark only one oval. Yes No Other:

8. What is the duration of your course? (Please state in years.) * Mark only one oval. 1 year 2 years 3 years 4 years 5 years or more

9. At what level are you currently doing in your course at this particular time? * Mark only one oval. 1st year 2nd year 3rd year 4th year 5th year or more

10. Does the course involve the use of maritime technological tools or equipment(s) for training of competence? * Mark only one oval. Yes No Other:

If yes, please tick the maritime technological tools or equipment(s) that your institution uses? (Tick all that apply) Check all that apply. Bridge simulator GMDSS simulator Shipboard Radar/ARPA Unit Video conference lecturing None of the above

11. How often do you train using these tools or equipment(s)? (Please indicate approximately) Mark only one oval. Daily A few times a week Once a week Once in two weeks Once a month Once a year Hardly ever, if ever one gets a chance in a given year Never Not Applicable

12. Please tick the maritime technological tools or equipment(s) your institution uses to assess your competence skills? (Tick all that apply) Check all that apply. Bridge simulator GMDSS simulator Shipboard Radar/ARPA Unit Video conference lecturing None of the above Other:

13. What other maritime technological tools or equipment(s) do you think the
institution would benefit from, that your institution does not already have? (Tick all that apply) * Check all that apply. Electronic chart display and information systems (ECDIS) simulator Bridge simulator GMDSS simulator Shipboard Radar/ARPA Unit LNG simulators Crane simulators Heavy lift simulators Engine room simulators Auxiliary machinery and propulsion training Video conference lecturing None of the above Other:

14. On a scale of 1 to 10, is technology based training more helpful in understanding and demonstrating your confidence than the traditional training methods (traditional being training methods that do not involve technology)? * Mark only one oval.

1 2 3 4 5 6 7 8 9 10

Not helpful at all

Extremely helpful

15. Please explain your reason for your answer above (number: 14) *
Appendix 6 – Global Professionals and Expert Interview

Global Professionals and Expert Interview

Greetings,

Thank you for participating on this interview form. This is a voluntary interview regarding a research topic on the "Response to technology advancement in Maritime Education and Training: A case study of the South African national maritime institutions." The purpose of this interview is to collect information from the maritime industry professionals and experts, as part of my dissertation requirement. The results of this interview findings will be used in a Master's thesis at World Maritime University, and will only serve as a part of the master's thesis. The interview form consists of 5 interview questions and once the finding has been processed, the original will be destroyed. Because of the inconvenience of printing and scanning of the attached Consent Form, by submitting this questionnaire you will be giving your consent for the researcher to use the information provided for the purpose of the study. Your participation is highly appreciated and will be extremely helpful in conducting a comprehensive research study with well-informed findings. Thanking you for your assistance in advance. * Required

1. I.) What country do you work in? (For example: Sweden) *

2. II.) What is your nationality? *

3. III.) What sector is your current employment in? *

4. IV.) What in the title of your position at work? (For example: Maritime Lecturer) *

5. V.) How long have you been in the maritime industry? *

1. What are the key methods and technology tools used to educate, train and assess seafarers in relation to the IMO's STCW International Convention requirements?
(IMO International Maritime Organization and STCW - Standards of Training, Certification and Watchkeeping for Seafarers) *

2. What is the impact of technology in maritime education and training, concerning the maritime professionals and seafarers? *

3. What is your opinion regarding the use of technology in maritime education and training in the future? *

4. What can the Maritime Education and Training (MET) industry do, in your opinion, in preparation for a technological future? *

5. What is the best way forward and key in terms of MET developments, for a developing country like South Africa that wants to globally compete on supplying seafarers? *

Thank you very much for your participation.