What drives the Ship: The Human Element.

The Development of a Learning Journey in Maritime Education and Training to Promote Safe Ship Operations

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Abstract

Seafarers are considered to be essential “key workers” (International Maritime Organization, 2020b) in the maritime transport and global trade network, facilitating the prosperity of society (International Maritime Organization, 2022). The ability of the human element to develop and apply the necessary "skills, education and training", is understood as the crucial element in the safe operation of ships and the protection of the marine environment (International Maritime Organization, 2022).

This study focuses on the human element within academic nautical education, aiming at a systematic approach to contextualise education and the application and transfer of knowledge to the safe operation of ships. For the empirical approach, qualitative interviews were conducted with maritime experts to explore the causes of human behaviour and to identify the competencies considered essential for a seafarer, now and in the future. Based on the findings, recommendations were made for methods of effective knowledge transfer to be integrated into the existing curriculum of higher education in nautical science.. This approach explores a reciprocal revelation of an extensive literature review and the application of the qualitative research, providing aspects within the global industry and the application to the educational scheme, advocating the promotion of the transfer knowledge in a contextual view.

Variables such as individual aspects of learning, the accelerating impact of technological advances, economic constraints, cultural perceptions and the educator - student relationship were identified as significant factors to consider.

A potential solution is proposed in the form of an integrated learning journey, which cultivates a comprehensive understanding of individual career motivations and reinforces individual strengths and skills. This recommendation advocates a lifelong learning perspective and a collaborative approach to the educational context with the wider maritime industry.

“Der Verlauf von Beziehungen, so macht uns eine innere Stimme glauben, muß aus dem Aufbau und der Gesetzmäßigkeit der mit Sinnen greifbaren Körper erklärt werden, die dabei in Beziehung zueinander stehen. […]. Die Beziehungen zwischen ihnen und damit die größere Einheit, die sie miteinander bilden, denken wir uns unwillkürlich als etwas Späteres und Nachträgliches. Aber diese Denkgewohnheiten, fruchtbar, wie sie bis zu einer gewissen Grenze bei der Bewältigung der Erfahrungen von unbelebten Substanzen sein mögen, führen immer von neuem zu ganz spezifischen Ungereimtheiten bei der gedanklichen Bewältigung jener anderen Erfahrungen, die wir uns selber, die uns Mensch und Gesellschaft bieten.“

Norbert Elias, Die Gesellschaft der Individuen, 2001

Acknowledgments

The term 'the human element' has become ubiquitous in so many ways and contexts. From my background of working and living on ships, I embarked on a personal quest to research and explore this concept. During my time at sea, I gained invaluable experience and encountered situations that inspired me to explore human interactions and system interdependencies, and allowed me to increasingly adopt a systemic approach. This journey has been accompanied by so many people who have deepened my motivation to learn and broadened my horizons in understanding the human element far beyond the nautical education perspective, and will enrich my future professional and personal life.

First and foremost, I would like to express my gratitude to the faculty librarians whose unwavering support, time and effort have been central to my research endeavours. Their assistance not only facilitated my progress, but also guided my course and motivation on numerous occasions.

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Namaste.

Plagiarism Declaration

I hereby declare that this written work is my own independent work, that all material and ideas from the work of others are acknowledged, and that quotations and paraphrases are clearly indicated in the appropriate form. I have not submitted, and will not submit, any part of this written work as examination material to this or any other educational institution. I have not used the work of any other student, past or present. I have not used the services of any professional person or agency in the preparation of this work.

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List of Acronyms

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
BIMCO	Baltic and International Maritime Council
BMDV	Federal Ministry for Digital and Transport (Bundesministerium für Digitales und Verkehr)
BSH	Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie)
BRM	Bridge Resource Management
ch.	Chapter
CoC	Certificate of Competency
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
DNV	Det Norske Veritas
ECDIS	Electronic Chart Display and Information System
ECTS	European Credit Transfer System
EQF	European Qualifications Framework
ESG	European Higher Education Area
et seq.	and the following
EU	European Union
FSA	Formal Safety Assessment
GMDSS	Global Maritime Distress and Safety System
GOC	General Operator's Certificate
GPS	Global Positioning System
HTW	Sub-Committee on Human Element, Training and Watchkeeping

IAMSAR	International Aeronautical and Maritime Search and Rescue Manual
IAMU	International Association of Maritime Universities
IATA	International Air Transport Association
ILO	International Labour Organization
IMO	International Maritime Organization
ICS	International Chamber of Shipping
INTERTANKO	International Association of Independent Tanker Owners
ISF	International Shipping Federation
ISGOTT	International Safety Guide for Oil Tankers and Terminals
IMDG Code	International Maritime Dangerous Goods Code
ISM Code	International Safety and Management Code
ISO	International Organization for Standardization
ISPS Code	International Ship and Port Facility Security Code
ITF	International Transport Workers' Federation
ITU	International Telecommunication Union
LOFT	Line-oriented Flight Training
MARPOL	International Convention for the Prevention of Pollution from Ships
MASS	Maritime Autonomous Surface Ships
MEPC	Marine Environment Protection Committee
MET	Maritime Education and Training
MLC	Maritime Labour Convention
MSC	Maritime Safety Committee
n.d.	no date

NGO	Non-Governmental Organization
NOA	Nautical Officer Assistant
OCIMF	Oil Companies International Marine Forum
para.	Paragraph
Reg.	Regulation
SAkk	Foundation Accreditation Council (Stiftung Akkreditierungsrat)
SAR	International Convention on Maritime Search and Rescue
See-BV	Verordnung über die Befähigung der Seeleute in der Seeschifffahrt, also Seeleute-Befähigungsverordnung
SOLAS	International Convention for the Safety of Life at Sea
StAK	Permanent Working Group of the Coastal States (Ständige Arbeitsgemeinschaft der Küstenländer für das Seefahrtbildungswesen)
STCW 78	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978
STCW Code	Seafarers' Training, Certification and Watchkeeping Code
UNCLOS	United Nations Convention on the Law of the Sea
VDR	Verband Deutscher Reeder
WMU	World Maritime University

1 Introduction

More than 80% of global trade is delivered by sea, making the maritime supply chain a driver of economic development and growth, influencing prosperity and social welfare (International Maritime Organization, 2020b). The role of the human element in the maritime industry has been recognised as an essential workforce that facilitates the international trade and as such forms the backbone of the global economy (International Maritime Organization, 2000).

The importance of the human element permeates all levels and functions of the maritime economy (Oltedal and Lützhöft, 2018b, p. 72). Actors in the macro-micro perspective of the maritime industry include regulators, shipyards, system and equipment designers, insurers, ship management companies and ship crews, all of whom are responsible for ensuring the safe operation of ships and minimising adverse effects and potential damage to human life, the environment and property (Maritime & Coastguard Agency, 2014). This understanding encompasses all human actions and the consequences of human behaviour as a shared responsibility involving the many stakeholders in the maritime industry. While the human element is recognised as essential to the safe operation of ships, it has also been identified as a significant causal factor in the majority of accidents in the industry (Witherbys, 2021, p. 11). Therefore, the implementation of effective safety management strategies needs to espouse the individual human capabilities and the limitations of the various interdependencies within the industry, including regulatory, economic and operational (Maritime & Coastguard Agency, 2014). Historically, the approach to accidents in the maritime industry has been characterised as “reactive” (Schröder-Hinrichs et al., 2013, p. 244), focusing primarily on the implementation of technical solutions and the application of linear cause-and-effect model solutions to mitigate the causes and effects of 'human error' (Schröder-Hinrichs et al., 2013, p. 256). This perspective focuses primarily on the role of seafarers on board, which involves physically managing the sociotechnical operation of ships as operators at the ‘sharp-end’ [original emphasis] (Reason, 2008, p. 98), based on a behaviour that is “observable and directly attributable to accidents” in this role (Grech, 2018, p. 91).

The application of technology-driven cause-and-effect solutions has led to a system view where the various elements, such as technical equipment, design and the human are considered controllable ‘components’ [original emphasis] (Schröder-Hinrichs et al., 2013, p. 257). Furthermore, education and training initiatives are primarily aimed at ensuring

compliance with the implemented regulatory framework (Grech, 2018, p. 91) and promoting technical solutions within the overall safety management system (Lützhöft and Vu, 2018, p. 110). Thus, the adoption of technical solutions and the appointment of the seafarers as the responsible and legally accountable individuals facilitates the safety approach in the maritime system (Dekker 2015, p. 2). However, the traditional focus of accident investigation and subsequent maritime education and training approaches fail to incorporate individual and organisational learning capabilities (Grech, 2018, p. 91), which are rooted in cognitive and behavioural change, as critically reiterated in accident investigation (Manuel, 2017, p. 164).

1.1 Objective and Scope

This study reviews and elaborates on educational methods for an integrated learning and training approach in maritime education with the aim of promoting a holistic safety culture in shipping. The approach considers bridging the perceived gap of human error as a critical element of safety in ship operations and effective knowledge transfer through the application of long-term knowledge transfer, linking university education with professional performance. The human element aspects of maritime education are explored with attention to the sociotechnical competences in the educational process and the methods to transfer knowledge appropriately and effectively to the complex working environment. The emphasis on sustainable educational methods and skills development in nautical education stems from the continuing recognition of the human element as the weak link in improving safety within the maritime industry. Building on this recognition, this research seeks to provide insights to advance educational approaches and implement potential methods to promote knowledge transfer from an academic perspective and embedded in a long-term perspective within the micro-macro context.

The key research questions of the thesis scrutinise on the following considerations:

(1) The perception of the human element in international shipping as the problem to be addressed in order to promote safety. Ship safety and related maritime education and training (MET) are governed by international regulatory frameworks, often established in response to accidents. Ship operations have been recognised as a complex safety environment in which an understanding of human capabilities plays a critical role in ensuring safe ship operations.

(2) The explication of the knowledge, skills and competences needed now and in the future by a nautical officer as the responsible operator in the sociotechnical system ship, recognising that the existing educational system has been developed as an approach to provide minimum standards of education with an emphasis on technical skills and compliance.

(3) The methods of incorporating learning and training elements into the academic nautical education to promote the human element perspective in the safe operation of ships. The implications of the current academic education in relation to the complex system management of the professional entity are elaborated on, promoting the learning abilities and skills of the individual to strengthen the overall focus of the development of the curriculum with elements of long-term persepective to support young professionals and the quality of education as part of safety in the maritime environment.

Considering the elaborations given in relation to the extensive scope of the human element in the maritime safety system, this research focuses on the current higher education system in nautical sciences. The focus is on seafarers' competencies and adaptation to the changing demands of the evolving working environment, in line with the methods of knowledge transfer in education and training. The qualifications of nautical officers and masters, outlined in chapter 3, are bound to the minimum performance standards set out in the global regulatory framework, the ‘International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978’ (STCW 78) along with the ‘Seafarers' Training, Certification and Watchkeeping Code’ (STCW Code) adopted in 1995 (Parsons and Allen, 2018, p. 24). The implementation of these standards was intended to address the existing deficiencies in MET and emphasised the need and importance of establishing a globally harmonised framework for the training and professional competence of seafarers as a critical element in maintaining safe shipboard operations (Morrison, 1998, p. 11).

In this study, academically certified officers in accordance with STCW 78 and the STCW Code will be referred to as "nautical officer", "bridge officer" or "deck officer" without any intention to distinguish between these terms or their roles. The interchangeable usage is based on the role of an officer who is part of the deck department, responsible for duties on the bridge and defined as "in charge of a navigational watch" (Chapter A-II/1, STCW Code, International Maritime Organization, 2017a), as opposed to officers assigned to the engineering department and in charge of the engine room (International Maritime Organization, 2017a).

The qualification of nautical officers follows traditional methods and repetitive processes in the established education system, with an emphasis on the compliance with procedures and performance as outlined in the competency-based education scheme (Manuel, 2017, p. 164) This approach was introduced in response to accidents, with a focus on a more systematic approach involving the various stakeholders and their responsibilities and contributions within national and educational concepts (Morrison, 1998, p. 11). Chapter 3.5 et seq. outlines the higher education system from the perspective of the German MET system using the example of the Maritime Faculty in Leer. The maritime industry's dependence on qualified seafarers and the challenge of the shortage of qualified personnel, which has been an ongoing issue in the industry, is discussed in chapter 3.7.2, together with the criticism of minimum competence standards, the integration of technical advances in the maritime industry into training and the need to meet the demands of the maritime profession in a dynamic working environment (Fei, 2019, p. 5).

The seafaring profession as a highly contextualised life of social deprivation and conservative hierarchies is then critically examined in chapter 4. This socially constructed view of a seafarer's life and work is reflected in the organisational structures that exist on ships and affect seafarers' lives on board within the various social dynamics, including lines of communication and the interrelationship between culture and safety system processes. Awareness of the social aspects of seafarers is then applied to the system of safe shipboard operations in chapter 5, where human error, accidents and the establishment of a safety culture are discussed as part of an existing framework for education, training and safe shipboard operations. The theories of the competency-based education system and the principles and process of learning are outlined in chapters 6 and 7, followed by the established methods of knowledge transfer in the higher education system in chapter 8.

The issues outlined above are explored in depth in the empirical research discussed in chapter 9. The analysis of expert interviews reviews the essential competencies, skills and knowledge required of nautical officers and challenges the view of the role of the sharp end operator. The contribution of the higher education system to the transfer of knowledge and the promotion of the skills and competencies required for nautical officers in ship operations provided in the context of higher education is reviewed. Based on the qualitative research findings, recommendations have been formulated in chapter 10.2 to integrate knowledge transfer methods into the educational curriculum, with a focus on

improving safe ship operations and promoting self-organised learning processes. Given the complexity of the research subject and the limitations of the qualitative approach, the recommendations advocate a flexible and long-term approach. The recommendations have been developed for practical application in lectures, informal learning methods and simulation scenarios. This approach aims to raise awareness of a broader societal concept of personal motivation, individual strengths and diversity in order to promote the essential skills and competencies for nautical officers, and encompasses both social and professional perspectives, where the motivation to learn and develop personal competencies and individual "talent" (Michaels et al., 2001, p. xii), advocates an individual and industry-driven, long-term approach.

1.2 Methodology

The study focuses on the human element in maritime higher education in nautical sciences and on the complexity of the human role as a responsible actor in the safe operation of ships. Given the complexity of the topic outlined and the limitations of the research question, a qualitative approach has been adopted (Flick, 2014, p. 26). The empirical research data were obtained through qualitative interviews that explored the knowledge, skills and competences and knowledge transfer methods in the maritime higher education system. The process involved a comprehensive literature review, and the conduct and analysis of expert interviews (Flick, 2014, p. 214).

The methodology of qualitative expert interviews and extensive literature review follows a theoretical-empirical approach (Hopf and Kuckartz, 2016, p. 17), utilising semi-structured interviews and content evaluation methods proposed by Meuser and Nagel (1991). The methodology used reveals the subjective perspectives of the experts and facilitates the processes of contributing to theory development (Flick, 2014, p. 214). This qualitative approach serves the purpose of openness to the research field, while engaging with the subjective insights of the interviewees (Hopf and Kuckartz, 2016, p. 17). Based on the findings, recommendations for an integrated learning journey have been developed. While the context of the study of maritime education and its practical application was approached with a view to the global nature of the maritime system, a German context was applied with a focus on the Maritime Faculty in Leer.

2 Historical Pillars of Nautical Education

The profession and education of seafarers have continuously evolved within the interdependencies of the micro-macro dynamics of society. The necessity for sea travel has entailed the development and incorporation of scientific knowledge, technical innovation, and competitive forces as the main drivers of the industry (Bergmann and Bungert 2022, p. 13). The historical development of waterborne transport is in itself a reflection of the rise and prosperity of the nations that commanded the seas and thus controlled the world (Raleigh, 1650, p. 35). Seafarers and travellers were the actors who stimulated both the ‘liquefaction’ and the ‘solidification’ of geographical and ethnological spaces and the transformation of cultures and knowledge. Thus, the development of nautical education has evolved through traditional structures and the need to incorporate and reflect the socioeconomic interdependencies and constraints of the trade, which has become a “tightly knit business community” (Stopford, 2009, p. 45). In order to provide a context for the subsequent discussion, a brief overview of relevant historical developments in the seafarer's profession and education is provided below.

2.1 Navigare necesse est

Navigation has been defined as a method of determining one's "position, direction and speed" using "maps and a compass or the sun and stars" and taking into account the anticipated perils of the sea in order to reach a destination safely (Sinclair, 1987, p. 959). Since the late 20th century, with the advent of new technologies and the introduction of satellite technology (Schneider, 2015, p. 32), the forms and meanings of 'navigation' have evolved from their traditional maritime context to encompass various contexts and environments, including the 'navigation' in road-based traffic and the 'navigation' utilised in internet-based orientation (Meyer-Haßfurther et al., 2002, p. 142).

Born out of necessity, seaborne navigation has traditionally been the initiator and promoter of trade and wealth, the disseminator of raw materials, cultural assets and language (Feddersen, 1991, p. 10; Jiffy, 1995, p. 36; Lengsfeld, 1991, p. 10; Stopford, 2009, p. 6). The history of seafaring reflects the evolution of symbols and language into skills and knowledge, shaped by the cultural exchange, exploration and exploitation in temporal and spatial contexts and aligned with technological advancement (Bitterli, 1982). Historically, travel has served as a means of permeating the various levels of

society and across societies, driven by ethical, spiritual, anthropological and scientific interests (Füssel, 2021, p. 96). The acquisition and acceleration of knowledge and skills is attributed to the narratives recited by monks, pilgrims, craftsmen, noblemen, or immigrants travelling by sea (Bitterli, 1982, p. 26; Schneider, 2015, p. 32). In this perspective, the seas have consistently contributed to knowledge-related mobility (Füssel, 2021, p. 97), including tacit knowledge and physical abilities, developed through travel and exploration at sea or when encountering unfamiliar shores (Schneider, 2015, p. 32).

The origins of European waterborne travel are associated with the ancient peoples of Akkad and Sumer, who sailed the Tigris and Euphrates rivers some 6,000 years ago (Mielke, 1958, p. 9). Their voyages to the eastern Mediterranean contributed significantly to the development of maritime symbols and signs that transcended the ancient cultures of Egypt, Greece, the Roman Empire and northern Germania (Jiffy, 1995, p. 37). The utilization of signs and symbols by seafarers was an indispensable necessity for the functioning of trade and a prerequisite for the subsequent development of the sciences of astronomy, mathematics and navigation (Jiffy, 1995, p. 37). The maritime language incorporates descendants from the Akkadian language, such as "nautic", derived from the Akkadian word "nun" for ship, and "tiknia" signifying technique (Jiffy, 1995, p. 58).

The ancient seafaring peoples held their seafarers in high esteem, in contrast to the Romans, who had a sophisticated land army and were highly regarded as land conquerors, but had little respect for, or interest in, maritime progress (Cotler, 1992, p. 132). It was only when the need arose, and the Italian peninsula was threatened by the maritime empire of Carthage, that the Romans created their own fleet (Cotler, 1992, p. 99). By decree of the Senate, a hundred ships were built in sixty days, based on a Carthaginian ship that had sunk in the Strait of Messina (Cotler, 1992, p. 99). As Roman citizens were reluctant to serve as sailors, reflecting the low esteem in which seamen were held, crews were recruited from shepherds in the hinterland and trained in a simulated process, rowing on benches to the rhythm set by a timekeeper (Cotler, 1992, p. 100). Over time, the knowledge of navigation was incorporated into the Roman imperial fleets, with subsequent recruitment from the traditional seafaring peoples of the Mediterranean and from remote areas of the empire, stretching from the Middle East to the islands of the Aegean (Cotler, 1992, p. 132).

In the early voyages, the role of seafarers is characterised as that of conquerors and distinguished from later endeavours associated with exploration (Haßfurther, 64). These

two aspects are to some extent intertwined (Bitterli, 1982, p. 74). Nevertheless, the different perceptions acknowledge that the initial discoveries were aimed at claiming unknown lands, as opposed to a deliberate, systematic and scientifically driven interest in exploration and the elaboration of specific knowledge (Bitterli, 1982, p. 74).

From the late fifteenth century onward, Europe embarked on a significant quest driven by the desire to acquire valuable commodities, such as silk and spices, through the establishment of profitable sea routes, which laid the foundations of a vast global maritime trade network and profoundly influenced trade for the next five centuries (Stopford, 2009, p. 13). The first phase of European maritime exploration was characterised by the growing influence and competition between the Portuguese and Spanish empires along the coasts of Africa and the Americas, with the main objective to find a sea route to India and avoid dependence on Arab traders (Meyer-Haßfurther et al., 2002, p. 4), and essentially to control the global trading interdependencies (Bitterli, 1982, p. 19). In an early attempt to methodise these voyages, Henry the Navigator established a maritime school in Portugal in the 15th century (Meyer-Haßfurther et al., 2002, p. 8). This initiative was based on commercial and political interests, but was also seen as a challenge to transcend the religious beliefs and superstitions prevalent in the Middle Ages, thus contributing to the formation of a more scientific world view (Bitterli, 1982, p. 24; Meyer-Haßfurther et al., 2002, p. 8).

The European Age of Discovery was marked by the transatlantic voyage under the Spanish crown and led by Christopher Columbus (Füssel, 2021, p. 97) and the Portuguese-funded circumnavigation of the globe led by Magellan, explorations that often involved barbaric conditions (Bitterli, 1982, p. 76). Conditions on board during sea voyages were known to be harsh and harmful to life and health, with the majority of seafarers losing their lives due to poor living and health standards (Bitterli, 1982, p. 24). With the introduction of new knowledge and equipment, such as the hammock from the voyages to the Americas, hygiene conditions gradually improved (Bitterli, 1982, p. 24). Due to the lack of education of the sailors, the reports of the voyages were often passed on orally or by accompanying travellers, such as clerics, doctors and naturalists, who tended to exaggerate and to fill in with imagination the lack of knowledge of the unknown in order to glorify the voyages for the European investors (Bitterli, 1982, p. 24). After Bartolomeu Dias crossed the equator and successfully circumnavigated the southern coast of Africa in 1488, and Vasco da Gama reached the Indian subcontinent a decade later, Portugal established both military and commercial outposts along the route to

control the maritime trade to the Indian Ocean (Bitterli, 1982, p. 19). Dutch merchants attempted to monopolise the lucrative spice trade from source to distribution with the establishment of the Dutch East India Company, as did English competitors with the establishment of the East India Company (Meyer-Haßfurther et al., 2002, p. 82). Both operated as merchant fleets controlling overseas posts, a situation that escalated and eventually developed into the systematic colonial administration of territories by the ruling empires (Meyer-Haßfurther et al., 2002, p. 82). Increased geographical knowledge of the seas and coastlines, coupled with naval and military capabilities, enabled European conquerors to establish a permanent relationship of power over the overseas territories (Meyer-Haßfurther et al., 2002, p. 82), a view that implied that the existence of the new lands and cultures had only begun with European exploration (Bitterli, 1982, p. 72).

The Age of Enlightenment and the Scientific Revolution were essential to the collaboration between seafarers, merchants and scientists, and to the processes of recognition and dissemination of systematic knowledge through documented narratives, profoundly shaping the seafaring profession through the means of communication and culture (Bitterli, 1982; Füssel, 2021, p. 99). Thus, the voyages carried out in the second half of the 18th century were a major step forward in scientific exploration (Meyer-Haßfurther et al., 2002, p. 83). The interest of research, increasingly involved a shift from religious reverence, marking a transition from the Enlightenment to the development of mathematical and scientific principles in the 19th century (Bitterli, 1982, p. 211), incorporating a focus on the systematic accumulation of knowledge based on the insights of Cartesian and Newtonian understanding (Bitterli, 1982, p. 212). Seafarers embarked on voyages of discovery with specific missions to establish peaceful contact with unknown cultures and to strengthen the power of a nation through scientific and systematic exploration and development (Bitterli, 1982, p. 29).

Advancing technological development and its integration into nautical tools and skills, especially in determining a ship's position and cartography, contributed to the growth of knowledge and the appreciation of scientific methods (Meyer-Haßfurther et al., 2002, p. 83), and also continued as a means of establishing power for colonial empires (Füssel, 2021, p. 73). The Dutch initially kept their methodical cartography of Asian regions strictly confidential, until artists began to publish their work, supporting the rise of the British Empire (Meyer-Haßfurther et al., 2002, p. 84). Gerhard Mercator, renowned for his 1569 world map, aimed to provide an accurate representation of the entire world for navigation purposes (Meyer-Haßfurther et al., 2002, p. 70). However, the 'Mercator Map', which

incorporated information from Portuguese and Spanish sea charts also depicted imaginary islands and creatures from medieval narratives and beliefs (Meyer-Haßfurther et al., 2002, p. 70). The map also used a cylindrical projection to show the spherical shape of the globe, including Latin explanations, making it difficult for the uneducated seafarers of the time to understand (Meyer-Haßfurther et al., 2002, p. 70).

Over time, cartography evolved from an artistic endeavour to a mathematical and scientific tool, facilitated by the invention of the telescope and subsequent astronomical calculations (Meyer-Haßfurther et al., 2002, p. 85). This included the use of clocks for navigation, which became more reliable and widely used, including by the esteemed captain and cartographer of the British fleet, James Cook (Bucher, 2011, p. 114). During the circumnavigations and voyages to the South Pacific, set out with the mission to observe the passage of Venus, the ship's geographical position was determined by the use of clocks and precise scientific methodologies (Bucher, 2011, p. 114). Subsequently, the establishment of a cartographic school on the banks of the Thames, which later became the Hydrographic Office of the British Admiralty, contributed substantially to the nautical knowledge and maritime power of the British Empire (Meyer-Haßfurther et al., 2002, p. 84). Travel accounts, such as that of Johann Reinhold Forster, who sailed under the command of Captain James Cook, contributed to the growth of scientific knowledge and the systematic study of fauna and flora, reflecting the perspectives of the Enlightenment (Füssel, 2021, p. 97). Later, Alexander von Humboldt's South American expeditions advanced knowledge of plants, climate and ocean currents (Meyer-Haßfurther et al., 2002, p. 140), as well as the application of advanced scientific research methods, including the systematic acquisition and analysis of information, the facilitation and promotion of interdisciplinary collaboration among scientists, and the promotion of geographical and ethnographic sciences within the European scientific landscape (Bitterli, 1982, p. 211; Meyer-Haßfurther et al., 2002, p. 141).

Eventually, the world map reflected the history of navigation as a representation of the centuries of European exploration, and despite competition and technological limitations, the integration of the data acquired and its meaning formed the pillars of the significant achievements of scientific knowledge (Bitterli, 1982, p. 19).

2.2 Evolution of the Nautical Profession

The historical evolution and development of professions is characterised by the differentiation of occupations in terms of specialised knowledge or skills, attire, the use of a particular language, and eventually some form of certification or qualification criteria (Füssel, 2021, p.142). The development of professions and the differentiation of professions serve the purpose of increasing economic efficiency (Füssel, 2021, p.142). The International Maritime Organization (2022), in its role as the principal overseer of the maritime industry, recognises the importance of the seafaring profession where “the safety and security of life at sea, protection of the environment, and world trade all depend on the competence and professionalism of the personnel employed or engaged in the maritime sector” (International Maritime Organization, 2022). The work of seafarers in delivering everyday goods and their contribution to the well-being of society has been recognised by the creation of the “Day of the Seafarer”, celebrated on 25 June (International Maritime Organization, 2020b). Notably, it was celebrated for the first time in 2011, following the adoption of major revisions to STCW 1978 in Manila, the Philippines, in 2010 (International Maritime Organization, 2023a). On the occasion of the “Day of the Seafarer” in 2020, and in recognition of the constraints of the Covid-19 pandemic, IMO Secretary-General Lim emphasised that "Seafarers are Key Workers: Essential to Shipping, Essential to the World" (International Maritime Organization, 2020d).

Elias (2007) argues, that professions serve and fulfil the social needs of people in society: „Berufe sind […] spezialisierte soziale Funktionen, die Menschen in Reaktion auf spezialisierte Bedürfnisse anderer ausführen“ (Elias, 2007, p. 27). Thus, the study of the genesis of a profession goes beyond an examination of the individuals who perform a specific function, but strives to investigate the relationships and activities and independence of the representatives of a group of professionals and in relation to the context of scientific developments (Elias, 2007, p. 28). The development of a profession takes place within a dynamic process of emerging technologies or institutions and human needs, and is ultimately determined by the established patterns between professional institutions and the societal needs they serve (Elias, 2007, p. 28). In this way, social forces and imbalances drive individuals to adapt and develop professionally (Elias 2007, p.28). The alignment between institutions and needs is an ongoing process influenced by the technological and social conditions of societies (Elias, 2007, p. 30), creating a long-term transformation of power and social structures (Kahlert, 2009, p. 265). Elias

(2007) examines the development of the seafaring profession in England as an example, emphasising that the evolution of professions is essentially dependent on the needs and functions of human relationships, independent yet inseparable from societal evolutions (Elias, 2007, pp. 27–28).

In the Middle Ages, when sea battles in the English Channel were a rare occurrence, England did not have a navy (Elias, 2007, pp. 27–28). When naval battles were fought, there was a clear separation of professions and duties, with sailors responsible for transport and knights for combat (Elias 2007, p.37). The dynamic shifted during the Age of Discovery, when control of trade routes to overseas territories depended on reinforcing a nation's maritime supremacy (Elias, 2007, p. 38), and control of the seas also meant control of world trade (Raleigh, 1650, p. 35). England's land and naval forces were then divided into two specialised sectors: commercial and military (Elias, 2007, p. 39). This division initiated the differentiation of the naval officer and the sailor as professions and the concept of "Arbeitsteilung" [original emphasis] (Elias, 2007, p. 39). This division of labour also affected differentiation, integration and specialisation in all areas of social life and the social roles associated with them (Elias, 2007, p. 39). During that period, the navy employed two types of captains: "Gentleman-Kommandanten" [original emphasis] and "Seemanns-Kommandanten" [original emphasis] (Elias, 2007, p. 43). The former served as officers and eventually commanded a vessel without the requirement of a formal education or training, and the latter who began a seafaring career at a young age, rising through the ranks from apprentice to the potential promotion to a commanding master on either a merchant or a warship, subject to the necessary approval of the Captain's Guild (Elias, 2007, p. 44). This system of division of labour and career progression in the maritime profession remained unchanged until the eighteenth century (Elias 2007, p. 46). These contrasts between social status and power relations are also reflected in other professions, such as the aviation industry in the twentieth century, and essentially illustrate the interdependencies between social status and power relations within a nation (Elias, 2007, p. 67).

Variations of the occupational characterisation can still be found today in terms such as “men of war” [original emphasis] referring to those serving in the naval fleet, and distinguishing them from merchant seamen (House 2014, p. 1). House (2014) describes “the art and science of seamanship” as an evolutionary process within the advanced technical and operational adaptations to the needs of the trade, and as a specialised profession that forms the “characters” of the seafarers (House 2014, p.1).

Reckwitz (2017) denotes the ongoing transformation of the world of work over the past decades as the *Singularisierung des Arbeitswesens* [original emphasis] (Reckwitz, 2017, p. 182), as the shift towards specialization and creativity (Reckwitz, 2017, p. 183). Repetitive and standardized work, referred to as "profane work", is devalued in a society that favours creative, highly specialised and subjectively satisfied professionals who dominate the top positions of the work hierarchy (Reckwitz, 2017, p. 184). The shift from routine, standardised work to a creative workforce has become an aspiration and a force for intrinsic motivation (Reckwitz, 2017, p. 185). “Das Erfordernis allgemeiner formaler Qualifikationen wird überlagert durch die Entwicklung eines einzigartigen *Profils* [original emphasis] von Kompetenzen und Potenzialen“ (Reckwitz, 2017, p. 182). The individual worker is characterised by a distinct, creative profile of competences and by a shift towards flexible specialisation, emphasising uniqueness and the prevalence of the specific over the general, which is predominantly associated with the higher-education academic system (Reckwitz, 2017, p. 183). Accordingly, the maritime sector is also experiencing a shift towards flexible specialisation and the uniqueness of specific skills, which is in line with the observed evolution in the academic education system, especially for higher-skilled individuals (Reckwitz, 2017, p. 183).

The profession of maritime professionals, including nautical officers and masters, and graduates from maritime higher education, reflects this broader shift, leading to a diverse range of specialized roles both at sea and on land. Today, career prospects extend beyond training as a watch officer and progression to the position of master, to a wide range of roles in the maritime and shipping industry, including pilotage, ship management with responsibility for audits and inspections, human resources, training and education, as well as public sector and non-governmental organisations and industry associations, insurance, port logistics and the offshore and energy sectors (City University of Applied Sciences Bremen, 2021; Deecke, 2006; Deutscher Bundestag, 2019; Hochschule Emden/Leer, 2023a; Schiff & Hafen, 2023).

2.3 Development of Nautical Education

The knowledge, skills, and competencies required of a nautical officer and master have evolved over centuries, adapting to changing circumstances and incorporating the technical advances necessary to sail a vessel to its intended destination (Witt, 2001, p. 220). The first migrations and settlements in the Pacific 35,000 years ago were an

achievement of seafarers who knew how to sail long distances without shelter or the aid of landmarks and coastlines (Rappenglück, 2008, p. 145). These endeavours depended on thorough planning and diligent application of knowledge and skills based on clear means of communication and overall meticulous organization (Rappenglück, 2008, p. 145). Initially, navigation techniques focused on determining a ship's position, course and speed by using landmarks and sounding the depth of the water, which was particularly important when navigating in coastal waters (Witt, 2001, p. 220). The specific knowledge and skills employed in the maritime practices have evolved through individual experience, often considered as an 'art' rather than a science (Witt, 2001, p. 220). Early navigation relied on dead reckoning, which is a method of determining a ship's position based solely on distance and course, without making allowance for external factors such as wind and currents (Witt, 2001, p. 221). During this era, significant deviations from assumed positions were common, especially when sailing on the high seas with no visible landmarks (Witt, 2001, p. 221). On the high seas, it was inevitable to practise astronomical navigation, using celestial bodies such as the stars, the sun and the moon as visual aids (Witt, 2001, p. 221). However, it was not until the nineteenth century that the use of chronometers, sextants and nautical almanacs became common practice (Meyer-Haßfurther et al., 2002, p. 142). Although a seaman was expected to have some knowledge of astronomical navigation, it was not a necessary skill for promotion to a higher rank (Welke, 1997, p. 140). The learning process was voluntary and self-motivated (Witt, 2001, p. 221), typically passed from one sailor to another, either practised during the voyage or theoretically at home when off-hire (Welke, 1997, p. 140).

By the eighteenth century, the role of a ship's captain had become a socially recognised position that required a minimum of theoretical education and practical skills (Welke, 1997, p. 144). The theoretical knowledge included the basic concepts of mathematics and the practical applications of these concepts (Welke, 1997, p. 145). In addition, reading, writing and social etiquette were considered appropriate skills for the social position of a ship's captain (Welke, 1997, p. 144). Traditionally, however, seafarers were not expected to acquire theoretical knowledge, as practical skills through hands-on experience were considered sufficient (Welke, 1997, p. 145). Where basic theory was taught, it was based on the practical application of the mechanical and mathematical principles required for the tasks on board (Welke, 1997, p. 145). Although ship owners and merchants scrutinized the poor quality of seafarers' education, there was no mandate for training or compulsory examination, leaving seafarers responsible for

acquiring the necessary knowledge (Welke, 1997, p. 145). Therefore, it was the seafarers themselves, driven by their own motivation and interest, who continued to pursue their education and training (Welke, 1997, p. 149). In the coastal countries of northern Europe, it became common practice for schoolteachers and retired captains to give basic lessons in navigation and elementary mathematics during the winter season, when the seafarers were at home (Witt, 2001, p. 221). In Germany, education included reading and writing in the German language, which was taught to the same extent as the nautical subjects (Welke, 1997, p. 146). However, shipowners were opposed to a compulsory ‘scientific’ training and examination system, preferring to rely on the tradition of seafaring and the practical acquisition of skills on board (Welke, 1997, p. 150). Furthermore, shipowners and merchants were reluctant to fund the training of seafarers hired on their ships (Welke, 1997, p. 148).

At the beginning of the 19th century, navigation faced a conflict between tradition and modernity (Meyer-Haßfurther et al., 2002, p. 143). The use of instruments and aids, such as sextants and nautical almanacs, was considered a sophisticated application in the art of seamanship (Meyer-Haßfurther et al., 2002, p. 143). In everyday practice, however, traditional and familiar methods were preferred due to the perceived cumbersomeness and expense of scientific methods and tools (Meyer-Haßfurther et al., 2002, p. 143). Furthermore, the use and application of scientific instruments was perceived as a way of establishing power relations, with a captain's authority linked to the privilege of owning and using the instruments (Welke, 1997, p. 176).

However, it has gradually been recognised that seafarers' education should include basic mathematical and scientific skills and should enhance their professional and social skills (Witt, 2001, p. 229). The practice of navigation became more systematic and scientific with the establishment of navigation schools (Meyer-Haßfurther et al., 2002, p. 142). In the major maritime trading cities of northern Europe, such as Copenhagen and Amsterdam, schools were mainly funded by merchants' associations such as the Dutch East India Company (Witt, 2001, pp. 230–231). These initiatives to promote and support the development of nautical education were justified on economic and political grounds, motivated by an interest in increasing and securing trade and strengthening power relations (Witt, 2001, p. 229).

3 The Framework of Nautical Education

The global structure of MET and the historical development and application of the requirements and responsibilities of the seafarers have been contextualised within the conventions adopted, encompassing a macro-micro level perspective in the safe operation of the maritime industry. The aspects are reflected within the global framework, and the German environment, and the interdependencies in the system driven by the economic and political motivations of the time. The wider implications of maritime labour and the shortage of seafarers, recognised as an essential labour force in world trade, together with gender considerations, are aspects at the core of the MET system examined below.

3.1 The Rationale for the Development of a Global Framework in MET

Historically, seafaring nations enacted individual laws to govern the ships under their jurisdiction (Morrison, 1998, p. 11). Mainly driven by economic stimulus and reinforced by technological advances following the Industrial Revolution and developments in the 18th and 19th centuries (Morrison, 1998, p. 5), the transition from sailing ships to steam ships, with increased efficiency through ship speed and cargo volume greatly facilitated the significant growth of the merchant fleet (Stopford, 2009, p. 32). However, the economic drive also brought with it the practice of overloading and over-insurance, and the consequent loss of ships due to unseaworthiness and poor quality (Knight, 1960, p. 299). In addition to the deficiencies in the design and operation of the vessels, the qualifications of the seafarers were also identified as a contributing factor to the loss of life and property (Geffken, 1988, p. 32; Knight, 1960, p. 299). The multiplicity of factors gave rise to calls for the establishment of a unified regulatory framework within the shipping industry (Stopford, 2009, p. 675). An early step in the implementation of legislation was the enforcement of the 'Plimsoll Act' [original emphasis] in the United Kingdom in 1876, which required the affixing of a Plimsoll mark on the hull of a ship to indicate the maximum permissible load line (Stopford, 2009, p. 676). The developments have had a multifaceted impact on the maritime system, including the implementation of the concept of hazards and risks, and technical equipment (House, 2014a, p. 177), such as the introduction of satellite-based communications means (Hahne, 2012, p. 14). The measures implemented aimed to improve both the efficiency and safety of ships,

however did not achieve the desired outcome (Hahne, 2012, p. 14). The economic quantitative growth of trade in the 1960s and 1970s led to a high demand for maritime transport and motivated stakeholders to participate in maritime business activities and in the profits generated by the sea transport (Morrison, 1998, p. 17; Stopford, 2009, 120ff). Shipowners increasingly registered their ships under a "flag of convenience", a practice that has become increasingly common in international shipping since the 1930s, whereby the state of a ship's registry offers commercial advantages to owners in terms of tax payments and the enforcement of international legal standards for ship safety and crew certification (Morrison, 1998, p. 17; Parsons and Allen, 2018, p. 24; Stopford, 2009, pp. 666–667). The detrimental effects of shipping on the marine and coastal environment have been brought to the attention of the public through increased media coverage and a heightened awareness of the risks associated with ships (Hahne, 2012, p. 14). This has frequently led to the conclusion that the root cause of the problem lies in human error rather than in technical issues (Hahne, 2012, p. 14; House, 2014a, p. 177). The assessment of the education and qualifications of masters and watchkeeping personnel was considered a crucial step in establishing globally accepted minimum standards of competence in the profession (Morrison, 1998, p. 15) and led to the incremental development of the STCW framework (Hahne, 2012, p. 14). The subsequent evolution of standards and regulations, derived from the aggregation of disparate approaches and experiences among maritime nations, serves as the foundation for the contemporary international regulatory framework (Stopford, 2009, p. 675).

3.2 The International Maritime Organization

At the end of the nineteenth century, an international conference for the first time addressed the safe operation of ships as a global concern and emphasised the need for an international effort to establish a harmonised system (Knight, 1960, p. 299). In 1889, the United States of America hosted a conference with participants from 37 countries[1], with the appeal to address the prevailing issues in the industry and the intention to accelerate the standardisation of regulations in an international perspective (Stopford, 2009, p. 676). Areas of concern and proposed regulations included the determination of

[1] including Germany, represented by Dr. F. Sieveking, appointed as chairman of the Committee on the International Rules of the Road (Report of the Committee on International Rules of the Road, United States of America State department, 1890, p. 20).

the seaworthiness of ships, which included the construction and equipment of ships, the number of crew required on board, and a uniform system of certification and inspection (United States of America State department, 1890).

The specific “subjects to be considered by the International Marine Conference” included the following (United States of America State department, 1890):

- collision prevention and navigation rules, including visibility of lights, sound signals and navigation rules,
- seaworthiness of vessels in terms of construction and equipment,
- maximum permissible loading conditions,
- safety of life and property from shipwreck,
- qualifications of officers and seafarers, including medical examinations,
- weather warnings; and
- the establishment of a permanent International Maritime Commission.

Although the conference only approved the first item on the list (Stopford, 2009, p. 676), which emerged as the “International Rules of the Road, 1889” (Knight, 1960, p. 299), the way was paved for future developments in the industry, leading to the current framework of international conventions and regulations. Nevertheless, as trade expanded and the exploitation of the sea progressed (Treves, 2008), economic interests prevailed, leading to a reduction in safety measures in order to increase profit (Morrison, 1998, p. 6).

The protracted negotiation at the United Nations General Assembly (Treves, 2008) resulted in the subsequent ratification of the United Nations Convention on the Law of the Sea (UNCLOS) (International Relations and Defence Committee, 2022, p. 3), a comprehensive multi-lateral treaty (Kreutzer, 2018, p. 703), forming the present basis of the law of the seas (Serdy, 2011, p. 348) and regarded as the “constitution of the oceans” (Treves, 2008). The treaty addresses the creation of maritime zones, which are divided into the high seas and coastal areas, including territorial seas and internal waters (Kreutzer, 2018, p. 704; Serdy, 2011, p. 350), as well as the application of sovereign states' jurisdiction (Kreutzer, 2018; Serdy, 2011, p. 355).

The responsibility of a state to “effectively exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag” (Article 94, *United Nations Convention on the Law of the Sea*) extends to matters of “manning of ships, labour conditions and the training of crews”, aligning international with state regulations (Article 94, 3 (b) *United Nations Convention on the Law of the Sea*). The term

"administration" as it pertains to a ship refers to “the Government of the State whose flag the ship is entitled to fly”, and is referred to as the “flag state”, in accordance with Reg. 2, of the International Convention for the Safety of Life at Sea (SOLAS) (International Maritime Organization, 2020c).

A further requirement of UNCLOS outlines that all appropriate measures are applied “that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship” (Article 94, 4 (b); United Nations, 1982). Futhermore, the crew is expected to have a full understanding of all rules and regulations in order to comply with the applicable laws relating to safety, collision avoidance and marine pollution prevention (Article 94, 4 (c) *United Nations Convention on the Law of the Sea*). These requirements and responsibilities have been contextualised within the conventions adopted in the maritime industry, encompassing a macro-micro perspective of safe operation and the responsibilities and competencies of the parties involved.

The International Maritime Organization (IMO) serves as a global regulatory body that oversees the development and needs of the maritime industry (Morrison, 1998, p. 7) and facilitates a consensus-based system among maritime nations and stakeholders to promote the interests of the global community (Morrison, 1998, p. 7). IMO is one of seventeen specialized United Nations agencies (Serdy, 2011, p. 366), with its headquarters in London, United Kingdom (International Maritime Organization, 2019a). The organisation was originally established in 1948 as the Intergovernmental Maritime Consultative Organisation under the auspices of the United Nations, and then renamed in 1982 to its present denomination (Stopford, 2009, p. 678).

IMO’s mission is “to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation” (International Maritime Organization, 2022), founded on its commitment to the adoption of uniform standards aimed at strengthening the industry and its stakeholders (Serdy, 2011, p. 367), as set forth in Article 1 (a) of the Convention of the International Maritime Organization (International Maritime Organization, 2019a). The IMO standards framework consists of conventions, codes, regulations and agreements that affect all aspects of the trade, including the operation, construction and manning of ships, associated liabilities, environmental aspects and the development of training standards (Kreutzer, 2018, p. 703). Industry practices are taken into account when developing new or amending existing regulatory standards (Kreutzer,

2018, p. 703). Furthermore, national regulations apply to ships that are registered and sailing under their flag or as laid down at the regional level, for instance by the European Community (Kreutzer, 2018, p. 703).

The IMO is organised and consists of an assembly, a council, five main committees and seven sub-committees (Kreutzer, 2018, p. 708). The assembly meets every two years and elects the members of the council, which acts as the governing body of the IMO and supervises the work of the organisation by receiving and forwarding to the assembly the draft regulations of the committees and subcommittees, which recommend the adoption of new regulations (Serdy, 2011, p. 369).

The main committees are (Serdy, 2011, p. 369):

- the Maritime Safety Committee (MSC),
- the Marine Environment Protection Committee (MEPC),
- the Legal Committee,
- the Technical Cooperation Committee and
- the Facilitation Committee.

The two main committees, MSC and MEPC, are assisted and reported to by the following sub-committees (Serdy, 2011, p. 371):

- Sub-Committee on Human Element, Training and Watchkeeping (HTW),
- Sub-Committee on Implementation of IMO Instruments,
- Sub-Committee on Navigation, Communications and Search and Rescue,
- Sub-Committee on Pollution Prevention and Response,
- Sub-Committee on Ship Design and Construction,
- Sub-Committee on Ship Systems and Equipment, and
- Sub-Committee on Carriage of Cargoes and Containers.

The committees and subcommittees are open to all member governments, which comprise 175 states, as well as the European Union as a contracting party (International Relations and Defence Committee, 2022, p. 3).

The adoption and enforcement of conventions involves a prolonged procedure, commencing with the submission of a proposed amendment by a contracting government, which is then circulated within the committee and requires the approval by a two-thirds majority (International Maritime Organization, 2019b). After adoption, the procedure for amendments may involve decades of negotiations or may ultimately fail to

be enforced (International Maritime Organization, 2019b)**.** To accelerate the adoption and enforcement process, the “tacit acceptance” procedure was introduced (International Maritime Organization, 2019b). Under this process, after a certain period of time, and provided that no more than one-third of the parties object, amendments to conventions are deemed to have been accepted and subsequently become legally enforceable through national ratification by governments (International Maritime Organization, 2019b; Kreutzer, 2018, p. 710). This means that amendments are automatically accepted unless the parties explicitly object (International Maritime Organization, 2019b). The process thus facilitates the implementation of amendments and circumvents the prolonged delays that are often caused by the traditional acceptance requirements (International Maritime Organization, 2019b). The tacit acceptance procedure has been applied to key conventions of significant importance in matters of safe and environmentally sound ship operation, and include the Convention on the International Regulations for Preventing Collisions at Sea (COLREG), adopted 1972, the International Convention for the Prevention of Pollution from Ships (MARPOL), adopted 1973 and amended with the Protocol of 1978, and the International Convention for the Safety of Life at Sea (SOLAS), adopted in 1974 (International Maritime Organization, 2019b; Serdy, 2011, pp. 374–375).

The safety system implications of the key conventions of the IMO global regulatory framework are considered the foundation of the maritime education and training (MET) system (Ziarati, 2012). The four pillars of MET include SOLAS, MARPOL, STCW and the Maritime Labour Convention (MLC) (Ziarati, 2012), which are elaborated on subsequently.

SOLAS was the first convention adopted by the IMO under the responsibility of the MSC Committee (International Maritime Organization, 2019b). It came into force in 1960 following a lengthy process of development, initiated in the wake of the sinking of the *Titanic* in 1912, with the objective of addressing safety concerns pertaining to the design and operation of ships (Schröder-Hinrichs et al., 2013, p. 243). Subsequently, SOLAS was updated on several occasions, culminating in a comprehensive revision in 1974, which incorporated all previous amendments and modifications (Stopford, 2009, p. 680). The adoption of SOLAS has been regarded as the most significant step towards establishing global measures for the safety of ship operations (Möckel et al., 2013, p. 305). However, Möckel et al. (2013) argue that the approach was reactive and primarily addressed past shortcomings revealed from the sinking of the *Titanic*, a

perspective not necessarily encouraging a forward-thinking, proactive approach to safety (Möckel et al., 2013, p. 305). Parsons and Allen (2018) concur, that the integration of technical and operational developments into the regulatory framework have been slow and reactive (Parsons and Allen, 2018, p. 17), and further argue, that the maritime approach prioritises profit over safety, potentially endangering human life, property, and the environment (Parsons and Allen, 2018, p. 19).

This view has been extended to the adoption and enforcement of the 'The International Safety Management (ISM) Code', as a reactive response to improve safety in shipping (Parsons and Allen, 2018, p. 20). The incorporation of the ISM Code into Chapter IX of the SOLAS Convention in 1994 was a regulatory measure taken in consequence of the sinking and investigation of the passenger ferry *Herald of Free Enterprise* in 1987 (Stopford, 2009, p. 680). In the investigation report, it was resumed that, "from top to bottom the body corporate was infected with the disease of sloppiness" (Department of Transport, 1987, p. 14). The statement highlighted the inadequacy and fallacy of the understanding of safety and the overall approach to safety by all concerned, both in ship operation and in shore-based management. In the aftermath of the accident, the maritime industry was forced to undertake a comprehensive review of the safety system in place for the operation of ships and a clear allocation of responsibilities for both shore-based ship management and those on board (Parsons and Allen, 2018, p. 25).

The ISM Code provides a concise and brief outline of the responsibilities, duties and training requirements for the safe operation of a ship by the company, the master and the crew (Lorenzon, 2011, p. 389).

The core elements of the ISM Code include the following provisions (International Maritime Organization, 2018a, pp. 15–22):

- the establishment of a Safety Management System (SMS) which means a "structured and documented system" (Article 1.1.4),
- the implementation of a "safety and environmental protection policy of the Company" both ashore and on board ships (Article 2.1, 2.2), including "procedures, plans and instructions, including checklists" for safe and environmental sound ship operations (Article 7),
- the preparation for potential emergency shipboard situations (Article 8.1),
- the appointment of a designated person ashore (Article 4) and

- the appointment a qualified master on board (Article 6), who is responsible for monitoring and implementing the provisions of the SMS, including the preparation for emergencies (Article 8.2), accidents (Article 8.3), the motivation and instruction of the crew (Article 5), and overall regulatory compliance (Article 12).

The provisions of the ISM Code emphasise the need for an effective safety management system that continuously measures, reflects, and improves (Batalden and Oltedal, 2018, p. 32), promoting a systematic and contextualised approach that is specific to the tasks and roles within the organisational structure (Parsons and Allen, 2018, p. 20).

The ISM Code aims to address the responsibilities of all actors in the system, whereas previously the focus of safety was on technical and regulatory matters (Stopford, 2009, p. 681). In addition to the ship management, the master and the crew, Article 4 of the ISM Code provides for the role of a “designated person” (International Maritime Organization, 2018a, p. 18), who acts as a liaison between ship and shore ensurse that matters related to safety and environmental protection are treated with high priority and that the necessary resources are made available (Lorenzon, 2011, p. 390). For this purpose, the designated person is given the authority and independence from the ship's management to carry out this responsibility (Lorenzon, 2011, p. 390). Notwithstanding the emphasis placed on the responsibility and “authority” of the master in Article 5 of the ISM Code (International Maritime Organization, 2018a, p. 18), the introduction of the various assignments, roles and interconnections between the actors in the safety management system has also been considered as a potential control measure and a perceived “corrosion” of the authority of the master (Beetham, 1995, p. 2).

MARPOL, as the second pillar to MET (Ziarati, 2012) is the main convention addressing maritime environmental pollution protection (Stopford, 2009, p. 682). The IMO’s main committee, MEPC, is tasked with overseeing matters and further elaborating on the integration of new developments in the global framework (Serdy, 2011, p. 371). MARPOL was established when incidents involving oil tankers and the resulting pollution and damage to marine and coastal life in the 1960s forced the shipping industry to integrate constructional and operational safety measures to prevent shipborne pollution and to accept environmental liability (Kuo, 2007, p. 37; Parsons and Allen, 2018, p. 23; Tsimplis, 2011, pp. 423–425). Following the grounding of the oil tanker *Amoco Cadiz*, a major accident with a significant impact on the marine and coastal environment, there was a heightened pressure on regulators and administrations to accelerate the adoption of appropriate safety and environmental measures in the shipping industry, with

particular emphasis on the role of the human element (Parsons and Allen, 2018, p. 24). Furthermore, the incidents served to heighten public awareness of perceived safety, risk, and the human involvement in maritime operations, which in turn, prompted regulatory responses aimed at establishing a comprehensive educational framework in accordance with the provisions of STCW 78 (Parsons and Allen, 2018, p. 23).

3.3 STCW 78

The experience gained from centuries of investigating maritime accidents and incidents reveals that, among a number of factors relating to the design, construction and proper equipment of ships “the most important element in the safe operation of any ship is the competence and experience of its master and crew” (Morrison, 1998, pp. 10–11). Morrison (1998) however, posits that, “absolute safety in the operation of ships can never be achieved, but a high degree of safety in their operation is attainable”, contingent upon the competence of the ship's master and crew (Morrison, 1998, p. 11).

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW 78), is the principal instrument governing seafarer’s education (Morrison, 1998, p. 6), and espoused with the aspects of safe and environmental responsible shipping (Lorenzon, 2011, p. 401). The International Maritime Organization adopted STCW 1978, which came into force in 1984, with the intention of addressing the human element issues and harmonising MET and certification standards (Lorenzon, 2011, p. 401). Prior to the implementation of STCW 78, the determination of training standards and certification varied significantly among the states participating in the maritime trade (Morrison, 1998, p. 11). Although STCW 78 had been widely ratified and implemented by the maritime community as the applicable law for the qualification of seafarers (Vanchiswar, 1997, p. 160), however its effectiveness was compromised for various reasons, including the lack of rule precision and the prevailing pursuit of economic interests in the efficient operation of ships (Morrison, 1998, p. 16; Vanchiswar, 1997, p. 160). Non-traditional flag states often lacked of a well-established MET infrastructure and failed to satisfy the stipulated legal requirements (Morrison, 1998, p. 17). The economic challenge of vessel over-capacity and declining freight rates was addressed through a reduction in investment in crew costs, training, and education, which were deemed to be a strategic and cost-effective measure (Morrison, 1998, p. 16). Furthermore, the assessment and certification standards set out in STCW 78 permitted

vague interpretations of the rules (Vanchiswar, 1997, p. 160), which compromised the consistent implementation of global education and training standards (Morrison, 1998, p. 16).

The principle of "no more favourable treatment" [original emphasis] was introduced into the convention as a means of establishing a "level playing field" and emphasising the responsibilities of the stakeholders participating in a global market (Morrison, 1998, p. 9). The application of this principle means that all ships and the flag administration responsible for certifying a ship, whether or not a signatory to STCW 78, must comply with the same minimum standards and rules laid down in the international framework relating to safety, security, pollution prevention and the working and living conditions of seafarers (International Shipping Federation, 2006, p. 8; Morrison, 1998, p. 10). The principle thus aims to promote fair competition and compliance in maritime trade by preventing preferential treatment on the basis of the flag state registration (Morrison, 1998, p. 10), under a "flag of convenience" (Morrison, 1998, p. 17). In this perspective, STCW 78 has been introduced as an international instrument to ensure minimum standards of education and training, based on a set of defined competencies to achieve "similar, acceptable, and consistent standards" (Lorenzon, 2011, p. 401), and based on the principle that the responsibility for training and certification lies with the national flag state administration, which issues seafarers' certificates of competency, according to Article VI, STCW 78 (International Maritime Organization, 2017a).

Nonetheless, during the 1990s it became evident that STCW 78 lacked precision in definitions and application, and had not effectively addressed the evolving requirements of the maritime industry (Lorenzon, 2011, p. 401; Morrison, 1998, p. 15). The analysis of maritime accidents emphasised on the role of the human element (Morrison, 1998, p. 19) and urged the shipping community to further improve the safety provisions in the regulatory framework (Morrison, 1998, p. 16). The differences in educational standards between states were so significant that STCW 78 was not truly recognised as an "international standard" (Vanchiswar, 1997, p. 160), and reiterated the responsibility of administrations in overseeing education (Vanchiswar, 1997, p. 161) and addressing the need for certified and well-trained seafarers (Precious, 1997, p. 121).

As a consequence, the 1995 revision to STCW 78 introduced the ‘Seafarer's Training, Certification and Watchkeeping Code’ (STCW Code), as an annex to the convention (Lorenzon, 2011, p. 401). The STCW Code provides detailed regulations and guidelines for the assessment of training outcomes (Vanchiswar, 1997, p. 162), and incorporate the

evolving technological advances in ship operation which have a significant impact on the current training framework (Srinivasan, 2022). The objective of the establishment of the STCW Code is to achieve globally harmonised levels of training and qualification for the associated Certificate of Competency (CoC) by providing competency tables, delineating functions and establishing levels of responsibility for seafarers (Srinivasan, 2022).

The STCW Code is divided into two parts, where compliance with part A is mandatory and part B provides guidance (Morrison, 1998, p. 25). The roles of the seafarers in the deck department are defined in accordance with Reg. I/1, STCW 78 as follows (International Maritime Organization, 2017a):

- *Master* [original emphasis] is a person "having command of a ship" (Reg. I/1.3);
- *Chief mate* [original emphasis] is a person certified to take control of a ship in lieu of a master, if necessary (Reg. I/1.6);
- *Deck officer* [original emphasis] is a person certified in line with STCW 78 requirements (Reg. I/1.5);[2]
- *Officer* [original emphasis] is any person on board as further defined by the flag state or other regulations (Reg. I/1.4).

A CoC is issued to "those candidates who, to the satisfaction of the Administration, meet the requirements for service, age, medical fitness, training, qualification and examinations" (Article VI (1), STCW Code, International Maritime Organization, 2017a). Thereafter, a CoC is relating to the competencies of a master and officer in three different functions: "navigation", "cargo handling and stowage", and "controlling the operation of the ship and care for persons on board" (Table A-II/1 and Table A-II/2 STCW Code, International Maritime Organization, 2017a) and on two levels[3] of responsibility, which refer to the operational level for officers, and the management level for chief mates and masters (Table A-II/1 and Table A-II/2 STCW Code, International Maritime Organization,

[2] In the context of this research, specifically referring to academically certified officers in alignment with STCW 78 and the STCW Code, the terms "nautical officer," "bridge officer," and "deck officer" are used interchangeably. This is done without any intent to distinguish between those individuals or their roles. The rationale behind this interchangeable usage stems from the role of a deck officer, whose responsibilities are associated to duties on the bridge of a vessel and whose position is defined as being "in charge of a navigational watch" (Table A-II/1, STCW-Code, International Maritime Organization, 2017a).
[3] A third level of responsibility is defined as "*Support level"* according to Section A-I/1, STCW 78; the support level applies to seafarers not being certified as officer or master, which includes the position of ratings and ratings as able seafarer deck, see Section A-II/4 STCW 78 (International Maritime Organization, 2017a).

2017a). The detailed knowledge, skills and competencies of the three functions include (Table A-II/1 and Table A-II/2, STCW Code, International Maritime Organization, 2017a):

- Function 1 - Navigation: plan and conduct a voyage, manoeuvre the ship and keep a safe navigational watch, in compliance with COLREG, apply ship resource management, use of standard marine communication phrases, and transmit distress signalling;
- Function 2 - Cargo handling and stowage: calculate the trim and stability of the ship, inspect and handle cargo, and assess cargo damage;
- Function 3 - Controlling the operation of the ship and care for persons on board: comply with environmental pollution prevention regulations, use of firefighting, and lifesaving equipment, apply medical care, leadership, and teamworking skills.

The assessment of the competence of the three functions is understood as “the application of knowledge, understanding, proficiency, skills, and experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner” (International Maritime Organization, 2014a, p. 65), carried out through various forms of examination, and ideally incorporating practical application and the use of simulation (International Maritime Organization, 2017b, p. 101). The issuance of a CoC, a flag state confirms that the officer or master has met the training requirements and is competent to perform the functions specified (Reg. I/10 STCW 78, International Maritime Organization, 2017a). If a certificate has been issued by a "non-party" to STCW 78, it must be "endorsed" to confirm the authenticity of the certificate and the fulfilment of the training requirements (Reg. I/10, STCW 78, International Maritime Organization, 2017a). The international recognition and confirmation of compliance expressed in the endorsement, including a translation if necessary, is intended to prevent fraudulent practices that have been a concern in the past (Morrison, 1998, p. 18). The responsibilities of industry stakeholders in enforcing and maintaining training requirements are addressed in STCW 78, including that of shipping companies “to ensure that each crew member can make a knowledgeable and informed contribution to the safe operation of the ship” (Chapter I, Section A-I/14, STCW 78, International Maritime Organization, 2017a) and governments, who are obliged to oversee “the training and assessment of seafarers” (Reg. I/6, STCW 78,International Maritime Organization, 2017a). Thereof, the IMO's main committee, the MSC, produces a "white list" of states that are considered to be in full compliance with the requirements of STCW

78 and support the widespread application of a globally harmonised system of qualifications (Kreutzer, 2018, p. 721; Lorenzon, 2011, p. 402).

Another major revision was adopted in 2010, known as the Manila amendments, in recognition of the host country of the conference, the Philippines (International Shipping Federation, 2011, p. 4), the world's largest seafaring nation (Turgo, 2021, p. 9). The 2010 and subsequent revisions reflect the evolving adaptation to technological innovation and industry requirements, the training and educational needs of seafarers and the human element perspective in MET (Parsons and Allen, 2018, p. 24). In line with the Maritime Labour Convention, the physical fitness of seafarers in relation to fatigue, drug and alcohol use has been addressed as an ongoing core matter (International Shipping Federation, 2011, pp. 27–32). Further amendments include the incorporation of leadership and teamwork competencies and requirements for specialized vessels or trades (International Shipping Federation, 2011, p. 58). The intention to undertake a comprehensive review and update the STCW framework at ten-year intervals was stated and emphasised at the 2010 Conference and has been a recurring item on the agenda of the Human Element, Training and Watchkeeping (HTW) Sub-Committee, which oversees the progress of MET topics (Srinivasan, 2022).

While the four pillars of maritime education, reflected in SOLAS, along with the ISM Code, MARPOL and STCW 78, have been established to “ensure” safety based on compliance, and considered “evidence" of the qualification and appropriate training of seafarers (Mandaraka-Sheppard, 2009, p. 551), the application and compliance with these regulatory standards only represent the minimum requirement (Ziarati, 2012). The 2010 Manila amendments to the STCW Code reaffirm the role of the human element and MET in the maritime safety system, however emphasise that “a large percentage of maritime casualties and pollution incidents are caused by human error” (International Maritime Organization, 2017a). This statement reaffirms the essential contribution of the human element and MET to the safe operation of ships, but arguably also recognises the limitations of the effectiveness of the global regulatory framework (Ziarati, 2012).

3.4 International Cooperation

Intergovernmental and non-governmental international organisations provide technical and professional advice and services to the IMO committees, sub-committees and their

members, and contribute to programme cooperation and human resource development (International Maritime Organization, 2019e). For over a century, the three specialised UN agencies, the International Labour Organization (ILO), the International Telecommunication Union (ITU), along with the IMO, have collaborated to shape and harmonise the rules and requirements of the maritime industry (International Telecommunication Union, 2016, p. 2; Stopford, 2009, pp. 656–658).

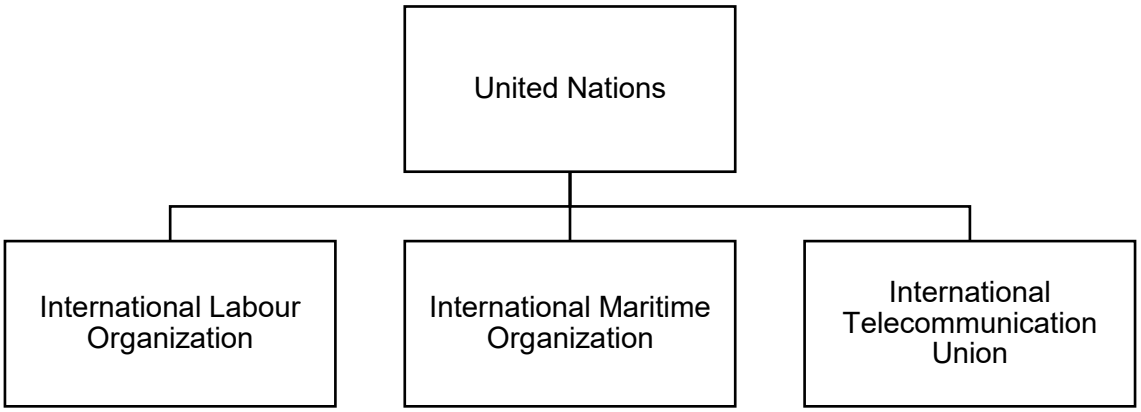

Figure 1: United Nations specialized agencies

The International Labour Organization (ILO) was established in 1919 by the Treaty of Versailles (Christodoulou-Varotsi and Pentsov, 2008, p. 3). Its main aim is to promote social justice and to improve working conditions through the development of conventions and recommendations that promote international labour standards (Christodoulou-Varotsi and Pentsov, 2008, p. 4). The ILO is the only tripartite UN agency representing the interests of governments, employers and workers from 187 member states (International Labour Organization, 2024). The ILO oversees the development of policies and programmes for both seafarers and port workers within an “ethical and proactive framework for a fair globalization” (International Labour Organization, 2024; Kreutzer, 2018, p. 703; Stopford, 2009, p. 684). The establishment of an international harmonised labour standard has emerged from the late 19th century, when the cooperation of European seafarers and railway workers, initiated transport union strikes in Rotterdam and Hamburg (Geffken, 1988, p. 35). Increased public awareness of the difficult working and living conditions and the associated risks to workers' lives led to the enforcement of improved labour and safety standards for seafarers and transport workers in non-maritime sectors, culminating in the creation of the International Transport Workers'

Federation (ITF) (Geffken, 1988, p. 35; Stopford, 2009, p. 35). The current framework adopted by the ILO, the Maritime Labour Convention (MLC) (Ziarati, 2012), entered into force in 2013 and consolidates and updates the outdated piecemeal approach of numerous regulations from previous decades (International Shipping Federation, 2006, p. 6). Today, the MLC represents the interests of more than 90 per cent of the world's merchant fleet (International Labour Organization, 2024; Lorenzon, 2011, pp. 406–410; Unruh, 2018, p. 673). It is structured into articles that outline general terms, followed by regulations and a code (Unruh, 2018, p. 673). The articles set out the overarching principles and objectives of the convention and define the rights of seafarers, the responsibilities of flag states and the obligations of shipowners with regard to minimum working and living conditions for seafarers (Unruh, 2018, p. 673).

The regulations are organized into five titles as follows (Lorenzon, 2011, p. 407):

1. Minimum requirements for seafarers to work on a ship;
2. Conditions of employment;
3. Accommodation, recreational facilities, food and catering;
4. Health protection, medical care, welfare and social security protection;
5. Compliance and enforcement.

The code contains detailed implementation provisions and guidance for flag states, shipowners and seafarers on the requirements of the MLC, further divided into a mandatory and a voluntary part (Lorenzon, 2011, p. 407; Unruh, 2018, p. 673). The MLC framework has been globally recognised and applies to ships whose states have ratified the convention (International Shipping Federation, 2006, p. 35). The outlines of the regulations cover the inspection of accommodation spaces on board, the certification for medical examinations, the documentation of working and rest hours, the contracts of employment and the minimum manning of ships (International Shipping Federation, 2006, pp. 14–15). However, the responsibility for defining “safe manning” as the minimum number of crew required for the safe operation of a merchant ship has been delegated to the flag state of the ship concerned (International Shipping Federation, 2006, p. 35). The impact of manning includes consideration of potential workload and has been associated with issues of 'fatigue' in both routine and exceptional circumstances of a voyage and the safe operation of a ship (International Shipping Federation, 2006, p. 35).

The ITU oversees the development of international communications networks and their technical standards, including global satellite systems and the procedures relevant to the radio regulations in the educational content and certification of seafarer in accordance with STCW 78 (International Chamber of Shipping, 2022, p. 79; International Telecommunication Union, 2016, pp. 17–18). National administrations are obliged to apply the regulations developed under the auspices of the ITU and to incorporate the operational procedures and education requirements into their national legal framework (International Telecommunication Union, 2016, p. 18). These requirements for the installation of radio equipment and its functional operation by trained personnel on merchant ships have been accelerated by the historic sinking of the *Titanic* (Röper, 2022, p. 43). Currently this is reflected in the certification for nautical officers and masters and the technical standards for ship communication equipment through ITU regulations (International Telecommunication Union, 2016, p. 18). These regulations on the functionality and certification of operators are aligned with those set out in SOLAS and the established Global Maritime and Distress Safety System (International Telecommunication Union, 2016, p. 25), which frameworks the global communication processes (International Telecommunication Union, 2016, p. 19).

The education and training requirements stipulated by the ITU “Radio Regulations” and SOLAS have been integrated into the provisions of STCW 78 and the STCW Code (International Maritime Organization, 2017a). This includes the use of standardised communication phrases during emergencies where effective coordination of all parties involved, including ships, shore-based operators and aircraft, is essential (International Telecommunication Union, 2016, p. 17). In order to facilitate effective coordination during emergency situations and in search and rescue operations, it is essential to possess and utilise standard English communication phrases effectively for the transmission of distress, urgency and safety messages (International Telecommunication Union, 2016, p. 14). These standardised phrases are contained in the “International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual”, a joint publication by IMO and the International Civil Aviation Organization (ICAO), aligning maritime and aeronautical rescue system requirements (International Telecommunication Union, 2016, p. 93). In the maritime context, the issuance of a General Operator's Certificate (GOC) serves to confirm that an individual has received adequate training and is able to communicate effectively while using on-board technical equipment in accordance with the requirements of Chapter IV of the STCW Code (International Chamber of Shipping, 2022, p. 79). Furthermore, it serves to corroborate the physical fitness requirements, in

accordance with the standards set forth by the MLC, particularly with regard to hearing, sight, and the prevention of fatigue, as outlined in chapter VIII of the STCW Code and Resolution 8 of STCW 78 (International Maritime Organization, 2017a; International Shipping Federation, 2006, p. 48).

In addition to the close collaboration of the three specialized UN agencies, other non-governmental organizations (NGOs) may be granted consultative status with the IMO, thereby enabling them to attend assembly and council meetings and to contribute to committees, including the MSC, MEPC, their sub-committees, as well as the Legal and the Facilitation Committee (International Maritime Organization, 2017a).

With approval of the assembly, the IMO council may grant consultative status to NGOs, who have the capability to make a substantial contribution to the work and meet the provisions contained in the “Rules and Guidelines for Consultative Status of Non-Governmental International Organizations with the International Maritme Organization” (International Maritime Organization, 2019e). The purpose of the consultative status are defined in Rule 2 (a) as ” to obtain information or expert advice from non-governmental international organizations with special knowledge in a particular sector of IMO's activities” and furthermore in Rule 2 (b) “to enable such non-governmental international organizations representing large groups whose activities have an important and direct bearing on the work of IMO to express their points of view to it” (International Maritime Organization, 2019e). An example of a member granted consultative status in order to provide expertise and to represent a broad maritime interest would be the International Group of Protection and Indemnity Associations (P&I Club), a club of independent insurers dealing with shipowners' liability, claims handling, passenger and cargo risk, towage, salvage and wreck removal (International Group of P&I Clubs, 2023). The P&I Club is involved in the management and development of sustainable strategies to enhance safety and environmental protection, as well as cyber security or the effects of the COVID-19 pandemic, thus reinforcing the evolving concerns of the maritime industry and its impact on society (International Group of P&I Clubs, 2023).

Organisations that hold consultative status and attended the adoption of the final act of the Conference of Parties to STCW 1978, held in Manila, the Philippines, from 21 to 25 June 2010 as observers, included inter alia parties with interests in commercial, educational and seafarer’s labour or legal matters, as outlined below (International Maritime Organization, 2017a):

- The European Commission, as an intergovernmental organization party to STCW 78;
- The Baltic and International Maritime Council (BIMCO), representing interests pertaining to a wider range of operational matters, including safety, security, the protection of the environment, the qualification of seafarers and legal compliance; contributing to the enhancement of operational and technical aspects with the publication of guidelines, manuals, and the "Seafarer Workforce Report" (Chambers, 2021), containing the statistical review and prospects of the global employment situation of seafarers (BIMCO and ISF, 2011)[4], which is published in cooperation with the
- International Shipping Federation (ISF), representing the interests of the employers in the maritime industry (BIMCO and ISF, 2011);
- The International Chamber of Shipping (ICS), INTERTANKO, and the Oil Companies International Marine Forum (OCIMF), who are in particular concerned with the interests of the tanker shipping industry, and the development of training guidelines for best practices on technical, operational, environmental, commercial and human element issues (Oil Companies International Marine Forum, 2017, p. iii), contributing to the IMO Model Course in Basic Training in Oil and Chemical Tanker Operations[5], publishing the Tanker Management Self Assessment programme (Oil Companies International Marine Forum, 2017), the International Safety Guide for Oil Tankers and Terminals (ISGOTT) in cooperation with the International Chamber of Shipping, which aims to "align policies and procedures with industry best practice" (OCIMF, 2024) and the requirements of the STCW and the ILO framework (Oil Companies International Marine Forum, 2017, p. iii);
- The International Transport Workers' Federation (ITF), concerned to enhance working and living conditions of seafarers, and extending to transport workers in non-maritime sectors (Geffken, 1988, p. 35; Stopford, 2009, p. 35);
- The International Association of Maritime Universities (IAMU), an association of universities "representing the five continents of the world" and encompassing over seventy member universities; initiating and coordinating funds of academic education research activities focused on MET (International Association of Maritime Universities, 2023);

[4] see also chapter 3.9.1 Excursus: Lack of Qualified Seafarers
[5] see also chapter 8.8 Model Training Courses

- The World Maritime University (WMU), established by the IMO in 1983, and situated in Malmö, Sweden, promoting maritime studies and research in global MET, the role of women in the industry, sustainability, and supporting developing countries with the admission to its educational programmes (World Maritime University, 2024); the initial development of STCW 78 was supported by the members of the WMU (Vanchiswar, 1997, p. 160).

The International Maritime Organization (2006) in its leading role in maritime trade and MET, emphasises the importance of cooperation and the need for all stakeholders to take a comprehensive approach to the human element when developing and implementing new or revised regulatory requirements and best practice guidance (International Maritime Organization, 2006).

These ongoing concerns have been communicated to the wider shipping community in the IMO vision statement for the “Revised Strategic Plan for the Organization for the six-year period 2018 to 2023”, in which the International Maritime Organization reaffirms its leadership and responsibility in shaping the maritime interdependencies of global trade (International Maritime Organization, 2022). Furthermore, the IMO's "2030 Agenda for Sustainable Development" reiterates the importance of addressing technological, environmental and human aspects in the future development of the maritime industry (International Maritime Organization, 2022).

3.5 The Interdependencies in the European Maritime Trade

Northwest Europe, including Germany, has played an important role in shaping the maritime trade in the region and has had a considerable influence on global developments (Stopford, 2009, p. 13). From the late fifteenth century, Europe's economic aspirations were driven primarily by the desire to acquire commodities such as silk and spices, and to establish and control a sea route to the Asian world (Stopford, 2009, p. 13). These early endeavours laid the foundations for a vast global maritime trading network that would have a profound impact on trade for the next five centuries (Stopford, 2009, p. 13). Through the development of the region's historic trade routes, and combined with the region's inland waterways, given that the Rhine flows from Basel in Switzerland to the mouth of the North Sea at Rotterdam, as the largest port in Europe, other major ports such as Hamburg, Bremen, Antwerp and Le Havre have developed

and prospered (Stopford, 2009, p. 367). The various economic and environmental factors, and in particular competition and innovation, have shaped the evolution of the ecological landscape (Bergmann and Bungert, 2022, p. 13). The technical achievements of the end of the 19th century supported the establishment of a network of liner services operated by steam-powered vessels (Stopford, 2009, p. 31).

Today, the shipping market in Western Europe continues to generate a substantial trade volume in seaborne commodities, with a shift from primarily importing raw materials establishing a “tightly knit global business” (Stopford, 2009, p. 46) characterised as “low-cost, high-volume business” (Stopford, 2009, p. 356), and world trade dependent on seaborne transport chains (Stopford, 2009, p. 388). While the maritime industry provides jobs, goods and services to the market, each organisation in the sector relies on interdependencies within the wider community, in various aspects, psychological, geographical, cultural and social (Drucker, 2014, p. 33), with an impact on individuals, communities and society as a whole, and thus a social responsibility in a micro-macro perspective (Drucker, 2014, p. 33). Organisations, including business enterprises and educational institutions, and their activities are never isolated, but function as a social organ to serve society (Drucker, 2014, p. 33). The interests of the various stakeholders in maritime trade and their impact on the role of seafarers as facilitators of trade, transferring economic value, are iterative to aspects such as capital, human resources, information or know-how, and permeate and shape the development of trade (Bergmann and Bungert, 2022, p. 24), as further outlined below.

3.6 Stakeholders in the German MET System

Both political and economic actors have a significant influence and shape the competitive landscape of the maritime business, with political entities setting the regulatory parameters that govern the trade in response to the impact of global economic, financial and legislative factors (BIMCO and ISF, 2011, p. 3). Stakeholders working together in the maritime industry represent their interests both horizontally and vertically, with a wide regional and national presence as part of a maritime cluster, in relation to maritime education and training (Bundesministerium für Digitales und Verkehr, 2003a).

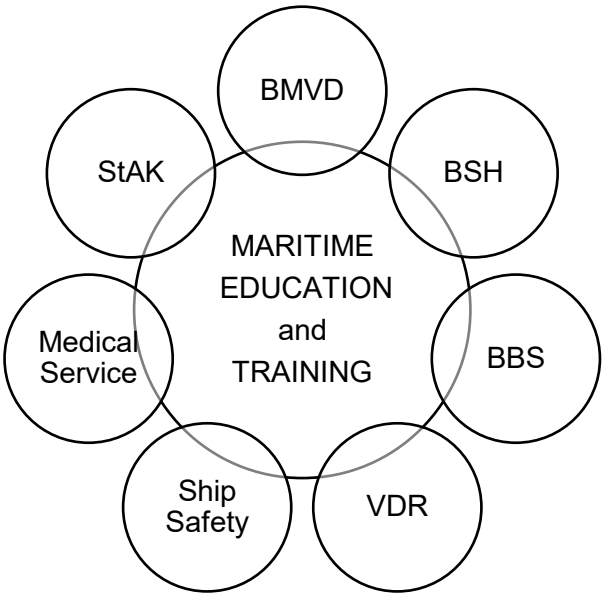

Figure 2: Stakeholders in the German MET System

The education system in Germany is determined and shaped by the sovereignty of the federal states, as laid down in Article 7 of the Constitutional Law, with the exception of a few fundamental matters which are subject to federal legislation (Hoffmann, 1985, p. 7). The sovereignty of the federal states in educational matters extends to vocational schools and universities, with federal authorities overseeing the content and organisation of education (Hoffmann, 1985, p. 7).

The Federal Ministry for Digital and Transport (BMVD) is the regulatory body in Germany responsible for the implementation of ratified conventions, codes and regulations, including the provisions of STCW 78 and the STCW Code (Bundesministerium für Digitales und Verkehr, 2003a). In the field of maritime and coastal shipping, it exercises the federal government's legislative powers and prescribes the competence and performance criteria for seafarers (Bundesministerium für Digitales und Verkehr, 2003a). The BMVD supervises other administrative bodies involved in maritime education, training and certification of seafarers and is responsible for the endorsement and recognition of seafarers' certificates in accordance with the European legal framework (European Union, 2019).

The Federal Maritime and Hydrographic Agency (BSH) is responsible for issuing, revalidating and registering certificates of competency (Deutsche Flagge, 2024g). In addition, the BSH oversees curricula, study programmes, examinations at maritime

institutions and the revision of regulations affecting MET (Deutsche Flagge, 2024a; Stiftung Akkreditierungsrat, 2024). The aim is to ensure the harmonised implementation of the European Union and international regulations governing the training and certification of seafarers (European Union, 2019). In the German education and training system, the global aspect of the maritime environment has been established by the federal legal framework laid down in the Seeleute-Befähigungsverordnung (See-BV) (Stiftung Akkreditierungsrat, 2024). This framework outlines the qualifications and requirements necessary for the issuing and withdrawal of certificates of competency for masters, officers and seafarers serving on merchant ships (Stiftung Akkreditierungsrat, 2024). Thereafter, and in accordance with the provisions of the See-BV, courses and procedures for the recognition of professional entrance examinations are approved in order to align with the global framework set out by the International Maritime Organization, the Standards of Training, Certification and Watchkeeping for Seafarers 2010 and the European Union Directive 2008/106/EC (Deutsche Flagge, 2024a, 2024i; Stiftung Akkreditierungsrat, 2024).

The Ship Safety Division administers and carries out duties on behalf of the Federal Administration relating to ship safety inspection and crew training in accordance with Chapter VI, STCW 78, including the provision and conduct of courses in basic safety, fire-fighting techniques and rescue boat operation and training (Deutsche Flagge, 2024a, 2024f).

The Maritime Medical Service is responsible for the approval, training and supervision of medical practitioners who carry out medical examinations of seafarers (Deutsche Flagge, 2024h). The Service is also responsible for the reassessment of medical fitness and the revocation of medical certificates of seafarers in accordance with Reg. I/8, STCW 78 and Section A-I/8, STCW Code (Deutsche Flagge, 2024h).

The organisation Berufsbildungsstelle Seeschifffahrt (BBS) is a cooperation between the BMVD, the coastal states and the German Shipowners' Association (Deutsche Flagge, 2024d). In the context of higher education, the responsibilities and tasks of the BBS include the monitoring and evaluation of the compliance of the on-board training of students serving in the position of Nautical Officer's Assistant (NOA) within the framework of approved MET programmes according to STCW 78 (Deutsche Flagge, 2024c). The BBS verifies the entries made in the “Training Record Book” and provides guidance to shipowners on the conduct and delivery of on-board training for 'Officer's Assistants and Ship Mechanics' (Deutsche Flagge, 2024b, 2024c). In addition, the BBS

oversees training programmes for ship mechanics (Deutsche Flagge, 2024c). The role of the BBS is to provide expertise and supervision of training, to conduct examinations for ship mechanics and to approve ships as suitable training facilities (Hoffmann, 1985, p. 31). The completion of the vocational programme results in a state-recognised vocational qualification that meets the practical training and seafaring requirements of universities, colleges and certificates of competence (Deutsche Flagge, 2024c).

The Alliance for Training and Employment in German Maritime Shipping, the "Maritime Alliance", was formed under the auspices of the BMDV and its social partners representing the interests of the coastal states of Lower Saxony, Bremen, Hamburg and Schleswig-Holstein, and the German Shipowners' Association (Bundesministerium für Digitales und Verkehr, 2023a; Deutsche Flagge, 2024e). The collaborative efforts of the Maritime Alliance aim to promote and maintain sufficient training capacity for ship officers and to encourage German shipowners subject to the German Safe Manning Ordinance to increase the number of ships flying the German flag (Deutsche Flagge, 2024e). The increase in the number of vessels is considered to be closely linked to the recruitment of seafarers and the support of training facilities for nautical officers' assistants and cadets of German or European nationality (Deutsche Flagge, 2024e).

The Permanent Working Group of the Coastal States, abbreviated as StAK, consists of the BMDV, the representatives of the coastal states offering MET courses, their social partners and relevant stakeholders (Hoffmann, 2006, p. 122). The StAK has a coordinating role and monitors that the requirements of the STCW framework, the European Directives and the German training standards laid down in the See-BV, are met in the German MET (Deutscher Bundestag, 2014). StAK provides guidance and approves framework programmes for the training of seafarers in order to promote national efforts in MET (Deutscher Bundestag, 2014; Wand and Reger, n.d.).

The German Shipowners' Association (VDR) works at the political and economic level, and networks with MET institutions and industry partners with the aim of maintaining and promoting the further development and strengthening of maritime know-how and the economic competitiveness of the German fleet (Deutsche Flagge, 2024d). The promotion of jobs in the maritime industry is financially supported by the VDR through the establishment of the "Stiftung Schifffahrtsstandort Deutschland" (Deutsche Flagge, 2024d). The core concern here is to improve the qualifications of seafarers (Hoffmann, 2015, p. 17) and to increase the attractiveness of maritime career prospects for the younger generation (Deutsche Flagge, 2024d).

Overall, the various horizontal and vertical, economic and political cooperations of the German maritime stakeholders aim to promote the economic strength, the attractiveness of the seafaring profession, the training and education standards, the improvement of working conditions, and the efforts for a sustainable knowledge transfer, thus the preservation of know-how and the German economic competitiveness (Bundesministerium für Digitales und Verkehr, 2023b).

3.7 Quality Management in MET

As an integral part of the higher education system, the programmes in nautical science are legally required to systematically and continuously assess and improve the quality of their programmes and teaching through a quality management process (Deutsche Gesellschaft für Qualität, 2015, p. 7). This obligation of any institution, organisation, and university, as a social entity is based and justified in its value to society (Drucker, 2014, p. 33). The existence of an educational institution and its social responsibility lies in its social impact and the social responsibility that comes with it (Drucker, 2014, p. 33). The success of any institution engaged in this endeavour can be measured by the evaluation of staff performance and the processes involved in a manageable system, organised in accordance with the legal framework (Drucker, 2014, pp. 32–33). The challenge of fulfilling this social responsibility lies in the shaping of the workforce to meet the demands of the labour market while considering the psychological and physical capabilities of individuals (Drucker, 2014, p. 33).

Higher education is a key driver of social cohesion, economic growth, innovation and global competitiveness in the knowledge society that Europe has sought to achieve through the efforts of the “Bologna process”' and the adaptation to the demands of skill development (Hochschulrektorenkonferenz, 2017, p. 2). The “European Higher Education Area” (ESG), which provides a framework for aligning national standards across the European Community, has been designed to ensure transparency in an increasingly diverse higher education system (Hochschulrektorenkonferenz, 2015, p. 7). The "Higher Education Qualifications Framework" provides the general outline of the knowledge and skills to be acquired by graduates of Bachelor, Master and Doctoral programmes, with particular attention to the application of scientific methods and the acquisition of reflective, critical and innovative knowledge (Hochschulrektorenkonferenz, 2017, p. 4). The provisions of the ESG have a direct impact on the principles set out in

the German “Higher Education Act” (Hochschulrektorenkonferenz, 2018). The Higher Education Act has the objective of developing, implementing, maintaining and improving the quality of teaching and research at German higher education institutions, thus to ensure that comparable quality standards are applied to study programmes at universities (Hochschulrektorenkonferenz, 2018). Furthermore, it delineates the criteria for accreditation programmes in accordance with German state law, as established by the resolutions of the Accreditation Council and in consideration of the guidelines of accreditation agencies (Hochschulrektorenkonferenz, 2018).

The “Foundation Accreditation Council” (SAkk) defines the specific requirements for programme accreditation based on the ESG standards and is responsible for ensuring the quality of teaching and learning at German higher education institutions, including those offering MET programmes, through an accreditation system (Röbbecke, 2010, p. 334). SAkk is responsible for making decisions on the accreditation of the study programmes accreditation system, which is supported by the "Bologna Process", where the ministries of education of all member states of the European Union have agreed on a common “European Higher Education Area” with comparable courses of study, and based of the provisions of the federal law and state ordinances (Hochschulrektorenkonferenz, 2018).

The accreditation process is commissioned by the university and consists of programme and system accreditation, where the implementation of the process is overseen by an agency and the assessment by an accreditation council (Deutsche Gesellschaft für Qualität, 2015, p. 18). In Germany, the accreditation council was established by the “German Rectors' Conference” and the “Standing Conference of the Ministers of Education and Cultural Affairs” in agreement with the “Federal Ministry of Education and Research” as a transnational foundation to provide minimum standards and criteria for accreditation and comparable quality standards for study programmes at universities within the ESG (Hochschulrektorenkonferenz, 2017, p. 2). The criteria for the accreditation of programmes at Bachelor's and Master's level relate specifically to the "learning outcomes, competences and skills" and the associated “European Credit Transfer System” (ECTS) for the qualification profiles (Hochschule Emden/Leer, 2024a). The accreditation of the ‘Bachelor of Science in Nautical Sciences and Maritime Transport’ in Leer has been evaluated by the “Central Evaluation Agency” (ZEvA)[6] in

[6] Abbreviation of the German denomination of “Zentrale Evaluations- und Akkreditierungsagentur” (Zentrale Evaluations- und Akkreditierungsagentur Hannover, 2024).

Hannover, and accredited the Accreditation Council (Stiftung Akkreditierungsrat, 2024). Study programmes that include a certificate of proficiency in accordance with the provisions of the “Regulations on the Competencies and Proficiencies of Seafarers in the Maritime Shipping industry” (See-BV)[7] and by resolution of the StAK, are subject to accreditation every five years (Stiftung Akkreditierungsrat, 2024). This process is carried out in a separate procedure by the Federal Maritime and Hydrographic Agency (Stiftung Akkreditierungsrat, 2024).

The functionality and effectiveness of a quality management system is demonstrated through an external certification process, typically based on the overarching principles of ISO 9001 (Deutsche Gesellschaft für Qualität, 2015, p. 17). The Maritime Faculty in Leer has implemented a quality management system based on the ISO 9001:2015 standard (DNV, 2023), assessed and certified by “non-governmental agencies” in order to comply with the requirements and standards set out in STCW 78 (International Maritime Organization, 2017a). The requirement to “maintain documented information“ (Deutsches Institut für Normung, 2015) is provided with the quality management manual which is based on a process cycle of “Plan-Do-Check-Act” (Deutsches Institut für Normung, 2015) and outlines all processes and operational procedures to develop and maintain the required quality standards of training with a view to ensuring the implementation of future developments in the curriculum in accordance with the STCW framework (Stiftung Akkreditierungsrat, 2024).

Essentially, the functioning of an organisation depends on its internal processes (Deutsche Gesellschaft für Qualität, 2015, p. 11), which, through collectively shared psychological aspects, form an organisational "culture" (Deutsche Gesellschaft für Qualität, 2015, p. 15). Internal processes for evaluating and reviewing processes, pedagogical training and lectures are based on student satisfaction surveys, and alumni surveys (Stiftung Akkreditierungsrat, 2024). These constitute internal quality assurance methods, promoting a quality management cycle through feedback and evaluation carried out regularly each semester with the results being published to facilitate transparency and continuous improvement (Stiftung Akkreditierungsrat, 2024).

[7] Translation of "See-BV“ provided by the Federal Ministry of Transport and Digital Infrastructure (Bundesamt für Justiz, 2016).

3.8 The Establishment of the Faculty of Maritime Sciences in Leer

The study of the genesis of a profession goes beyond an examination of the individuals who perform a specific function, but strives to investigate the relationships, activities, and independences with respect to the context of scientific developments (Elias, 2007, p. 28). These processes take place within a dynamic of emerging technologies, institutions and individual needs, and are therefore ultimately determined by the established patterns between professional institutions and the historical societal needs they serve (Elias, 2007, p. 28). Therefore, the historical development of the Maritime Faculty in Leer and the social and economic interdependencies that led to the establishment and structuring of education are elaborated further on.

Historically, the conditions of human life in the vast moorlands of East Frisia were characterised by poverty, dependent on agriculture and fishing (Müller, 1990, p. 3). The excavation and transport of peat led to the cultivation of these areas which gradually developed into a dense network of canals, the only transport route available at the time (Böhlhoff, 2004, p. 16). The descendants of these so-called "Fehntjer" [original emphasis] were then called “shippers” who gradually sailed further down the river Ems and into coastal waters, eventually becoming open sea sailors (Möller, 1954, p. 17). Despite the necessity to sail and the aspiration to earn a better living at sea, the lack of even a basic education and adequate training in the skills of seamanship posed a significant challenge to those early seafarers (Möller, 1954, p. 11). Initially, seafarers received some basic education through private initiatives led by primary school teachers or pastors who taught in their private homes (Lehmann, 2000, p. 190). These initiatives formed the predecessors of navigation schools in the seventeenth and eighteenth centuries in the coastal areas and on the Frisian islands (Lehmann, 2000, pp. 190–191; Möller, 1954, pp. 14–17; Ostfriesland Tourismus GmbH, 2022). Nevertheless, there was no evidence to substantiate the acquisition of knowledge or skills, and the demand for examinations was disseminated throughout the merchant community (Möller, 1954, p. 16).

In 1793 the city council of Emden, then ruled by the House of Hanover, issued a decree stating that no seaman would be employed on a ship in Emden without evidence of a helmsman[8] training (Möller, 1954, p. 16). This decision marked the first step towards the

[8] Translated from the German “Steuermann”: the person at the “helm” of a ship, which refers to the wheel on the navigation bridge; in American English called the “wheelman” (Dluhy, 1999, p. 558).

helmsman's examination, which came into force in 1845, just three years after the establishment of the first navigation school in Frisia, in the city of Emden (Möller, 1954, pp. 15–16). Over the following years, in addition to the school in Emden, a number of other schools were established in Frisia, including in Papenburg, Timmel, Leer and Westrhauderfehn (Möller, 1954, p. 18). The school in Leer was funded as a private institution through the efforts of the commercial deputation of the city of Leer, with the stated purpose of educating seafarers in the sciences and skills required for the helmsman examinations, as mandated by the applicable law (Badewien et al., 2018, p. 38). The examinations included basic mathematical and German language skills, both written and oral (Möller, 1954, p. 16). The knowledge of German was a novelty requirement because of the lack of navigation books in German language (Möller, 1954, pp. 18–22). Due to the close vicinity to the Netherlands as one of the main trading partners (Müller, 1990, p. 8), Dutch had prevailed until then as the working language on board (Möller, 1954, pp. 18–21). However, there was no uniform specification or implementation of the lesson content, teachers interpreted and designed the content as they saw fit for the examination (Möller, 1954, p. 22).

After the Hanoverian dynasty, Frisia became a part of Prussia in 1866 (Rothstein and van Geuns, 2004, p. 25). During this era, Prussia established numerous state navigation schools, particularly along the Baltic Sea coast, with a structured curriculum and examination plan, and the introduction of a “Certificate of Competence” (Möller, 1954, p. 13). However, attending school and taking the examination were not made compulsory, scholars could receive certificates for partial attendance without undergoing an examination (Möller, 1954, p. 13). In 1869, the North German Confederation[9] introduced regulations regarding the proof of qualification for shippers and helmsmen[10] which was a significant achievement for the nautical education system (Möller, 1954, p. 22). The certification system for helmsmen and shippers consisted of various levels, such as coastal, European, and unlimited licenses (Bundesgesetzblatt des Norddeutschen Bundes, 1869, §§ 1–10). Further distinctions were determined by factors such as ship size and number of crew on board (Bundesgesetzblatt des Norddeutschen Bundes, 1869). However, certificates issued for limited or coastal trade before the new regulations were still recognized and remained valid (Bundesgesetzblatt des Norddeutschen Bundes, 1869). Disputes arose over the best methods of teaching and

[9] Translated from the German term “Norddeutscher Bund”.
[10] The ranks of shippers and helmsman then is equivalent to the present rank of captain and officer.

examination, with some advocating for theoretical and mathematical knowledge while others emphasised on the practical skills required for a helmsman (Möller, 1954, p. 24). Although standardized examination provisions were enacted, the internal affairs of schools, such as the selection of instructors and the application of teaching methods, remained under the jurisdiction of individual states, which led to diverse methodologies in the schools (Möller, 1954, p. 24). Nevertheless, the harmonisation of regulations permitted individuals certified under the common rules to be employed on any ship registered in the states of Bremen or Hamburg (Möller, 1954, p. 22). This resulted in an increase in the number of students at navigation schools, who were seeking economic and social well-being through the profession of seafarers and thus contributing to the prosperity of the region (Rothstein and van Geuns, 2004, p. 25).

By the end of the nineteenth century, the peat trade in Frisia, which had been a major source of income, had ceased (Müller, 1990, p. 83). The transition from sailing ships to more efficient steamships resulted in a reduction in the number of seamen required on board (Rothstein and van Geuns, 2004, p. 28). This, in turn, caused a significant economic decline in the region and a decrease in the number of students pursuing a seagoing career (Rothstein and van Geuns, 2004, p. 28). During the centenary celebration in Emden in 1882, initial considerations were made for the merger of the schools in Leer and Emden due to the declining number of students from the region (Möller, 1954, p. 27). This was attributed to the increased employment of foreign seafarers on board German-flagged ships (Möller, 1954, p. 27). By 1924, all schools in Frisia and in the Emsland region, with the exception of Leer, had ceased operations as a consequence of economic constraints and a decline in employment opportunities for seamen, which was evidenced by a decline in student enrolment (Rothstein and van Geuns, 2004, p. 29).

The University of Applied Sciences in Emden was established in 1971, and in 1973, the nautical school in Leer was affiliated, laying the foundation for academic education in nautical science (Rothstein and van Geuns, 2004, p. 31). In the early 1980s, however, the fluctuations in world trade and the resulting increase in the practice of flagging out the German merchant fleet brought about a long-term change in the maritime economic landscape (Kampen, 1982). Political measures were implemented to enhance job prospects for German seafarers, and economic funding for professorships was allocated from the local economy in order to confirm the existence of the faculty in Leer (van Geuns, 2004, pp. 44–46).

In 2023, five German universities of applied sciences, including those in Bremen, Flensburg, Warnemünde, Elsfleth, and Leer, offer studies for nautical officers with a Bachelor of Science degree (Deutsche Flagge, 2024i). The city of Leer, home to the Faculty of Maritime Studies, has become the second largest shipping community in Germany, where the port of Leer serves as the key municipal inland port in Lower Saxony and the core of an extensive maritime cluster with two shipyards and numerous maritime service providers in the region (Seaports of Niedersachsen, 2022).

3.9 Study Programme of Nautical Sciences at the Maritime Faculty in Leer

The Faculty of Maritime Sciences offers two Bachelor programmes, including 'Maritime Engineering and Management' and 'Nautical Science and Maritime Traffic', and in cooperation with the Western Norway University of Applied Sciences a joint Master programme in 'Maritime Operations' (Hochschule Emden/Leer, 2024a). In addition, the Faculty houses a 'Technical School for Maritime Studies', which offers a two-year programme leading to the qualification of a “Navigational Watchkeeping Officer” (Hochschule Emden/Leer, 2024a). The academic programme in nautical sciences provides an initial professional qualification leading to the CoC of a nautical officer in accordance with the international requirements stipulated in STCW 78 and the German regulations of the See-BV (Hochschule Emden/Leer, 2023a, 2023b). Admission to the programme is subject to the general admission requirements of para. 18, Lower Saxony Higher Education Act (Hochschule Emden/Leer, 2021b).

The Bachelor of Science degree is awarded upon the successful completion of a total of eight semesters, equivalent to 240 credit points in accordance with the provisions of the of ECTS (Hochschule Emden/Leer, 2024a). The career progression from student to an officer in charge of a navigational watch to a certified master follows the certification steps shown in Figure 3 below, in accordance with international and German national regulations (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 6). The three potential pathways, as illustrated above, are as follows: firstly, general school graduation and vocational training as a 'Ship Mechanic' [original emphasis]; secondly, completion of secondary school and twelve-month practical training as a ‘Nautical Officer's Assistant’ (NOA) as well as vocational training as a 'Ship Operation Assistant' [original emphasis]; and thirdly, an educational degree qualifying for higher education, in addition to vocational training or twelve months as a cadet or NOA, followed by a minimum of six

semesters, equivalent to three years of university studies (Bundesamt für Seeschifffahrt und Hydrographie, 2006). Prior to the commencement of studies and the practical semesters at sea, contenders need to undertake a medical examination to ascertain the fitness of seafarers in accordance with the framework of STCW 78 (Deutsche Flagge, 2024i). All graduates holding a CoC of a nautical officer then serve on a vessel either twelve months as a second officer and an additional twelve months as a first officer, or alternatively twenty-four months as a second officer (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 6). The verification of the seagoing service in the associated rank qualifies for the issue of a CoC as master (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 6). All levels of CoC are issued by the BSH as the national German administration (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 6).

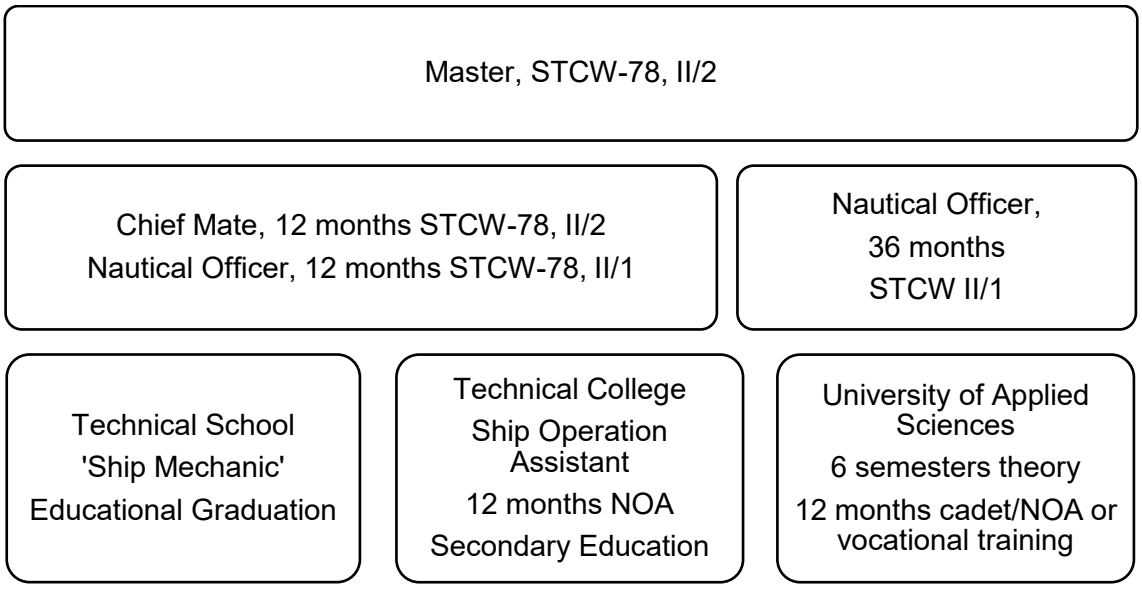

Figure 3: Career path from student to master (adopted after Bundesamt für Seeschifffahrt und Hydrographie, 2006, p.6)

The theoretical studies of the university curriculum are divided into subject-specific modules of basic nautical science subjects, including mathematics, physics, computer science, business studies and maritime English (Hochschule Emden/Leer, 2023a). From the fourth semester onwards, the university programme offers a choice of specialised modules in environmental, safety and quality management or ship handling subjects, which combine the theoretical and practical knowledge acquired with the skills and competencies required by the international regulations and guidelines promulgated by the IMO (Hochschule Emden/Leer, 2023a; International Maritime Organization, 2014a,

2014b). Competence-based education and training mainly refers to the combination of knowledge, skills and attitudes on the basis of an educational framework structure (Schaperunter, 2012, p. 28). This concept of designing a competency-based curriculum has been a commonly applied principle in the international academic landscape since the 1970s originating from the Anglo-Saxon system (Schaperunter, 2012, p. 31). The aim is to develop professional skills and to promote the “employability” [original emphasis] of graduates (Schaperunter, 2012, p. 32). The assessment of the professional skills requirements of graduates is usually developed with feedback and expert input from the field (Schaperunter, 2012, p. 32).

The German framework includes subject-specific, domain-combining and generic competences (Schaperunter, 2012, p. 27). The categories and levels are not strictly defined, allowing for a wide application and interpretation in order to define the assessment of competences and learning outcomes in the curriculum (Schaperunter, 2012, p. 28) The structuring of key competences in the subjects espouse methodological, social and personal competences, understood as key competences embracing the professional, social and personal development (Schaperunter, 2012, p. 28). Typically, in MET, the curriculum of a study programme prescribes learning outcomes, which are aligned with the STCW 78 requirements (Kalnina and Priednieks, 2017, p. 140). The subject modules define a student’s individual ability to demonstrate the knowledge, skills and competencies achieved, using the “Bloom's taxonomy” (Kalnina and Priednieks, 2017, p. 141). Bloom’s “Taxonomy of Educational Objectives”, first published in 1956, aims to structure cognitive learning objectives through the concept of a classification system (Bloom, 1956, p. 18). The category system comprises of six domains, namely “knowledge, comprehension, application, analysis, synthesis, evaluation” and was later revised by Krathwohl (2002) in categorical hierarchies and sub-categories utilizing verbal terms such as “remember, understand, apply, analyse, evaluate, or create” (Krathwohl, 2002, p. 215). These taxonomy derived denominations are integrated into the German higher MET curricula, where learning outcomes are linked to the qualification objectives of the nautical profession (City University of Applied Sciences Bremen, 2021; Hochschule Emden/Leer, 2023a). The areas of competence of the graduates correspond to the level of responsibility defined in STCW 78, where the management level is related to the master and chief officer and at the operational level to a nautical officer (Hochschule Emden/Leer, 2023a).

The competencies and learning outcomes are primarily concerned with the safe operation and management of ships and include the below (Hochschule Emden/Leer, 2023a):

- Planning and carrying out a journey, determining and evaluating the position;
- Undertaking a safe navigational watch;
- Using radar equipment, ARPA[11] and electronic sea charts;[12]
- Preparing for and responding to emergencies, including medical first aid;
- Use of English language and the IMO standard phrases for maritime shipping;
- Ship manoeuvring and understanding of hydrodynamics;
- Understanding and evaluating weather forecasts;
- Cargo handling, storage, and assessing damaged cargo;
- Compliance with legal regulations in the maritime industry;
- Basic knowledge of ship design, construction, trim and stability;
- Radio and distress communication.

Furthermore, the curriculum incorporates provisions for the development of social, interpersonal and cognitive skills, which are considered essential in a multicultural and international profession with management responsibilities (Hochschule Emden/Leer, 2023a). The award of the related social credit points, which are a mandatory component of the curriculum, are granted for engagement and collaborative work in various areas, including participation in tutorials or university committees responsibilities (Hochschule Emden/Leer, 2023b).

The practical training at sea is an obligatory part of the training for nautical officers, as required by the BMVD in accordance with para. 30, See-BV and the Maritime Vocational Training Ordinance (Hochschule Emden/Leer, 2023b). Prerequisites for practical training include physical fitness and the completion of the “Basic Safety Training”, a familiarization training for seafarers in accordance with para.1, Part A-VI/1, STCW Code (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 7; Hochschule Emden/Leer, 2021c). The training content of the two 52-week practical training are documented in the “On Board Training Record Book”, issued by the BSH and endorsed by the BMVD or its

[11] Automatic Radar Plotting Aid (ARPA) refers to technical equipment used to simulate and calculate a vessel’s movement and to predict its future course, the performance standard for ARPA as determined by the IMO (International Maritime Organization, 2017a).
[12] Referring to the electronic chart display and information system (ECDIS) (International Maritime Organization, 2017a).

authorized entity (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 8). An outline of on-board practical training content and timeframes is given in Table 1.

Table 1: Training Record Book time table (adapted after Hochschule Emden/Leer, 2021c)

Training tasks	**Standard time values (in weeks)**
Navigation on the support level	**26**
Plan and conduct a passage and determine position	6
Maintain a safe navigational watch and harbour watch	7
Use of radar and electronic sea charts systems	4
Respond to emergencies and distress signals	1
Use of the English IMO Standard Marine Communication Phrases	always
Steering the ship	2
Project assignments in various tasks and training subjects	6
Navigation on the operational level	**6**
Signalling incl. morse code	0,5
Maneouvring the ship	2
Engine room training	2
Project assignments in various tasks and training subjects	1,5
Cargo handling and stowage on the operational level	**14**
Supervise cargo operations and document cargo damage	8
Cargoes care and maintenance of installations during the voyage	1,5
Trim and Stability	1,5
Project assignments in various tasks and training subjects	3
Controlling the operation of the ship and care for persons on board at the operational level	**6**
Compliance with rules and regulations for all aspects	always
Maintain seaworthiness of the ship	always
Prevention and control of fire on board	2
Use of life saving appliancies	2
Apply medical first aid on board	0,5
Apply security measures	0,5
Use of leadership and teamworking competency	always
Project assignments in various tasks and training subjects	1
Total time	**52**

The primary objective of the initial practical training is to acquaint students with the maritime work and life environment (Hochschule Emden/Leer, 2021c, 2023a). Initially,

the focus is on developing a broad awareness and understanding of the living and working environment on board, the familiarisation with daily routines, operational maintenance and gaining practical experience to reinforce and consolidate the theoretical training (Hochschule Emden/Leer, 2021c). Subsequently, all aspects of shipboard and bridge duties in the deck and engine areas are covered within the allotted time (Hochschule Emden/Leer, 2021c) The overarching aim is to bridge theoretical knowledge with practical application and to further augment the skill set acquired on board (Hochschule Emden/Leer, 2021c). The comprehensive practical training is supervised by the captain and an assigned officer and structured in a set of defined activities, documented in prescribed time values (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 9; Hochschule Emden/Leer, 2023a). The contents of the "On Board Training Record Book" reflects the three functions of a nautical officer and the associated levels of knowledge, skills and competencies as set out in Tables A-II/1, and A-II/2 of the STCW Code, illustrated in Table 1 (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 9; Hochschule Emden/Leer, 2021c; International Maritime Organization, 2017a). For students engaged on board as NOA, the BBS serves as the central point of contact and is responsible for approving the formalities associated with the performance and documentation of all duties carried out during the practical training (Hochschule Emden/Leer, 2021c). For students sailing as cadets, an assigned lecturer at the Faculty in Leer acts as a contact and assessor for the verification of the training content (Hochschule Emden/Leer, 2021c).

3.9.1 Excursus: Lack of Qualified Seafarers

The role of seafarers as “essential workers” is closely associated with the interdependencies of the world trade in delivering ubiquitous goods of daily life (International Maritime Organization, 2000) and providing for a society's established “standard of life” (Durkheim, 1956, p. 56), and social wellbeing (Ziarati, 2012). Maritime transport networks and supply chains forward more than 90% of goods globally (International Maritime Organization, 2017a) and drive economic and social well-being, prosperity and competitiveness, both globally and locally (BIMCO and ISF, 2011, p. 3). In the European context, maritime transport facilitates 77% of the Union’s external trade and 35% of intra-European trade in terms of value (European Environment Agency and European Maritime Safety Agency, 2021, p. 15). Around one third of the ships operating

in international trade are owned by European Union-based companies (European Environment Agency and European Maritime Safety Agency, 2021, p. 15). The German flagged merchant fleet has experienced a sustained decline over the past decades (Deutscher Bundestag, 2019). Nevertheless, it still represents the sixth largest fleet by ownership in the world merchant fleet (Müller, 2022, p. 137), and ranks first in terms of the global ownership of the container ship fleet (Deutsche Wirtschaft Nachrichten, 2022, p. 104). Germany's main imports and exports by waterway consist mainly of exports of machinery, automobiles and chemical products, and imports of commodities such as petroleum, natural gas and agricultural products (Deutsche Wirtschaft Nachrichten, 2022, p. 104; Statistisches Bundesamt, 2022, p. 147). These economic facts serve to illustrate the significant dependence of global and regional economies on maritime transport and seafarers as "essential workers" in their role to enable and sustain the economic development, social prosperity and the enhancement of market value and competitiveness.

The reliance of the maritime industry on educated and skilled labour is critically highlighted and reflected throughout the history of maritime trade (Witt, 2001, p. 228) and subject to further in-depth analysis in the employment statistics generated over the past decades (BIMCO and ISF, 2011). In the 1995 revision to STCW 78, the lack of adequately trained seafarers was acknowledged, with the objective of promoting and implementing enhanced recruitment strategies and governmental support for training initiatives (International Maritime Organization, 2017a). At the 2010 Manila Conference and the adoption of the amendments to STCW 78, recommendations were added to the wider industry on “attracting new entrants to, and retaining seafarers in, the maritime profession” (International Maritime Organization, 2017a). This highlighted on a global scale the need to create a deeper understanding of the seafaring profession, to improve the living and working environment on board, and to promote long-term training opportunities for seafarers, including further career prospects ashore (International Maritime Organization, 2017a). In addition to the adoption of the 2010 amendments to STCW 78 and the STCW Code, the importance of the profession and the role of seafarers in the global trade interdependencies were recognised by adopting the "Day of the Seafarer" (Resolution 19, STCW 78) and proclaiming 2010 the "Year of the Seafarer" (International Maritime Organization, 2017a).

The global statistical assessment of the maritime labour market, conducted since the 1990s on the initiative of the industry associations of BIMCO and ISF, reveals a

persistent shortage of qualified seafarers and continues to forecast future shortages (BIMCO and ISF, 2011, p. IV). The latest workforce reports indicate that there are around 1.9 million registered seafarers worldwide (Chambers, 2021). By 2026, a shortage of approximately 90,000 qualified technical and nautical officers is anticipated, particularly in specialised trades such as tanker shipping and the offshore industry (Chambers, 2021). The majority of seafarers currently registered are from the Philippines, the Russian Federation, Indonesia, China and India (International Chamber of Shipping, 2021). However, critiques of the statistical data provided by BIMCO and ISF have identified discrepancies in the figures provided by maritime authorities, which do not distinguish between active job seekers and the total number of certificate holders, and consequently do not allow for an accurate account of maritime labour (Tang and Bhattacharya, 2021, p. 484).

A reflection of the German maritime labour market indicates a persistently low number of applicants entering the industry (Beveridge, 2022, p. 29). This steady decline over the past forty years has been exacerbated by negative perceptions during the COVID-19 pandemic (Beveridge, 2022, p. 29) with the lowest numbers registered during that period (Berufsbildungsstelle Seeschifffahrt, 2020, p. 5). These figures are also reflected in the total number of apprentices and students enrolled at maritime universities, which show a significant decrease over the past decade (Berufsbildungsstelle Seeschifffahrt, 2020, pp. 5–7). The shortage and decline of experienced seafarers pursuing a career at sea has been assessed as a combination of factors where the personnel reflection of the recent pandemic has reaffirmed the importance of seafarers as essential workers in the global supply chain of world trade, but also the recognised the physical and mental well-being of seafarers and the “value of their life at sea” (Lloyds Register, 2023). Furthermore, in consideration of the German industry and its economic constraints, the practice of flagging out and outsourcing recruitment to crewing agencies has been identified as a contributing factor in the observed decrease in the number of German seafarers employed in the global fleet (Bundesministerium für Digitales und Verkehr, 2003b). The figures have been augmented due to the transition of experienced professionals to shore-based roles (Beveridge, 2022, p. 29) and the demographic shift towards a knowledge-based society, particularly in relation to higher qualifications (Brandt et al., 2009, p. 159).

The career path of a nautical officer requires extensive commitment, including eight semesters of study and an average of a decade of sea-going experience, to progress to

a senior officer or a master's position (Nicolai, 2012). Those who aspire to advance their professional careers at sea must endure long assignments at sea, extended working hours, uncertain job prospects, and social deprivation (Nicolai, 2012). The significance of the physical and mental well-being of seafarers in ensuring the safety of the work environment has been recognised as a fundamental aspect of a comprehensive approach to the matter (Justers, 2023, p. 26). Thereafter, the CEO of the German Shipowners' Association, Martin Kröger (2023), highlights the importance of understanding the characteristics of the Generation Z in order to attract young professionals (Kröger, 2023, p. 17). This encompasses commitments to environmental sustainability, provisions for job flexibility, and aptitude in technical and digital skills, all of which should be integrated and reflected in educational and workplace contexts (Kröger, 2023, p. 17). It has been widely acknowledged that the provision of institutional training and qualifications is of paramount importance in maintaining and advancing the competitiveness of the maritime economy (Brandt et al., 2009, p. 159). The challenge is not only to attract students but also to support the development of the competencies essential to meet future skill requirements in evolving technical advancements and digitalisation, while adhering to the principles of traditional seafaring (The European Community Shipowner's Association, 2018). Sustainable strategies for future developments should also integrate and enhance diversity prospects within the maritime workforce (Beveridge, 2022, p. 29). Currently, female labour only represents around one percent of the total workforce in the industry (Beveridge, 2022, p. 29), predominantly found on passenger ships and in supporting roles, with only a minority serving as certified officers (European Maritime Safety Agency, 2022, p. 15).

The significance of the seafarers' role in the global interdependencies of the world trade and their contribution to social wealth highlights the necessity for collaborative efforts to address the shortage of labour (International Chamber of Shipping, 2021) and the provisions of sustainable future prospects for attracting and retaining the workforce (Ziarati, 2012).

3.9.2 Excursus: Gender Aspects in MET

Gender is a socially constructed concept that encompasses the norms, behaviours, roles and relationships associated with being a woman, man, girl or boy, embedded in a dynamic concept of a society and its time (World Health Organization, 2023). Gender is

distinct from the definition of sex, which refers to an individual's "biological and physiological characteristics" related to "chromosomes, hormones and reproductive organs" (World Health Organization, 2023). The term “gender” [original emphasis] was first introduced in the 1950s as a form of a binary distinction between the sexes, and consequently advanced as a socially constructed norm of identity, individual “roles” and their associated behaviour (Brussino and McBrien, 2022, pp. 8–9).

Nevertheless, gender identity is an individual's distinct internal perception of gender, which may not align with their biological or assigned sex at birth (World Health Organization, 2023). This understanding is essential for an appreciation of the complexity of gender issues and the impact they have on society (World Health Organization, 2023). In general, the gender theory discourse focuses on a dichotomous concept (Ruhne, 2011, p. 109) and stereotyping, carrying significant influence on shaping the identities of children and young people, and their educational and career path chosen (Brussino and McBrien, 2022, p. 6). Historically rooted notions of masculinity and femininity permeate social attributes with implications for occupational roles and their association with particular gender characteristics, thus establishing stereotypes and influencing the evaluation and differentiation of women's and men's roles (Faulstich-Wieland and Scholand, 2017, pp. 24–25). Gender biases still exist in the evaluation, recognition and compensation of workers, notwithstanding individual qualification or experience, but reinforcing inequalities (Faulstich-Wieland and Scholand, 2017, pp. 24–25).

The term *doing gender* [original emphasis], characterises gender acts *as a routine, methodical, and recurring accomplishment* [original emphasis] (West and Zimmermann, 1991, p.13 cited inMohr, 2022, p. 69).The behaviour of individuals derives from the social context, in which acquired behaviours are considered appropriate for their respective sex, and reflected as perceived expectations of the social environment (Mohr, 2022, p. 69). Bourdieu (1977) sees the specific conditions of a given environment, such as the social and material circumstances of a particular social class, which form a person’s understanding and social behaviour as “habitus”, explained as a “subjective but not individual system of internalized structures, schemes of perception, conception, and action common to all members of the same group or class” (Bourdieu, 1977, p. 86). Habitus thus dominates the collective "world view" of the social unit (Bourdieu, 1977, p. 86)., generating and reproducing practices that are endorsed by the conditions and situational demands of the environment (Bourdieu, 1977, p. 78). These practices are accepted as forming and reinforcing gender norms and shaping an individual behaviour

and perception, encompassing education, work, family and other social structures and environments (Bourdieu, 1977, p. 18). This means, that “habitus” is concerned with the cognitive and behavioural patterns of individuals, influenced by societal norms and values, and perpetuated through community practices (Holzer et al., 2012, p. 86). Factors such as personal interest (Micus-Loos et al., 2016, p. 19), but also the influence of gender conformity, and socially related prestige norms affect career choices (Micus-Loos et al., 2016; Mohr, 2022, p. 67), and interests are shaped by the stereotypical perceptions of occupations associated with masculinity or femininity (Micus-Loos et al., 2016, p. 197).

Until the late 19th century, education was generally not provided for girls (Beck-Gernsheim, 2021, p. 15), and until the mid-20th century, women's professional status was largely confined to domestic and family care (Onnen-Isemann and Bollmann, 2010, p. 24). A woman's pursuit of a profession was contingent upon her husband's consent and was generally considered feasible only if it did not conflict with her family responsibilities (Onnen-Isemann and Bollmann, 2010, p. 24). Feminist movements and the changes in society eventually culminated in the passing of the Equal Rights Act in 1957, which provided a legal basis for women’s rights (Botsch, 2015, p. 7). However, the practical impact on everyday life remained limited (Onnen-Isemann and Bollmann, 2010, p. 24). It wasn't until two decades later that women were actually given the autonomy to pursue professional fulfilment without the consent of their husbands (Botsch, 2015, p. 7).

Traditionally, the maritime industry has been male-dominated, with women on board confined to the role of accompanying wife to their working husband (Rohmer, 1998). In the early 20th century, women began to be employed on ships in the capacity of nurses or stewardesses, performing duties that assisted passengers but did not constitute part of the ship’s crew (Belcher et al., 2003, p. 5). In the German shipping industry, particularly in eastern Germany, women were increasingly recruited as radio officers during the 1950s due to the demand for seafaring personnel (Keitsch, 2007, p. 182). However, with the introduction of modern telecommunications systems in the 1980s, the position of radio communications officer became obsolete, resulting again in a decline of women in the field (Keitsch, 2007, p. 183).

Today, despite ongoing efforts in the maritime industry, the overall representation of women as seafarers and generally in the maritime industry remains significantly low (Kitada, 2021, p. 65). This is particularly the case for women in leadership positions (Pohl, 2005, p. 49). Referring to the manpower report published by BIMCO and ICS in

2016, Kitada (2021) points out that female seafarers make up only 1% of the total maritime workforce, including female cadets and trainees who are not yet qualified as officers (Kitada, 2021, p. 66). Ultimately, the total number of qualified female nautical officers is estimated to be 0.5% of the total number of seafarers (Kitada, 2021, p. 66). Political and commercial initiatives promote gender equality and highlight the competitive advantage of companies with diverse teams and female leaders (Iszkowska et al., 2021). The global maritime efforts include the adoption of the “International Day for Women in Maritime” (International Maritime Organization, 2021) as well as the adoption of Resolution 14 to STCW 78, entitled “Promotion of the participation of women in the maritime industry” (International Maritime Organization, 2017a), urging stakeholders in “empowering women and advancing gender equality” in order to provide career opportunities in the industry (International Maritime Organization, 2021). However, over the past decades, stereotyping and openness to hire women have persisted as challenges within the maritime industry (Pohl, 2005, pp. 49–50). Despite efforts to promote the recruitment of female seafarers in the recent decades, the overall number of female seafarers remains significantly low (Nastali et al., 2021, p. 37). Consequently, it is still common on commercial vessels to have only one female member of the crew, if at all, working alongside a male crew (Kitada, 2021, p. 65).

The implications of being a female seafarer were recently presented by Justesen and Javornik (2023), who identified the key challenges and divided those into several perspectives as follows (Justesen and Javornik, 2023, 10ff):

- The general employment situation at sea encompasses established practices, including the assignment and duration of contracts on board, as well as the absence of family planning options. This situation frequently presents female seafarers with a dilemma, forcing them to choose between having a family and pursuing a career at sea.
- From a professional perspective, women are subjected to disrespect and discrimination based on their gender by men in positions of authority, which can result in women feeling compelled to seek recognition for their competence and to advance in their careers. Furthermore, women are frequently undervalued and subjected to discrimination based on their physical capabilities, which can result in them being assigned to different tasks..
- In the social context, women are confronted with complex interpersonal relationships and the potential for gossip, which can result in feelings of isolation and loneliness

on board. Additionally, there is a risk of abuse of power by male officers, which may include sexual misconduct, ranging from sexual harassment to sexual assault.

- The physical challenges on board include the lack of access to sanitary products, the absence of work equipment designed for women, such as coveralls and boots, and the absence of changing facilities and toilets..

The survey results provide valuable insights into the requirements and shortcomings of life at sea for women and indicate the potential to improve diversity, equality, and inclusion on board (Justesen and Javornik, 2023, p. 20). Moreover, the shortage of skilled labour in the maritime industry has promted a growing interest in recognising the potential of employing women (Kitada, 2021, p. 68). However, given the implications outlined and the extensive training and education required to become a qualified officer, a career in the maritime industry remains a "long-term investment" in a professional path chosen (Kitada, 2021, p. 65).

In the context of higher education, the integration of gender perspectives and women remains a challenging issue (Kahlert, 2017, p. 40). Furthermore, the landscape of maritime studies reflects structures in which gender stereotypes are prevalent (Boström Cars and Österman, 2015, p. 150). The curriculum of nautical sciences primarily encompasses scientific and technical subjects, associated with STEM studies (Hochschule Emden/Leer, 2024b)[13], referring to “Science, Technology, Engineering, and Mathematics” (Maastricht University, 2024), fields where females tend to be underrepresented (Kompetenzzentrum Technik-Diversity-Chancengleichheit, 2023). This is evidenced by the statistical data presented in the factsheets of nautical sciences for the years 2015 and 2018, which indicate that all professors are male, and that approximately 12% of all students are female (Hochschule Emden/Leer, 2021a).

A recent study conducted at the University Emden/Leer analysed the self-presentation of the university's study programmes (Suhrcke, 2020). The study analysed the presentation of the academic study programmes in the online university profiles from a gender and equality perspective (Suhrcke, 2020). The disciplines scrutinised include social work, health, technology, and maritime sciences (Suhrcke, 2020, pp. 9–17).

[13] Translated from the German abbreviation MINT, short for Mathematik, Informatik, Naturwissenschaften, Technik. (Mohr, 2022, p. 7).

The Faculty of Maritime Sciences' profile illustrations are presented below in summary form (Suhrcke, 2020, pp. 14–15):

- a male student in a navigation bridge simulator, handling ship's navigation equipment while being engaged in a phone conversation,
- a female wearing a virtual reality headset, and experiencing a presumed enjoyable situation through the simulated environment, and
- a group of eight students, including three males, are using a computer software in a laboratory, while some students are observing and explaining.

Suhrcke (2020) found that human-machine interaction dominates all three situations, with a particular emphasis on individual actions, illustrating a historically stereotypical male environment, with the captain in a dominant role (Suhrcke, 2020, pp. 14–16). The captain's role, however is presented in a casual and enjoyable manner, with an emphasis on the use of technical equipment (Suhrcke, 2020, p. 16). Additionally, this representation fails to capture the wide spectrum of responsibilities and competencies required of a captain, including cargo management and teamwork (Suhrcke, 2020, p. 16). Furthermore, the study findings indicate that due to the diversity of maritime education programmes available, only approximately one-third of the graduates of the Maritime Faculty in Leer eventually pursue a career at sea (Suhrcke, 2020, pp. 14–16).

Boström Cars and Österman (2015) concur that integrating gender-specific subjects into maritime higher education profiles in a structured and intentional manner is a necessary issue to be addressed by educators within the curriculum (Boström Cars and Österman, 2015, p. 151). The analysis of gender aspects in the module handbook of the Maritime Faculty in Leer reveals the following keywords: leadership skills, teamwork, personnel management, performance assessment, creation of a humane work environment, empathy, cooperation, emotional intelligence, general and maritime psychology and sociology in multi-cultural work environements, and social responsibility (Hochschule Emden/Leer, 2021a). (Boström Cars and Österman, 2015, p. 152) argue that, despite the individual efforts of various stakeholders, a clear approach and iterative effort are still lacking with regard to gender issues in the maritime field (Boström Cars and Österman, 2015, p. 152). According to Baya (2015), discussing sensitive issues such as gender requires a formal tone and precise choice of terms, which can fundamentally challenge gender perceptions and behaviours among professionals (Baya, 2015, p. 167). Nonetheless, the development of gender competence is crucial for educators and

students alike, both during the educational process and in their professional lives (Budde and Venth, 2010, p. 26). Analytical skills such as reflection and comprehension in various social contexts promote gender-related development (Budde and Venth, 2010, p. 26). Ideally, this involves the transition into conceptual frameworks within higher education institutions, implementing gender topics in practical settings, and incorporating them into organizational processes or seminar sessions with the aim of bridging theory and practice (Budde and Venth, 2010, p. 26). This requires an emphasis on collaboration between industry stakeholders, which is essential to recognise and embrace the diverse skills and competencies needed to innovate the industry's future agenda (Justesen and Javornik, 2023, p. 20).

4 Social Environment Ship

Living and working at sea is characterised by physical deprivation from family, friends and society, under coercive living conditions (Couper, 1999, p. 1) and in a physically and mentally demanding working environment (International Maritime Organization, 2020d), where profit takes precedence over human well-being (Parsons and Allen, 2018, p. 16).

Luckmann and Schütz (2003) explain that an individual's interest in the environment is primarily related to spatial orientation and to the objects in that environment, which are perceived in relative terms such as right or left and near or far (Luckmann and Schütz, 2003, p. 71). According to Ratcliff (2005), an individual's spatial context is related to their “feeling of being” and is articulated in terms such as ‘home’ [original emphasis], ‘disconnected from the world’ [original emphasis], ‘part of the real world again’ [original emphasis], ‘watched’ [original emphasis], or ‘abandoned’ [original emphasis]; all expressions of a subjective “feeling” in relation to the perceived environment, which subsequently dominates “all experiences” (Ratcliffe, 2005, p. 45).

In recourse to the anthropological research of Edward Hall, Schmitz (2012) elaborates on the allowance of personal physical space as a matter of learned and adapted practices, needs and cultural conditioning, where one may *feel* [original emphasis] and *perceive* [original emphasis] constraint in a personal physical space (Schmitz, 2012, p. 177). The perception and understanding of space and comfort on board a ship encompasses a physical environment defined by the ship's hull (Gerstenberger and Welke, 2004). Within this space, work and personal life coexist, shaping relationships

and forms of communication, collaboration, and individual empowerment associated with rank or authority, rooted in personal and cultural attributes (Schmitz, 2012, p. 181). Based on these views, the following chapter elaborated on the creation of a perceived environment, where work and personal life are inseparable and profoundly influence relationships and behaviour, and dominate the 'feeling' of isolation, hierarchy, culture, teamwork and leadership, which determines all 'experiences' and actions on board a ship.

4.1 Shipboard Culture

An organisational culture is shaped by the dynamic interactions of the individuals and the creation of structures, routines, rules, and norms that allow or constrain behaviour (Schein, 2004, p. 1). The established “culture” on board a ship has a profound impact on the communication patterns, behaviour of individuals and teams, their social formation or segregation, and on the hierarchical structure of the organisation (Sampson, 2021, p. 94).

The term 'culture' has been used in various ways and with ambiguous definitions (Dumetz, 2012, p. 21). Depending on the contextual perspective taken, numerous definitions of culture are permissible (Dorsch et al., 2009, p. 556). In its literal sense, culture refers to the act of “tilling the soil” (Dumetz, 2012, p. 21), which involves the active worship, appropriation, and refinement of nature by humans (Dorsch et al., 2009, p. 556). Kroeber and Kluckhohn (1952) present a comprehensive compilation of cultural definitions, demonstrating the extensive spectrum of possible conceptualizations and affiliations, which incorporate tangible and intangible dimensions of culture in a community, in human beliefs, behaviours, knowledge and in artistic creations, such as literature, paintings, and architecture (Kroeber and Kluckhohn, 1952). These diverse cultural affiliations evoke profound emotional connections that become deeply embedded within the associated community (Cohen, 1974, p. ix). A society's evolutionary process, achievements, values, ideas, and principles are reflected in the creation of unique symbols (Kroeber and Kluckhohn, 1952, p. 181). From a semiotic perspective, culture is considered “a communal system of meanings that provides the means for human beings to translate their instincts, urges, needs, and other propensities through *representational* [original emphasis] and *communicative* [original emphasis] structures” (Danesi and Perron, 1999, p. 14). This definition emphasises the significance

of culture in facilitating human communication and interpreting symbols or signs “that stands for something other than itself” (Danesi and Perron, 1999, p. 46). Illustratively, Captain James Cook used “lines in the sand” to physically demarcate boundaries when communicating with people from different cultures, especially in situations where language barriers existed; a symbolic act that was soon adopted by his counterparts (Schwarz, 2008, p. 55). Seafaring has historically played a significant role in the distribution of cultural elements such as crafts, pottery, clothing, writing, and technology (Jiffy, 1995, p. 37). Moreover, the survival of ancient seafaring nations, such as the Greeks, depended on preserving their cultural heritage (Burić and Težak-Gregl, 2015, p. 1). Hence, Jiffy (1995) argues that world culture has its roots in the seafaring heritage, that enabled the spread of cultural achievements through maritime trade (Jiffy, 1995, p. 37).

Schein (2004) argues that culture, despite its abstract nature, exerts a significant impact on social and organsational settings, generating powerful forces that shape behaviour and dynamics within these contexts (Schein, 2004, p. 3). Organisations are cultural constructs that are shaped by the communication of shared meaning and reflect the common understanding of a defined society (Dumetz, 2012, p. 21). An organisational culture includes the basic assumptions, values, norms and artefacts that collectively define it (Schein, 2004, p. 14) and associated with patterns of behaviour such as “decision-making, tolerance of the unexpected, moral values, honour, trust and respect” (Dumetz, 2012, p. 22). The core level, the basic assumptions represent the “essence of culture” (Schein, 2004, p. 25), rooted in the unconscious ideas and behaviours of individuals (Wiesinger et al., 2012, p. 66). Basic assumptions are the foundation of an organisation's strength and stability and create a sense of belonging to a particular group (Schein, 2004, p. 63) while also distinguishing outsiders from the members of the defined group (Schein, 2004, p. 25). This means, that basic assumptions convey a powerful impact on social relations (Schein, 2004, p. 63). The second level, known as values, refers to intangible concepts that are demonstrated through observable actions (Wiesinger et al., 2012, p. 66). The third level, artefacts, encompasses symbols, structures, and rules of procedure, all of which are visible (Wiesinger et al., 2012, p. 66). Witzel and Kühn (1999) highlight that social norms and rules are understood as adaptable elements with both limiting and facilitating aspects within social systems (Witzel and Kühn, 1999, p. 12). Therefore, an organisational culture is related to the interdependence of the cultural processes created by management and leadership (Schein, 2004, p. 1). Ship crews are typically composed of individuals from various

nationalities, each with their own cultural values and social norms that can consciously or subconsciously affect their understanding of behaviour and effective communication (Schütte, 2018, p. 658). Communication is the "essence of relationships" and, from a cultural perspective, and conveys the "meaning" that is fundamental to interpersonal and organisational relationships (Trompenaars, 2012, p. 117). This affects how individuals perceive collaboration and trust across different nationalities, ranks, ages, and genders (Sampson, 2021, p. 95) and create “mental programs” (Hofstede, 2001, p. 1). The formulation of cultural models aims to enhance the understanding of the fundamental principles of the underlying cultural and social implications for behaviour and action, based on the need to establish a “common language” (Schein, 2012, p. 4).

The extensive research by the Dutch social scientist Geert Hofstede highlighted the importance of culture in influencing interpersonal differences (Schütte, 2018, p. 658). Hofstede's cultural model was developed on the basis of studies conducted in the 1970s in a multinational corporate environment (McSweeney, 2002, p. 90), including subsidiaries in over 40 countries and 20 languages spoken (Wiesinger et al., 2012, p. 67). The data analysed led to the definition of dimensions of cultural aspects, described as indicators and ratings in relation to the nationality of the interviewees (Wiesinger et al., 2012, p. 67). The five dimensions demarcated by Hofstede (2001) for distinguishing national cultures are outlined below:

“Power Distance” implies dependency of the many on the few, and those in power having privileges that subordinates accept (Hofstede, 2001, p. 98), obedience and respect for authority perpetuates the accepted behaviour across generations and relationships, such as parent-child, or teacher-student (Hofstede, 2001, p. 100).

"Individualism and Collectivism" are indicators of an individual's emotional dependence on groups (Hofstede, 2001, p. 209) and the associated culture, which can be both defined as a spatial and historical perspective, such as European or Asian culture (Danesi and Perron, 1999, p. 3). Depending on the associated context in the society, a high indication of individualism or collectivism can be perceived as a favourable asset or alienating factor (Hofstede, 2001, p. 209).

“Masculinity and Femininity” refer to societal characteristics, where former is characterized by assertiveness, ambition, material possessions, and ego, and latter by equality, solidarity, and the promotion of relationships (Hofstede, 2001, p. 279).

“Uncertainty Avoidance” refers to the level of anxiety individuals experience when faced with unfamiliar situations (Hofstede, 2001, p. 145). A high level indicates a preference for rules and regulations (Wiesinger et al., 2012, p. 67), and in contrast, a low level of uncertainty avoidance indicates flexibility and openness to uncertainty and ambiguity (Schmitz, 2012, p. 187).

“Short-term versus Long-term Orientation” refers to an emphasis on immediate gratification and keeping “face” in situations as a short-term indication, versus long-term planning and tradition, a perception rooted in Confucian philosophy (Hofstede, 2001, p. 351). These two concepts are distinguished by their acceptance of established structures by government and law, or by their adaptiveness and willingness to change established relationships when necessary (Hofstede, 2001, p. 366).

Hofstede (2001) remarks that cultural variations go beyond societal norms and include the values of specific groups (Hofstede, 2001, p. 210), which is reiterated as a crucial aspect in the application of national culture theory as an oversimplified model with limited ability to integrate the dynamic interaction between macro and micro aspects of cultural dimensions (McSweeney, 2002, p. 113). Thus, the application of cultural dimensions may be limited to those employed in a particular profession and to the constraints of an organisational environment (Wiesinger et al., 2012, p. 68). However, while the generalisation within the dimensions may be perceived as a weakness, it can also facilitate their application and aid in understanding the fundamental principles of social and “mental programs”, as “human behaviour is not random, but to some extent predictable” (Hofstede, 2001, p. 1). Comprehension is particularly useful in the maritime context and within multicultural working environments on board ships (Schütte, 2018, p. 658). While the dimensions of national cultures are mainly related to “values”, an organizational culture is based on established or required “practices” (Hofstede, 2001, p. 373). In the organizational context, mainly “power distance” and “uncertainty avoidance” have a prominent effect on managerial and hierarchical structures, established communication lines and leadership concepts (Hofstede, 2001, p. 375). Furthermore, Strauch (2017) argues that the pervasive and influential role of culture on human behaviour is at the core of examining and understanding the concept of human error (Strauch, 2017, p. 143).

Another crucial aspect of cultural understanding is acknowledging and addressing ethnocentrism, which occurs when individuals or groups judge other cultures based on their own ideals (Hofstede, 2001, p. 18). Ethnocentrism is a behaviour that arises when

individuals in a multicultural environment fail to consider perceived cultural differences and instead evaluate others based on their own norms and values (Hofstede, 2001, p. 18). This perception often leads to the belief that one's own culture is superior, which can be detrimental to effective cross-cultural teamwork (Bitterli, 1982, p. 67; Dumetz, 2012, p. 25). This tendency can lead to stereotyping, as individuals or groups form opinions about others based on limited knowledge or preconceptions (Dumetz, 2012, p. 25). These are important issues to address and understand in order to promote cultural awareness and understanding, and to encourage constructive interactions between different cultural groups (Bitterli, 1982, p. 79). Cultural differences and their resulting cultural conditioning, as reflected in established norms and values, are evident in organisations at individual, national, or corporate levels (Schein, 2004, p. 279). These differences are particularly evident in situations that require effective problem-solving and leadership skills (Weick, 1995, p. 186). To minimize conflicts within a team, effective leadership should acknowledge individual strengths and personalities while recognizing cultural dimensions (Schütte, 2018, p. 658). In this context, the existing organisational culture reveals either a willingness to adapt and grow flexibly or a resistance to change (Weick, 1995, p. 186). The ability for an organisation to adapt to the complex demands of the industry is crucial for economic sustainability and competitiveness (Schmitz, 2012, p. 189). Accordingly, Weick (1995) argues that an organisation's purpose in action and effort is defined in terms of movement, change and process (Weick, 1995, p. 187). Culture has been described as an "elusive phenomenon" (Hofstede et al., 2002, p. 41). This view challenges pre-defined models and requires careful observation and description in order to understand the contextual meaning of behaviour, sensemaking, tolerance and the wider understanding at micro and macro levels that govern arranged, managed and balanced misperceptions (Weick, 1995, p. 186), in order to accept rather than oversimplify the dynamics of the cultural concept (Dumetz, 2012, p. 44).

4.2 Total Institution Ship

The concept of total institutions has been associated with spatially confined facilities like psychiatric clinics or prisons (Behnam Shad, 2020, p. 73). Goffman (1977) defines social institutions as spaces where specific activities are regularly performed, including working and living environments (Goffman, 1977, p. 15). Thereafter, institutions may be classified according to their objectives (Goffman, 1977, p. 16). For instance, psychiatric institutions

are designed to provide care, although patients may be perceived as potential societal threats (Goffman, 1977, p. 16). Prisons, on the other hand, are designed to isolate inmates and to reduce the potential for harm to the outside world and to ensure the well-being of society (Goffman, 1977, p. 16).

The character of a total institution is defined by the limitations imposed on inmates' interactions within the institution's spatial confines and with the outside world (Goffman, 1977, p. 16). The institution's coercive nature aims to shape the identity of its inmates (Behnam Shad, 2020, p. 74) in order to serve its defined purpose (Goffman, 1977, p. 15). The main characteristics of an institution include the suspension of the conventional physical separation between the three domains of social life: work, leisure, and sleep (Lisch, 1976, p. 11). According to Goffman, the separation of the three areas is a common condition of social life, as opposed to the confinement in a total institution preventing their separation (Goffman, 1977, p. 17). Thus, the spatial and social constraints of this situation result in the imposition of physical and social barriers on individuals, without possibilities for social communication and interactions (Lisch, 1976, p. 11). Deprived of a normal social environment, inmates are forced to adopt new roles and identities (Goffman, 1977, p. 21). All aspects of life and work are meticulously regulated and dictated by the highly structured environment that governs every aspect of their lives, including daily routines that involve either heavy workloads or boredom (Goffman, 1977, p. 21). Goffman (1977) posits that a ship, boarding school, or work camp can be classified as a total institution due to its central focus on work-related purposes (Goffman, 1977, p. 16). The concept can also be applied to the spatial construct of ships, which are physically confined by their hulls and isolated from society (Gerstenberger and Welke, 2004, p. 19).

Lisch (1976) justifies the characterisation of a ship as a total institution by emphasising the physical deprivation, the lack of separation between work, sleep and leisure, and the mental effects on a seafarer's well-being (Lisch, 1976, p. 98). This includes the ship's purpose, which has been optimised through historically established role allocations and a hierarchical communication structure, enhancing work efficiency and economic performance (Lisch, 1976, p. 98). In an empirical study with particular reference to Goffman's outline of total institutions, Lisch (1976) examined the living and working conditions of ship crews and their perceived experience on board, and acknowledges the relevance of the concept, however also highlights the limitations of a general applicability (Lisch, 1976, p. 97). Furthermore, Schülein (2007) reasons that an

understanding of Goffman's appraisal of total institutions must be contextualised within the prevailing views of the era (Schülein, 2007, p. 32). Gerstenberger and Welke (2004) argue that defining a ship as a total institution based solely on physical constraints overemphasises this one aspect and neglects the dynamics of the social environment, which is shaped by many characteristics, including the ship's purpose, crew composition, social norms, and economic and legal demands, all of which transcend the spatial confines of a ship's structure (Gerstenberger and Welke, 2004, p. 19).

4.3 Hierarchy

The traditional establishment of hierarchical structures has shaped the profession of a seafarer within a multifaceted framework of legal and social contexts, with a significant impact on individual and collective established norms, behaviours and actions (Sampson, 2021, p. 88). In contrast to land-based organisations, the hierarchical structure of authority and responsibility still prevails on board (Gerstenberger and Welke, 2004, p. 70). The organisation of a ship and the operation of the various systems on board are influenced by both “horizontal and vertical structures” (Kristiansen, 2013, p. 364), which impact the communication and the overall safety concept in the maritime industry (Kristiansen, 2013, p. 440). The horizontal system considerations include actions and communication processes in the aggregate performance of "human-machine interaction" or "personnel training", vertical relations directly affect the actions and outcomes on all system levels through decision-making lines (Kristiansen, 2013, p. 364).

The ship has been established as an economically competitive and efficient transportation method in the world trade, with a ritualised hierarchical, formal organisation established through role assignments and top-down communication lines (Gerstenberger and Welke, 2004; Lisch, 1976; Manuel, 2017, p. 16). The incorporation of hierarchical structures defines an organisation by the manner in which power is controlled (Trompenaars, 2012, p. 139). The hierarchical organisation of ships has evolved over centuries and places great emphasis on the authority of the ship's captain, formally referred to as the 'master', who holds overall legal and social responsibility for all operational and organisational matters on board (Manuel, 2017, p. 17). In a legal context, the obligation and responsibility of the ship's captain is still referred to as "master under god" [original emphasis], under the “English Marine Insurance Act of 1906” (Jeffery, 2007, p. 25).

In the historical era of the great sailing ships, the role of the captain was to oversee all matters on board, including technical and navigational aspects, based on extensive experience and the application of complex skills (Gerstenberger and Welke, 2004, p. 74). Nevertheless, the hierarchical and competency-based role of the master and the roles of the ship's officers and crew still apply (Gerstenberger and Welke, 2004, p. 75). The social order on board continues to exert a significant influence on occupational and social activities, with the captain holding a position of authority and responsibility in setting standards of behaviour in matters of work and life (Sampson, 2021, p. 90).

The definition of the master's "responsibility and authority" is allotted by the shipowner, the company or organisation responsible for the safe operation of the ship in routine and emergency situations, the preservation of the marine environment and the well-being of all persons on board (International Maritime Organization, 2024b). This authority is explicitly set out in the Safety Management System (SMS), which serves as a documentary outline of a company's policy, detailing procedures and roles both ashore and on board (International Maritime Organization, 2024b). The SMS defines the "levels of authority and lines of communication" between shoreside and shipboard personnel, as well as the "master's responsibility", which extends to the compliance with legal and company requirements, the issuance of "orders and instructions" to ensure the fulfilment of assigned duties and the appropriate communication to "motivate" the crew to fulfil their duties (International Maritime Organization, 2024b). Nevertheless, the ISM Code does not define the specific responsibilities of the master; rather, it leaves the definition of these responsibilities to the shipowner, who is responsible for ensuring the clear communication between the company's requirements and the ship, as well as the detailed application of the appropriate measures for the operation of the ship (International Maritime Organization, 2024b). Accordingly, the legal framework in the international maritime context requires a clear communication hierarchy, with the ship's master assuming the role of "overriding authority" and responsibility for communication and decision-making (International Maritime Organization, 2024b). This overriding authority has been exemplified in the case of the sinking of the chemical tanker *Bow Mariner*, where the company defined the master's role as having "full authority over all persons (personnel and passengers) onboard his vessel. The Master's authority is not questioned and must be supported and maintained by onboard personnel" (United States Department of Homeland Security, 2005, p. 42). The official investigation report observed that "such absolute authority is not uncommon aboard seagoing vessels" (United States Department of Homeland Security, 2005, p. 42).

In accordance with German law, the master of a ship sailing under German law and flying the German flag is held accountable for the safety of the ship and the crew in relation to labour conditions, including health and safety in accordance with the Work Constitution Act[14] (Rosenkranz, 2015, pp. 125–129), and the Maritime Labour Act (Deutsche Flagge, 2024j), in accordance with Section 479, of the German Commercial Code (Federal Ministry of Justice, 2020; Peetz, 2015, p. 157). In accordance with the aforementioned legal framework, the right of direction is vested in the master, who is empowered to engage and dismiss crew members (Bültjer, 2013, p. 130). Nevertheless, this power to terminate the employment contracts of officers and crew members is not absolute, and the final decision rests with the shipowner (Bültjer, 2013, p. 130). This procedure serves to protect the legal and social rights of seafarers employed under German jurisdiction (Peetz, 2015, p. 156).

On merchant ships, the various ranks are associated with specific tasks, competencies and experience, linked to formal skill requirements, qualifications, and associated wages and privileges on board (Gerstenberger and Welke, 2004, p. 71). The practice of addressing individuals by rank rather than personal name is a common practice on ships (Gerstenberger and Welke, 2004, p. 71). This practice serves to reinforce the dominance of work and the maintenance of the formalised, hierarchical structure, while simultaneously diminishing a person's identity and individuality (Gerstenberger and Welke, 2004, p. 70). This formalised communication with a strong emphasises on work related duties derived from the need to increase economic efficiency while minimising the number of crew and effectively managing a multicultural workforce (Gerstenberger and Welke, 2004, p. 71). This prevailing perspective on the economic purpose of a ship extends to the limited degree of spatial segregation between working and other living or recreational areas, such as mess and cabins (Gerstenberger and Welke, 1995, p. 70). The seafarer's life becomes subject to a structured and formalised manner throughout (Gerstenberger and Welke, 2004, p. 70), with the master exercising anoverriding authority (Gerstenberger and Welke, 2004, p. 74). The traditional ship's hierarchy is organised in a pyramidal structure of departements, positions and ranks (Jung and Kleine, 1993, p. 46), as illustrated in Figure 4 below.

[14] Denominating the “Betriebsverfassungsgesetz – BetrVG”, English translation provided by the Language Service of the Federal Ministry of Labour and Social Affairs (Federal Ministry of Justice, n.d.).

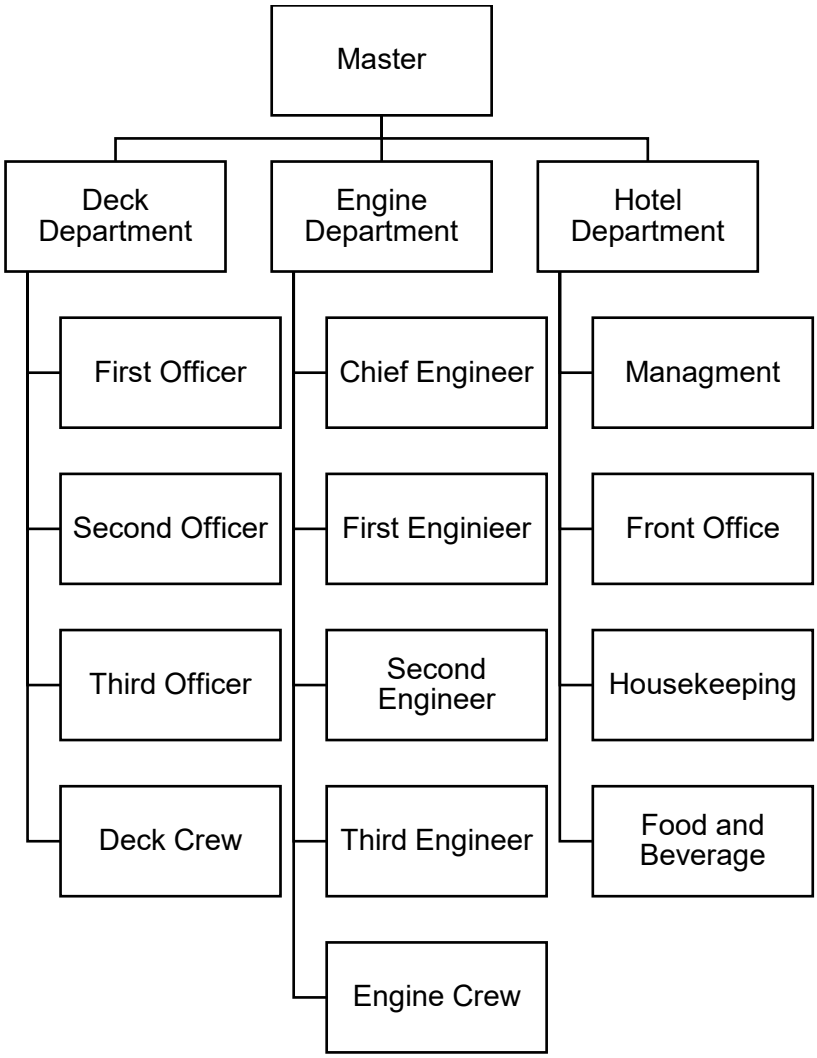

Figure 4: Diagram of a ship's hierarchy[15] (adapted after Manuel, 2017, p. 17; Bielić et al., 2014)

The role of the master, as defined by the legal framework and in ship management procedures remains unchallenged as a legal obligation in maritime law, nevertheless persists as an idealised concept (Gerstenberger and Welke, 2004, p. 74). The transition from a vertically structured, hierarchical pyramid to a horizontally organised, task-oriented and cooperative system has been a topic of discussion since the 1970s (Gerstenberger and Welke, 2004, p. 74). Despite the formal structure on board and the position and responsibility of the captain, all of which are focused on economic efficiency,

[15] This example serves to illustrate the organization a large merchant ship, inspired by the passenger ship *Costa Concordia*, consisting of 38 different nationalities, a maximum capacity of 1,023 crew, including 39 officers and 77 deck crew, 58 engine crew, 581 hotel staff and 268 other service staff, overall responsible for a maximum of 3,780 persons on board (Ministry of Infrastructures and Transports, 2012, p. 12).

the multinational dynamic on board was found to have a significant impact on the work efficiency, social interactions and social deprivation of seafarers (Sampson, 2021, p. 93). This acknowledges the crucial role of effective communication and a leadership style that encourages individual motivation, inclusive teamwork, and diversity in ensuring the safe and efficient operation of ships (International Chamber of Shipping, 2022, p. 28).

Furthermore, Bielić et al. (2014) argue that the transformation of traditional organisational hierarchies on ships into collaborative teamwork systems and the restructuring of roles are crucial for the effective and comprehensive integration of technological advances (Bielić et al., 2014, p. 437). The role of the master should be regarded as that of a strategic manager, with responsibility for overseeing tasks and acting as a communicator with all individuals on board and with shore-based organisations (Bielić et al., 2014, p. 437). In this role of a manager and facilitator, the objective is to influence behaviour by empowering individuals and teams to optimise and promote effective overall performance, which can be achieved by setting clear expectations and providing support (Hackman, 1987, p. 339). This transformative shift in the social structure is reinforced by the contextual shifts in specialisation and the corresponding increase in education and training, which facilitate the achievement of desired efficiency and the incorporation of technological advances into the overarching safety concepts on ships (Bielić et al., 2014, p. 437).

4.4 Leadership – Management

The ability to apply effective leadership, management and teamwork skills is a fundamental requirement in the field of nautical operations (International Maritime Organization, 2014a, pp. 23–24). A number of case studies, ranging from the sinking of the *Titanic* in 1912 to the grounding of the passenger ship *Costa Concordia* in 2012, illustrate how the inadequate implementation of safety management systems, which encompass leadership, teamwork and communication, contributed to the outcome of the accidents (Parsons and Allen, 2018, 21ff). The distinction between leadership and management has become a complex topic and encompasses various concepts that highlight the inherent interrelationship and importance of leadership and management in any context or situation involving a leader and subordinates (Drucker and Maciariello, 2005, p. 16; Jeffery, 2007, p. 24).

Leadership relates to “awareness, direction, openness, atmosphere and doing” (Jeffery, 2007, p. 25), thus associated with the “lifting of a person’s vision to higher sights, the raising of a person’s performance to a higher standard, the building of a person’s personality” (Drucker and Maciariello, 2005, p. 15). Thus, leadership qualities include havinb an interest in people and the ability to create or achieve solutions that motivate people to exceed their expected performance or defined goals (Hinterhuber and Krauthammer, 2005, pp. 17–18). The International Maritime Organization (2014a) defines leadership as ”a process whereby an individual influences a group of individuals to achieve a common goal” (International Maritime Organization, 2014a, p. 27). Leaders carry out this process by incorporating a variety of different leadership styles (International Maritime Organization, 2014a, pp. 27–29). The leader's personality, skills and experience, as well as the situational context, determine the use of one or more leadership styles (International Maritime Organization, 2014a, p. 29). Leadership styles are defined by their key characteristics as displayed in Table 2 (International Maritime Organization, 2014a, pp. 27–29).

Table 2: Leadership styles (extracts adapted after International Maritime Organization, 2014a, pp. 27-29)

Leadership style	**Key characteristics**
Autocratic	Exercise of power and control, when needed, such as in emergencies or when overseeing unskilled work.
Bureaucratic	Closely following rules and procedures, appropriate when safety risks are involved.
Charismatic	Inspiration by personality, polarizing.
Democratic or Participative	Involvement and empowerment based on mutual decision-making processes.
Laissez-faire	Little involvement or guidance, acceptable for skilled individuals; could imply weak skills in the position or job, and may be detrimental to safe work processes.
Task-oriented	Akin to autocratic style, with focus on performance.
People-oriented or relations-oriented	Enhancement of teams’ and individual skills.
Transactional	A form of management promoting short-term tasks, along with reward or penalty.
Transformational	Inspirational, introducing a shared vision, adding new value and change.
Servant	Influence through informal status.

A number of factors, including the context of the task and the human and technical resources available, determine which leadership style is used (International Maritime Organization, 2014a, p. 29). In reality, the knowledge and application of a combination of styles is essential (International Maritime Organization, 2014a, p. 29). Jeffery (2007) explains that in an emergency situation, considered a “command and control environment”, where an immediate response to a threat is required, the autocratic style is used (Jeffery, 2007, p. 24). This means, that a leader controls those who „work for him“ which is seen as a necessary appropriation in certain situations, but would be inappropriate in a day-to-day commercial working environment (Jeffery, 2007, p. 24).

Moreover, the concept of control is closely related to management, which is characterised by “task, process, routine, procedures, control” (Jeffery, 2007, p. 25). According to Hollnagel (2022) the principles of management involve a task-related process within time constraints (Hollnagel, 2022, p. 9). The aim of management is “to *maintain [original emphasis]* a current state or position by compensating for potentially destabilising internal or external influences, to *approach* [original emphasis] a more attractive future state or position, or to *avoid [original emphasis] a* potentially unfavourable or destabilising future state or position” (Hollnagel, 2022, p. 9). This emphasises, that effective managment “requires knowledge about the *goals* [original emphasis], knowledge about the current state or *position* [original emphasis] (relative to the goals), and knowledge about effective ways or *means* [original emphasis] to achieve the goal” (Hollnagel, 2022, p. 9). Personnel management, also referred to as human resource management, focuses on behavioural control and includes both a hierarchical and a goal-oriented approach and influence (Berthel and Becker, 2022, p. 17), a view reflected in contemporary definitions of management as “the process of preparing, organising, and controlling the resources of an organisation” (Hollnagel, 2022, p. 9). Understanding these underlying mechanisms is essential to the sustainability of an organisation (Hollnagel, 2022, p. 10). Based on the work of Frederick Taylor and earlier ideas of rational thinking derived from the Enlightenment, management principles have applied scientific thinking to the work environment in the form of structure, control and hierarchy with the aim of increasing efficiency in organisational processes (Dekker, 2015, p. 10). These views were shaped by Taylor's upbringing in a family where strict order and rules were the norm (Wilson, 2004, p. 28), and consequently perpetuated in current management principles as “resting upon clearly defined laws, rules and principles” (Wilson, 2004, p. 25).

For a master, and in accordance with the STCW framework, this understanding and application of human resource management is relevant to the responsibility for overseeing the overall safe operation of a ship. As defined in Table A-II/2, of the STCW Code, the function of "controlling the operation of the ship and care for persons on board" involves the "use of leadership and managerial skill", which includes the "knowledge and ability to apply effective resource management", in relation to crew motivation and task assignment, taking into account different levels of experience and abilities, and including effective internal and external lines of communication (International Maritime Organization, 2017a).

From this perspective, management involves a goal-oriented approach and setting boundaries within an existing system, while leadership has the potential to shape and transform a system by introducing potentials for change (Hinterhuber and Krauthammer, 2005, p. 21). Drucker and Maciariello (2005) concur on the interdependence of leadership and management, suggesting that leadership quality is a management spirit that affirms strict principles of conduct and responsibility for high standards of performance and also recognises individual effort (Drucker and Maciariello, 2005, p. 16).

The successful application of leadership involves a process of influencing a group or individuals to achieve a common goal (International Maritime Organization, 2014a, p. 27). Thus, leadership is not bound to a formal title or position in a hierarchy (Jeffery, 2007, p. 137), but to the application of the necessary skills (International Maritime Organization, 2014a, p. 27). The effectiveness of these skills is based on the credibility of the leader who shows genuine care, interest and respect for people (Hinterhuber and Krauthammer, 2005, p. 17) as core characteristic of social relationships (Blau and Scott, 2003). Leadership skills can only be developed through practical application and experience (Drucker and Maciariello, 2005, p. 9). This can be illustrated as a circular process as shown in Figure 5 below.

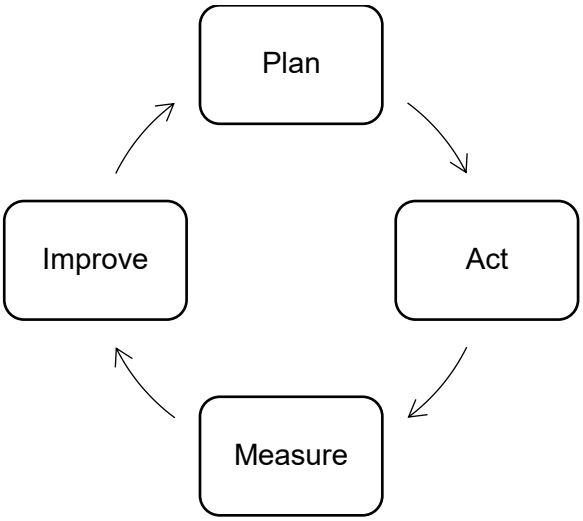

Figure 5: Leadership cycle (adapted after Oil Companies International Marine Forum, 2017, p. 4)

Leadership is presented as a circular process, similar to a quality management system, consisting of the key components of “plan, act, measure, improve” forming a “continual improvement cycle” (Oil Companies International Marine Forum, 2017, p. 4). Effective leadership relies on communication at all levels of an organisation, serving as a critical link in the learning and improvement process, and is closely linked to an organisation's norms and values, which are reflected through the established safety management system (Oil Companies International Marine Forum, 2017, p. 4). Organisational norms and values, expressed in “shared visions” and the acquisition of knowledge, have become valuable assets, but effectiveness is core to achieving tangible results (Drucker, 2014, p. 229). A measure of efficiency in various processes is related to an assessment based on quantity and quality aspects, however is distinct from efficiency in leadership and learning processes, where efficiency refers to the “ability to do things right, which differs from the ability to do the right things right” (Drucker, 2014, p. 230). Leadership can only be effective when knowledge permeates an organization and serves to develop the skills of the individuals and reciprocally advances this knowledge as a resource to motivate and create a common vision (Drucker, 2014, p. 236). The International Maritime Organization (2017a) emphasises this view within the STCW training framework, linking leadership effectiveness and skills to the application and enhancement of ongoing developments throughout the industry, rooted in the knowledge and understanding required to effect change (International Maritime Organization, 2017a, p. 28).

4.5 Team

The functions, roles, and power relations within an organizational structure are interdependent and only meaningful and relevant within their specific contexts (Treibel, 2003, p. 32). As a basic condition, social relations are defined by the “frequency and duration of the contacts between people” and by the “feelings of attraction, respect, and hostility” involved (Blau and Scott, 2003, p. 33). The social relations among group members shape the status hierarchy and relationships both within and with those outside the group (Blau and Scott, 2003, p. 34). When considering the relationship between the ship's crew, within their confined living and working environment, and the social dynamics of cooperation, it is crucial to distinguish between groups and teams.

Katzenbach and Smith (1993) explain that working in groups promotes individual responsibility, perspective and decision-making in order to improve an individual job performance (Katzenbach and Smith, 1993). The emphasis is placed on individual objectives rather than taking accountability for collective results or monitoring joint contributions (Katzenbach and Smith, 1993). The importance of understanding human needs and motivation for organisational performance has been promoted by scholars such as Herzberg and Argyris, who advocate a more humanistic approach (Nicotera, 2020, p. 128). This shift from vertical hierarchy management to team-based approaches has been stimulated by the understanding that human contribution is a critical resource for organisational growth and development (Nicotera, 2020, p. 129).

The view of teamwork introduced an image of togetherness and of collective performance-oriented goals, serving to improve a company's public image and competitiveness (Zimbardo et al., 2003, p. 747). Teams, as opposed to working groups, require both individual and collective accountability, as well as internal cohesion, to collaborate and succeed (Katzenbach and Smith, 1993). The shared commitment entails self-defined objectives within a specific framework and control of the work process, resulting in a “synthesis” that exceeds the sum of individual contributions (Born and Eiselin 1996, p. 17 cited in Zimbardo et al., 1999). In a team, individual commitment extends beyond the scope of a specific task, affecting motivation towards collective performance goals (Hackman, 1987, p. 323).

The crew on board and their coordination and allocation of tasks is referred to as team management, and specifically as bridge team management for the officers and crew responsible for navigation (Witherbys, 2021, p. 34). The ship's crew, defined by its roles

and associated tasks within the team, is a construct defined by the legal framework that determines the manning of the ship, that is the minimum number of crew required to work on board in order to maintain the functionality and safety requirements for all aspects of the ship (International Chamber of Shipping, 2022, p. 33). The familiarisation and training is a core element of safety and risk assessment and management (Edmondson, 2002, p. 2), and required by the ISM Code and the STCW framework (International Chamber of Shipping, 2022, p. 33). New crew members need to be familiarised with the general outline of the working environment and, in particular with the specific duties and responsibilities appropriate to the individual's role and rank (International Chamber of Shipping, 2022, p. 32). George Herbert Mead's theory of role taking suggests that actions are part of a reflexive action characteristic of a person in a social role, and behaviour implies that role taking is bound by the reactions of others and their expectations within that role (Schneider, 2008, p. 208). Role taking depends on the extent to which meeting requirements and complying with the law is prioritised over achieving individual objectives (Schneider, 2008, p. 212). This emphasises that the individual is aware of the role and, in anticipation of the associated reaction of others, adopts a behaviour that is in line with the established norms, thus contributing to the individual's confidence in performance and to the associated environment (Schneider, 2008, p. 212). The roles, tasks and communication lines on a ship are described in the company's safety management system (International Maritime Organization, 2024b). It outlines the hierarchical structure from the master through the officers and crew to newly assigned crew members, the roles and associated duties and tasks of each individual (International Maritime Organization, 2024b).

The procedures for introducing personnel to the ship's "environment" [original emphasis], includes the following aspects (Witherbys, 2021, p. 3):

- the organizational culture and its communication structure,
- the work place, which refers to the bridge or other areas on the ship, and
- the teamwork.

The performance of a bridge team, particularly when responding to emergencies, is related to the effective resource management (International Chamber of Shipping, 2022, p. 27). This depends on the implementation of effective leadership and management skills such as communication, teamwork and compliance (International Chamber of Shipping, 2022, p. 27), as described in the "Bridge Resource Management" (BRM)" training required for watchkeeping officers (International Chamber of Shipping, 2022,

p. 28). The focus of the BRM is to coordinate the roles and tasks of the navigational watch team and hence to maintain situational awareness in coordination with the engine control room and other departments as required (International Chamber of Shipping, 2022, p. 28). All members of the bridge team must have a clear understanding of the communication within the team and to the master (International Chamber of Shipping, 2022, p. 28). Effective communication is particularly important in emergency situations where the awareness and contribution of all bridge team members is required to provide the master with the information necessary for an overall assessment and decision making process (International Chamber of Shipping, 2022, p. 28). Teamwork on board extends to the incorporation of external parties such as pilots, tugboats or port authorities (International Chamber of Shipping, 2022, p. 33).

The role of the pilot is that of an external and temporary element of a ship's complement, in accordance with national and regional requirements which may require a pilot to be on board to allow a ship to enter a port (Hetherington et al., 2006, p. 406). The pilot acts as an advisor providing local expertise on environmental conditions and circumstances affecting the safe navigation of the vessel (Damgaard, 2023, p. 5). This requirement was introduced as a safety measure and to incorporate local knowledge provided to the master and bridge team during navigational situations such as entering and leaving ports and transiting coastal areas (Damgaard, 2023, p. 4). The pilot's presence as a temporary team member affects established bridge relationships and lines of communication (Hetherington et al., 2006, p. 406). During pilotage, the master or officer in charge of the navigational watch remains responsible for the safety of the ship and is legally liable for decisions and actions taken (Hetherington et al., 2006, p. 406). Effective communication between the master, pilot and bridge team is required to establish a common understanding of the ship's environmental conditions and navigational implications as required by para. 49, Section A-VIII/1, STCW Code (International Maritime Organization, 2017a). While the knowledge and experience of a pilot is essential in the concept of safe navigation, the involvement of pilots in incidents and underlines has been critically reiterated in the context of effective BRM practices in pilotage (Damgaard, 2023, p. 5), and the understanding of communication and responsibilities of assigned roles (Di Lieto, 2022, p. 86). All internal and external team members communicate and collaborate in their shared responsibility for the safe navigation and operation of the vessel in the given circumstances (International Chamber of Shipping, 2022, p. 28).

The performance of roles depends on the individual and the context, which in turn depends on the motivation to achieve a common goal (Schütte, 2018, p. 655). While technical and organisational solutions can be applied to standard and routine tasks, the effective functioning of a team and the leadership role within a team consist of skills and abilities that go beyond the handling of standard procedures and the application of routine protocols and processes (Schütte, 2018, p. 655). Human actions and errors are influenced by organisational practices and values, highlighting the importance of aligning these factors to optimise task performance, including effective teamwork, adherence to procedures, and conscientious and proactive addressing of procedural deficiencies (U.S. Nuclear Regulatory Commission, 2001, p. 24). Particularly in non-routine situations, it is the involvement of the team and the application of collective knowledge and experience that determines the effective decision-making process in the context (U.S. Nuclear Regulatory Commission, 2001, p. 24). Weick (1987) argues, that a crucial aspect of a team's effectiveness lies is its diversity (Weick, 1987, p. 116). In this context, diversity does not necessarily focus on the gender, age or expertise of the team members, but on their diverse viewpoints (Weick, 1987, p. 116). The effectiveness and strength of a team hence, is primarily associated to the accumulation of different points of view that provide a broader perspective than any one person could achieve alone (Weick, 1987, p. 116). As team members assimilate, their perspectives gradually converge and the resulting collective knowledge no longer extends beyond their individual insights (Weick, 1987, p. 116). The motivation to collaborate and also to contribute individually, especially in unfamiliar and non-routine tasks, minimises the possibility of human error (U.S. Nuclear Regulatory Commission, 2001, p. 24). Therefore, the effective application of leadership in BRM means encouraging team members to actively participate in identifying risks in order to reduce the possibility of errors and their consequences, essentially valuing the process of teamwork (U.S. Nuclear Regulatory Commission, 2001, p. 24).

4.6 Communication

According to Cooley (1909), communication is defined as the “mechanism through which human relations exist and develop” and encompasses "all the symbols of the mind, together with the means of conveying them [through] the expression of the face, attitude and gesture, the tones of the voice, words [and] writing” (Cooley, 1909). This definition aligns with the simplified model of social communication, where the transmission and

interpretation of signs and information begins with the sender, who uses a medium to convey the information to the receiver (Strübing et al., 2016, p. 306). This process includes all forms of “observable behaviour” in human interaction (Watzlawick and Beavin, 1967, p. 4), however the interpretation of meaning depends on the context (Leydesdorff, 2001, pp. 42–43). Watzlawick and Beavin (1967) concur that “*all* [original emphasis] behaviour” is a form of communication, espousing powerful effects, even if not conveyed intentionally (Watzlawick and Beavin, 1967, p. 5), thus all social interaction is “synonymous with what is observable” (Watzlawick and Beavin, 1967, p. 4). In this view, human interaction studies perceive communication as more than a means to an end, or a mere expression, but postulating the understanding of behaviour (Watzlawick and Beavin, 1967, p. 4). Effective communication, hence assumes the perceptions and intentions of both the sender and receiver, embracing nonverbal cues, cognitive processes, emotions, and subjective interpretations (Watzlawick and Beavin, 1967, p. 5). Understanding communicational patterns and the potential for misinterpretations is significant, especially when applied in conflict resolution (Watzlawick and Beavin, 1967, p. 5). This understanding makes on-board communication all the more important to ensure clear and effective understanding in the event of an emergency.

Hetherington et al. (2006) emphasise that “one of the core skills central to effective and safe production and performance in all high-risk industries is communication, this also influences team situation awareness as well as team working and effective decision-making” (Hetherington et al., 2006, p. 406). As "the maritime industry is characterised as high risk" (Oltedal and Lützhöft, 2018b, p. 1), communication is central to the safe operation of ships. The means and forms of communication on board ships are distinct from common forms of communication, and are characterised by formalised structures and specific standardized phrases used (House, 2014b, p. 299). The transmission of information is primarily intended for navigational and safety-related purposes and involve various methods and equipment, including satellite technology, radiocommunication, flags, and the Morse code (House, 2014b, 301ff). The sender and receiver define external lines of communication, such as “ship-to-shore” (International Telecommunication Union, 2016, p. 1) or "bridge-to-bridge" communication between ships (House, 2014b, p. 299). Standard formats and phrases are used for each level of message, including distress, urgency, safety, and routine, to ensure clear communication and understanding between sender and receiver (International Telecommunication Union, 2016, p. 19).

The principles of the required forms of communication are prescribed globally by the telecommunication sector of the ITU, in the “Radio Regulations” and are integrated into the “Global Maritime Distress and Safety System” (GMDSS), with further requirements for functional and operational provisions laid down in SOLAS and STCW 78 (International Chamber of Shipping, 2022, p. 79; International Telecommunication Union, 2016, p. 19). The knowledge and application of “effective communication on board and ashore” is a requirement of the STCW Code as part of the “leadership and teamworking skills”, and is therefore an essential skill for all involved in the communication process including the nautical officer and the master, as stipulated in Tables A-II/1 and A-II/2, STCW Code (International Maritime Organization, 2017a). In particular, Regulation 14.3, Chapter V, SOLAS emphasizes the importance of establishing a common working language on board and maintaining the necessary level of knowledge and skills for all crew to "understand and, where appropriate, give orders and instructions and report in that language" (International Maritime Organization, 2020c).

English is the dedicated language in the global maritime trade, and for a qualified nautical officer the level of proficiency is specified in the STCW Code, which essentially means internal and external communication involving a “multinational crew” using the “IMO Standard Marine Communication Phrases” (International Maritime Organization, 2017a). In addition, the STCW Code outlines the requirements for sufficient proficiency in English, both written and spoken, which applies to all crew members (International Chamber of Shipping, 2022, p. 34). The requirement to communicate and understand a common language is particularly important when a ship is navigating with a pilot as a temporary member of the bridge team (International Chamber of Shipping, 2022, p. 121). All members of the bridge team including the pilot, and local parties such as the pilot boat, tugboats and vessel traffic services, need to use a clear and concise language that is understood by all involved in order to process the available information and context of the situation for the safe navigation of the ship (International Chamber of Shipping, 2022, p. 34). Internal communication on ships is dominated by a hierarchical line of information transmission, referred to in the ISM Code as “orders and instructions” (International Maritime Organization, 2024b). This communication form is considered essential in bridge resource management, operational leadership, and teamwork (International Maritime Organization, 2017a).

The forms and methods of communication used on board include the following:

- 'Challenge and Response': Team members are encouraged to provide input and “challenge” decision-makers to enhance situational awareness and a comprehensive safety culture (International Chamber of Shipping, 2022, p. 29).
- “Thinking Aloud” : The process of “verbalizing intentions” (Di Lieto, 2022, p. 94), which allows individuals to re-evaluate actions and improve decision-making and problem-solving skills (International Chamber of Shipping, 2022, p. 30).
- “Briefing and Debriefing”: Information is shared between team members before and after certain operations or situations, such as arrivals and departures to and from ports, bad weather or emergencies, with the aim of establishing a mutual understanding of a plan and subsequently evaluating and improving it (International Chamber of Shipping, 2022, p. 30).
- “Closed Loop Communication”: The recipient of a verbal message or order repeats the message verbatim as an acknowledgement to the sender (Witherbys, 2021, p. 11).
- The “FACE” model: Derived from the aviation industry, it describes the four stages of the communication process, in which assertiveness gradually increases as “find out, alert, challenge, emergency”, and is used in particular when seeking clarification about a particular situation (Witherbys, 2021, p. 16). The process begins with establishing a shared understanding by seeking information (find out), followed by expressing disagreement and pointing out misunderstandings (alert), requesting an alternative action or decision (challenge), and finally taking action when a situation is expected to escalate (emergency) (Witherbys, 2021, p. 17).

Misunderstandings can arise on board ships where multinational crew members communicate in a working language that may not be their native language, particularly in stressful or emergency situations (Hetherington et al., 2006, p. 406). Hetherington et al. (2006) argue, that “misunderstanding” [original emphasis] “potentially reflects a lack of situation awareness and poor team working as well as inadequate communication” (Hetherington et al., 2006, p. 406). The use of formal communication phrases and lines as well as a defined working language, as “minimum standards” aims to reduce miscommunication as a significant factor in the overall safety management concept (Hetherington et al., 2006, p. 406). However, Watzlawick and Beavin (1967) argue, that the acknowledgement of a message does not preclude individuals from agreeing or disagreeing, which is influenced by the dynamics of the relationship as a self-reflexive

process (Watzlawick and Beavin, 1967, p. 7). In particular, the use of a "jargon" language on ships can lead to misunderstandings and alienation between crew members from different nationalities and cultures, and especially for those who are new to the industry or the team (Acejo, 2021, p. 104). The communication of both the sender and the receiver of a message extends beyond verbal language including gestures, tone of voice, and individual thoughts, emotions, and experiences (Acejo, 2021, p. 104), that shape the individual's perception of a “common language” (Acejo, 2021, p. 106; Strübing et al., 2016, p. 308).

4.7 Decision-making and Sense-making

All communication contains information, a message and understanding (Luhmann, 2000, p. 43). The availability of information, the appropriate formulation of words, sentences, and the use of a language facilitate sense-making and convey meaning (Luhmann, 2000, p. 93). The communication process therefore involves the availability of information, making sense of it and applying it in a meaningful way through observable behaviour and actions. According to Max Weber, purposeful action involves meaning, which is derived from a decision-making process (Kaufmann, 2009, p. 18). Action refers to deliberate, purposeful and reflexive behaviour, as opposed to a mere reaction to an external stimulus (Kaufmann, 2009, p. 18). For example, the conscious consideration of the risks involved in a planned course of action may lead to a re-evaluation of the options and result in an alternative decision (Kaufmann, 2009, p. 18). For an observer, it may not always be possible to distinguish between conscious actions, which refer to learned behaviour, and unconscious actions (Kaufmann, 2009, p. 18). Purposeful actions and behaviours are delimited by meaning, and decision-making processes are embedded in organisational structures where the framework and inherent constraints for action are determined by outcomes or goals (Weick and Sutcliffe, 2015, p. 34), task allocation and task performance (Schein, 2004, p. 95). Building on the concept of decision making within organisational structures, the concept of situational awareness gains importance.

In the context of accident investigation and human error, reports show that the outcome of situations doesn't necessarily result from the operator's failure to act appropriately (Endsley, 2001, p. 3). Rather, it is the ability to understand the complexity and dynamics of all the system elements in a situation that is referred to as “situational awareness” (Endsley, 2001, p. 3). The level of awareness depends on the effectiveness of the

assessment and application of the appropriate information (Endsley, 2021, p. 126). In complex, dynamic environments, the actor's understanding of a situation and the decisions made are the result of the “situation awareness” (Endsley, 1995, p. 65). This is a process that requires basic knowledge and relevant contextual information (Endsley, 2021, p. 124). Information processing and the resulting “sense-making” can be divided into three stages (Endsley, 1995, p. 65). First, an individual obtains information and aligns it with an intended outcome, then makes sense of the situation, and finally takes action based on the interpretation made (Endsley, 1995, p. 65). However, the derived meaning is contextual and “can be changed with hindsight” (Leydesdorff, 2001, pp. 42–43). This recognition is particularly relevant to accident investigation, where the process of information, decision-making and meaning may be biased by the knowledge of the outcome (Dekker, 2015, p. 65). Dekker (2015) notes that the appropriation of 'loss of situational awareness' as a causal factor in accidents is linked to the way in which complex systems are retrospectively broken down into linear components and linear interdependencies, leading to the view of human error (Dekker, 2015, p. 119). This conclusion is based on the assumption that the information analysed in hindsight was available and obvious to the operator at the time of the decision-making (Dekker, 2015, p. 65).

Several factors are crucial for the decision-making process and the dynamics of applying situational awareness (Strauch, 2017, p. 239). Factors such as time constraints, workload, and experience have a significant impact on the processing of information and the timely interpretation of its relevance, including the ability to prioritise available information (Strauch, 2017, p. 240). While these factors may not be significant during routine operations, they become critical in unexpected situations where an operator's ability to evaluate and respond effectively in a complex and unfamiliar context is required (Strauch, 2017, p. 239). In a complex sociotechnical system, such as commercial shipping operations, the process of applying situational awareness and making appropriate decisions involves both human knowledge and the interpretation of information provided by technical system interfaces (Strauch, 2017, p. 239). Similar to the purposeful and goal-oriented human behaviour “all technical systems are designed for very definite reasons” (Ramussen, 1979, p. 7).

With recourse to Polanyi, Ramussen (1979) states, that human action serves as the "final cause" [original emphasis] in a decision-making process that includes both behavioural and design aspects of the system, forming a "causal structure of the system” (Ramussen,

1979, p. 7). The extent of information provided by automation can lead to a situation where individuals in routine working conditions may become overly reliant on automation (Strauch, 2017, p. 241). The challenge is therefore to respond effectively to unfamiliar situations and prioritise tasks efficiently, especially when time constraints, high workloads and unexpected contextual dynamics arise (Strauch, 2017, p. 241).

However, in Smith and Hancock's (1995) line of argument, situational awareness encompasses an individual's motivation to respond to the environment based on a conscious act and intention towards a goal (Smith and Hancock, 1995, p. 139). The observable application of an operator's conscious response to the environment is what Smith and Hancock (1995) term "situation awareness" (Smith and Hancock, 1995, p. 139). "Adapted, externally directed consciousness" enables individuals to generate suitable behaviour in order to react to changing situations (Smith and Hancock, 1995, p. 140), and this "competence directs behaviour but is independent of the situation" (Smith and Hancock, 1995, p. 140). An individual's ability to apply situational awareness effectively depends on experience, competence and the specific situation (Smith and Hancock, 1995, p. 139). The observable action depends on competent behaviour in a situation, which is related to an inherent ability to apply contextual knowledge as required to initiate the appropriate actions (Smith and Hancock, 1995, p. 141). In this perspective, the application of situational awareness defines the competence to understand and accomplish a task and to act as required (Smith and Hancock, 1995, p. 141). Situational awareness is therefore an essential element of effective communication, involving deliberate, purposeful and reflective behaviour that requires analytical skills, goal-directed interpretation, decision making and purposeful action.

5 The Human Element in the Maritime Safety System

The human element, considered a crucial but unreliable "component" of safe ship operation (Hollnagel, 2014, p. 22) will be the subject to scrutiny henceforth. The elaboration encompasses the assessment of accidents and the characterisation of human error, the subsequent development of safety models as defensive measures to reduce risk, and the understanding of a safety culture in the socioeconomic system. The human element has been identified as a crucial factor in ensuring the safe operation of a ship (Marine Accident Investigators' International Forum, 2014, p. 66). This perspective encompasses both intentional and unintentional actions or omissions that can have a

significant impact on marine accidents by impairing system functioning and task performance (Marine Accident Investigators' International Forum, 2014, p. 66). The human contribution to maritime safety systems has been referred to in various synonymous terms, including "human factor," "human element," and "human error," despite the distinct meanings associated with each term (Oltedal and Lützhöft, 2018c, p. 72).

The understanding of human factors has evolved from the enhanced elaboration of human involvement with technology, defined as “the applied science of people working together with devices” (Helmreich and Foushee, 2010, p. 4). The term “human factor” is espoused to the idea of “ergonomics” and “concerned with the application of what we know about people, their abilities, characteristics, and limitations to the design of equipment they use, environments in which they function, and jobs they perform” (Human Factors and Ergonomics Society, 2023). Thereafter, the International Maritime Organization defines the human factor concept as encompassing the “personality, physical condition, behaviour and attitude and its interaction with the assigned duties, organization on board, working and living conditions, ship factors, shore-side management, and external influences and environment” (Marine Accident Investigators' International Forum, 2014, p. 69). Accordingly, the human factor refers to the idea of contextualizing human abilities and actions with design and equipment parameters required to perform a task skillfully (Human Factors and Ergonomics Society, 2023).

The concept of the “human element” was first introduced by the International Maritime Organization in 1997 (Oltedal and Lützhöft, 2018c, p. 73). This encompasses the interdependence of human activities on a micro-macro scale across the entire maritime industry and a wide range of actors, from shoreside management and authorities to shipbuilders, technology designers, and shipboard operators (Oltedal and Lützhöft, 2018c, p. 73). Although the concept of the human element encompasses a wide range of activities and processes, the term has been found to lack specificity and consistent application (Oltedal and Lützhöft, 2018c, p. 73). The concept of human error has been primarily derived from accident investigations, where “the absence of mechanical failure in an accident is often taken as automatic evidence that human error is the cause” (Dekker, 2015, p. 36). This perspective on human error and safety has led to two main conclusions: firstly, accidents are caused predominantly by the actions and inactions of humans rather than by technical malfunctions, and secondly, the human error issue

requires more comprehensive measures than the installation of technological solutions (Hahne, 2012, p. 14; House, 2014a, p. 177).

Hollnagel (2009) posits that “safety requires knowledge” and concurs that the importance of safety is indisputable (Hollnagel, 2009, p. 7). However, the definition of safety and the assessment of its presence remain ambiguous matters (Hollnagel, 2009, p. 7). It is therefore essential to examine the role of the human actor and its interdependencies in the sociotechnical system in order to evaluate and enhance the effectiveness of the established maritime safety system (International Maritime Organization, 2014c).

5.1 The Nature of Accidents

Maritime safety has become a major focus in response to accidents where human error has been identified as a critical factor in most cases (International Maritime Organization, 2019c). Accidents in the shipping industry can be defined as “an undesirable event that results in damage to life, property and the environment” (Kristiansen, 2013, p. 23). The evaluation of accidents is based on the collection of statistical data on the number of accidents and on their “nature” (International Maritime Organization, 2018b, p. 5). The “nature” refers to the outcome of an event, and is classified as “collision, grounding, hull and machinery failure, fire and explosion” (International Maritime Organization, 2018b, p. 7; Kristiansen, 2013, p. 22). Statistically, the human element has been identified as the principal cause or contributing factor in around 80% of the vast majority of accidents (Franca et al., 2022, p. 2). The Marine Accident Investigators' International Forum (2014) highlights that “the remaining 20% of accidents include classifications such as mechanical failure, environmental factors or, conceivably, an ‘act of god’ [original emphasis]. However, all of these latter categories, including an ‘act of god’ [original emphasis], also involve human behaviour” (Marine Accident Investigators' International Forum, 2014, p. 62). This perspective places considerable emphasis on the ship's crew as the actors at the "sharp end" who are ultimately responsible for the outcome (Grech, 2018, p. 91). Investigations into crew behaviour and actions have identified deficiencies in knowledge, skills and training relating to safety, risk and compliance as causal factors (Grech, 2018, p. 91).

The classification and assignment of categories to adverse outcomes creates and defines the “boundaries” of a system and consequently a “judgement” of behaviour

(Dekker, 2012, p. 73). The assignment of responsibility and blame, as a form of legal accountability aligns “human error” [original emphasis] with static aspects of behaviour, facilitating the establishment of power dynamics, a view reflected in the historical establishment of the regulatory framework in the maritime industry (Dekker, 2012, p. 73). The increase in public awareness of safety issues in shipping in the 1970s and 1980s (Schröder-Hinrichs et al., 2013, p. 258) facilitated the establishment and ongoing modification of today's global regulatory framework for shipping (Parsons and Allen, 2018, p. 23), a system based on “practice and custom of seaman” (Mandaraka-Sheppard, 2009, p. 533). The focus on the maritime environmental protection was triggered by the grounding and sinking of the oil tanker *Torrey Canyon* [original emphasis], off the coast of the United Kingdom in 1967 (Mandaraka-Sheppard, 2009, p. 952) followed by the grounding of the oil tanker *Amoco Cadiz* a decade later (Parsons and Allen, 2018, p. 23) which initiated legislation on master and crew liability and compliance (Mandaraka-Sheppard, 2009, pp. 958–960). The evolving focus on the human behaviour and the contribution to accidents profoundly accelerated the path towards the adoption of STCW 78 (Parsons and Allen, 2018, p. 24).

In terms of safety management, the need for a more holistic approach arose following the capsizing of the ferry *Herald of Free Enterprise* in 1986, considered a turning point in the maritime safety system (Schröder-Hinrichs et al., 2013, p. 258). The organisational view of safety management in shipping, as formulated in the ISM Code, introduced both the allocation of responsibilities of the human actors on the ship and on shore (Kristiansen, 2013, p. 369). The aim is to establish a safety culture as a systematic approach and to provide an overall safety system that goes beyond the actions of the master or the "sharp end" operator and include the actions of the management or organisation of the ship (Hollnagel, 2009, p. 127; Parsons and Allen, 2018, p. 25). In accordance with the established safety framework, the flag States are tasked with analysing the underlying causes of accidents, identifying the formal measures to be taken to prevent similar events from recurring, and formulating the appropriate legal sanctions (Dekker, 2012, p. 12; Kristiansen, 2013, p. 363). The focus is put on legal procedures and compliance, as well as clarifying the causes, definitions and allocation of liability to the parties involved (Mandaraka-Sheppard, 2009, p. 576). Assigning compliance as a quantifiable measure of system safety may involve the acceptance of latent conditions and a continuous “drifting into failure” (Dekker, 2015, p. 153). This process, which prioritises economic focus and compliance based on quantifiable measures, is a gradual process and may evolve unnoticed and eventually become an

established practice (Dekker, 2015, p. 155). The regime of a safety culture suggests that compliance with legislation and a condition of acceptable risk are perceived as individually applicable norms (Gale, 2016, p. 6). The overall focus is on minimising the likelihood of recurrence and identifying both regulatory and technical measures based on the findings of the investigation (Schröder-Hinrichs et al., 2013, p. 243).

However, the outcome of accidents cannot be attributed to a single cause and effect scenario, as they involve numerous elements, including design, technology, the evaluation of MET and conflicting interests within the industrial application of safety regulations (Grech, 2018, p. 91). The incorporation of horizontal and vertical interdependencies and perspectives represents a significant contribution to the understanding of lessons learned in a systems view of safety (Schröder-Hinrichs et al., 2013, p. 250). Despite improvements in the maritime industry's approach to safety, human error remains at its core (Parsons and Allen, 2018, p. 27).

The focus on seafarer behaviour is seen as a solution to a complex systemic failure (Grech, 2018, p. 91), a reactive concept used to justify the introduction of new rules and new technologies within the maritime industry (Praetorius and Lutzhoft, 2011, p. 1798). Hollnagel (2009) reiterates that investigating accidents should go beyond examining actions and behaviours at the sharp end (Hollnagel, 2009, p. 127). A systematic approach needs to consider and promote the wider system implications of the human factors approach of operators, management, regulators, manufacturers, designers, and should include human physiological, perceptual or cognitive capabilities in the system functions (Marine Accident Investigators' International Forum, 2014, p. 69). This sociotechnical system view contextualises human capabilities and actions within the system design and equipment, taking into account physical circumstances as well as economic and social factors (Dekker, 2012, pp. 12–14; Grech, 2018, p. 91).

Hollnagel (2009) emphasises that the categorisation and assignement of “nature” to accidents does not necessarily imply a deeper understanding of the complex processes that are involved (Hollnagel, 2009, p. 124). Furthermore, the concept of a defined or acceptable level of safety (Hollnagel, 2009, p. 8), may not lead to a change in behaviour when an an outcome-based categorisation of unsafe human actions, notwithstanding inherent safety conditions, risk and other variables in the context define an event (Hollnagel, 2009, pp. 123–124).

5.2 Safety as a Composite Linear Concept

The concept of safety and the understanding of the human actor involved in the process has gradually evolved over the last century into the science of “human factors” [original emphasis] (Dekker, 2015, p. 1). The evolving perspective on the role of the human is associated with the evolution and introduction of mechanical equipment and technologies in living and working environments (Kjellén and Albrechtsen, 2017, p. 3) and ultimately to the creation of sociotechnical systems (Dekker, 2015, p. viii). Accidents became a matter of quantifiable, numerical measurement, and individual behaviour and attitudes were perceived as the cause of accidents across all industries (Dekker, 2015, p. 14). As technology advanced, there was an increased reliance on mechanical performance, motivated by the goal of improving economic efficiency (Hollnagel, 2014, p. 22). As a direct consequence, the human performance became the unreliable “component” in the process (Hollnagel, 2014, p. 22). Despite the common conviction that the human represents the vulnerable element in the system safety, the provision or consideration of worker safety was commonly neglected (Crandall et al., 2014, p. 256). When labour was inexpensive, the physical and legal protection of workers from harm was considered dispensable (Crandall et al., 2014, p. 256). The emphasis was put on controlling the human actions and on adapting human behaviour to the functioning of the mechanical equipment; the challenge was to 'engineer' observed human behaviour to make people fit to established systems (Dekker, 2015, p. 1). Efficiency and cost control, driven by competitiveness and concerns about loss of profit, aimed to match human capabilities to a required task or job (Dekker, 2015, p. 16).

A growing scientific interest contributed to the study of personal behaviour and its psychological attributes in relation to human physical capabilities (Dekker, 2015, p. 15). This formed the beginning of the science of “behaviourism”, which was concerned with “the prediction and control of behaviour” (Watson 1978, p. 435 quoted in Dekker, 2015, p. 16), applying the principles of Taylor's thinking[16] (Kjellén and Albrechtsen, 2017, p. 5). A division of labour was introduced between workers and supervisors, and between humans and technology (Wilson, 2004, p. 25), breaking down elements and activities into time-relevant parts and processes (Wilson, 2004, p. 28). Knowledge was an element privy to superiors who established a system of process control and compliance (Wilson,

[16] see also chapter 4.4 Leadership – Management

2004, p. 28). In general, the principles of efficient work were based on the alienation of human behaviour from technological activities and on the separation of the level of knowledge and the level of manual operators (Kjellén and Albrechtsen, 2017, p. 3).

This safety paradigm proposes a simple linear thinking, as represented by the Domino model, associated with the work of Heinrich in the 1930s, which had a significant influence on the evolving views (Strauch, 2017, p. 18). Applied to the safety system view, this means that a level of safety can be achieved by establishing improved defences, control and prevention, leading to a desired effect, in a chain or linear sequence of cause and effect relationships (Strauch, 2017, p. 18). The Newtonian-based concept, with its emphasis on linear cause-and-effect thinking, in which people constitute a problem to be controlled, hinders the systemic analysis of complexity and interconnectedness (Dekker, 2015, p. 48). Based on this linear view, any situation can be analysed and explained with a “definitive, identifiable cause and a definitive effect” (Dekker, 2015, p. 46). This perception is closely linked to “hindsight” bias (Dekker, 2015, p. 66). The principle of a Newtonian view comprises of four elements, namely “causes for effects, foreseeability, time reversibility and a completeness of knowledge” (Dekker, 2015, pp. 46–47). Accordingly, the first element suggests that all phenomena, whether physical, psychological, or social, can be explained by the movement of physical components in three-dimensional Euclidean space (Dekker, 2015, p. 46). According to this perspective, particles are distinguished only by their location in space, and change, evolution, and accidents can be understood through the geometric arrangement and interactions of these particles, which are governed by linear cause-and-effect laws of motion (Dekker, 2015, p. 46). The dominance of the Newtonian model in scientific thinking often leads to the belief that accident analysis methods or agencies that lack a clear reduction to deterministic cause-and-effect relationships may be considered less credible or valuable (Dekker, 2015, p. 46). The principle of "foreseeability" implies that, with knowledge of the initial conditions of any system, all subsequent events can be predicted with absolute certainty, which remains the responsibility of the actor (Dekker, 2015, p. 46). The complete knowledge of a system, its elements and the laws that govern their motion allows theoretically to predict the future development of the system and anticipate the consequences (Dekker, 2015, p. 47). This process of analysis and action remains the responsibility of the human actor involved (Dekker, 2015, p. 47). The concept of “time-reversibility” implies that the state of a system can be reconstructed by tracing back along the causal chain in time, confirming the principles of Newtonian physics, where the accuracy of the representation of events is the only obstacle to the representation

(Dekker, 2015, p. 47). Eventually, "completeness of knowledge" of the laws governing the world is achievable, so that investigations can consciously combine objectivity with subjective perspectives by involving all relevant stakeholders and allowing their contributions to ensure a holistic approach (Dekker, 2015, p. 47).

In general, the application of a Newtonian worldview actively hinders the ability to create a safety mindset that is suited to complexity and dynamic interconnectedness of the systems introduced in the second half of the twentieth century (Dekker, 2015, p. 49), when comprehensive technological devices and regulatory measures were widely introduced in all aspects and industries (Praetorius and Lutzhoft, 2011, p. 1798). The quantification of events, failures, production losses and accidents and the avoidance of errors dominated the common thinking (Dekker, 2015, p. 21). The focus shifted to improving the design and technology in order to protect the human being, considered the weak element in the process (Dekker, 2015, p. 2). It was understood that advances in technology had to recognise the capabilities and limitations of the human operator (Dekker, 2015, p. 3). The focus on production efficiency and the consideration of the human factor addressed the design of equipment and its quality (Dekker, 2015, p. 22). Thinking was shifted from safety to quality management as a cycle of integrated steps in managing the process by Deming, who saw production as a means of reviewing and advancing a system using the “plan-do-check-act” principle (Kjellén and Albrechtsen, 2017, p. 5). The principle was based on the design of improved technology and the avoidance of accidents, to promote safety through system control, rules and procedures (Dekker, 2015, p. 24). Human were still considered the weak system part in achieving absolute safety (Dekker, 2015, p. 25).

In the 1980s, James Reason developed the "Swiss Cheese Model" as a systematic approach to analysing and understanding the challenges of promoting a safety systems perspective (Dekker, 2015, p. 26). The work of Reason approaches the subject of accident analysis by attempting to explain the interrelationship between organisational, technical and individual factors, and barriers to errors and accidents (Kjellén and Albrechtsen, 2017, p. 37). The different levels of a system or organisation are aligned as 'defences' in order to prevent an unsafe act from leading to an accident (Reason, 2008, p. 96). Hollnagel (2014) termed this view as a “composite linear causality” (Hollnagel, 2014, p. 66). This refers to the original understanding based on the causal process of accidents from design through management to the operator decision level and the implementation of linear "safeguards" (Reason, 2008, p. 96). In a later adaptation of the

model Reason (2008) acknowledges the limitations of the original model by classifying failures as either “latent failure”, which is considered to be an inherent state of a system, or otherwise as “active failure” (Reason, 2008, p. 96). The ‘sharp end’ [original emphasis] view in the model, although presented as the last layer of defence in the linear composition of the model, as Reason (2008) stresses, does not imply a human error view of the operator, however reflects the interdependencies and impacts of all elements and all levels as essential in establishing a safety concept (Reason, 2008, p. 98).

The contemporary view of the shipping industry is recognised as high risk (Oltedal and Lützhöft, 2018b, p. 1) and complex (Manuel, 2017, p. 14). The view of risk and complexity was introduced by Charles Perrow in the 1980s in the 'normal accident theory', and subsequently shaped the view of complexity in technological work environments and their inherent potential for error (Hollnagel, 2018, 8f; Strauch, 2017, p. 16). The argument is that accidents have become inevitable and should be accepted as 'normal' in high technology systems, because the abundant element functions and their adjustable dynamics cannot be entirely monitored or controlled by an operator (Hollnagel, 2018, p. 9). These systems are characterized by the 'tight couplings' of simultaneous “nonlinear” interdependent elements (Hollnagel, 2018, p. 9). To manage a complex system effectively, it is essential to understand the dynamics and functions of its components and to clarify the meaning of complexity (Hollnagel, 2018, p. 10). Complexity refers to the multiplicity of possible configurations within systems arising from the interactions between their constituent elements (Proske, 2010, p. 260). Thus, complexity is not an inherent property of systems, but rather a characterisation of the variability of inherent elemental interactions (Proske, 2010, p. 260). Understanding the workings of complex systems can focus on the connections that lead to an intended outcome, or on the malfunctioning of its components that has reinforced an undesired outcome (Dekker, 2015, p. 48). Therefore, (Dekker, 2015, p. 49) argues that a linear, simplified view of systems is inadequate for understanding how multiple elements and complex system processes interact when exposed to various influences simultaneously (Dekker, 2015, p. 49). Complexity arises from the dynamic relationships between system components, with the emphasis on the importance of relationships rather than individual elements (Dekker, 2015, p. 49). The properties of a complex system arise from these interactions rather than from isolated components, and the system can generate new structures internally without external design (Dekker, 2015, p. 49). In response to changing environmental conditions, the system must adapt its internal structure (Dekker, 2015, p. 49).

Applying the human error view to interpreting interactions in complex sociotechnical systems can lead to oversimplification of interdependencies and inappropriate decision making (Proske, 2010, p. 261). As the number of system elements increases, the human operator is faced with the need to select actions, which in turn increasingly compromises the system's potential (Luhmann, 2017, p. 36). Perrow (1987) highlights the technical complexity and inherent error-proneness of such systems (Perrow, 1987, p. 268). Promoting the social element of the system, and involving human skills in teamwork, can improve system performance and reduce errors and accidents (Perrow, 1987, p. 276).

In conclusion, Kristiansen (2013), summarises the inherent implications of adopting a comprehensive sociotechnical systems view and enhancing system safety as follows (Kristiansen, 2013, pp. 10–11):

- Complexity arises from the interaction of technological, human and organisational components;
- Focusing on effects rather than the causes and interactions of elements leads to biased results;
- Lack of reflection leads to limited awareness of the shortcomings of a system;
- Quick fixes through technical solutions are favoured over the slower process of changing human behaviour;
- Human resistance to behavioural change is an obstacle to change;
- The use of oversimplified concepts prevails in safety risk models.

Despite sociotechnological developments, safety assessment practices remain rooted in the historically derived tendency to attribute human error as the main cause of accidents (Franca et al., 2022, p. 2). To reveal the complexities of sociotechnical systems, it is necessary to employ methods capable of analysing the multifaceted dynamics and interdependencies (Franca et al., 2022, p. 2).

Nevertheless, Hollnagel (2009) argues that acceptable explanations for accidents must provide a clear explanation that is consistent with established and acceptable standards and must include a straightforward, acceptable and understandable solution that is economical and timely (Hollnagel, 2009, p. 10). This approach reflects a linear view of efficiency, in which failures are attributed to specific elements and functions as a prerequisite for maintaining control and the successful management (Dekker, 2015,

p. 3). However, sustainable management of socio-technical systems requires a departure from the linear decomposition of system elements, which fails to recognise the human element and its mental and psychological aspects and capabilities (Dekker, 2015, p. 3).

5.3 Safety and Risk

The concepts of "safety" and "risk" have become pervasive and applicable in a multitude of contexts in everyday life and work. However, their definitions and meanings vary considerably (Hollnagel, 2009, p. 8). A widely accepted definition of safety is that of "freedom from unacceptable risks" (Hollnagel, 2009, p. 8), which implies a presumed interdependence between safety and risk. In accordance with these perceptions, safety and risk are conceived as a dichotomy, representing opposing aspects of environments where the achievement of safety is reciprocally dependent on the reduction of risk (Hollnagel, 2009, p. 8). Furthermore, this conviction necessitates the implementation of risk avoidance measures, which ultimately results in a status of acceptable safety (Hollnagel, 2009, p. 8). This entails firstly identifying and addressing potential hazards in a system with the objective of eliminating risks, and secondly the incorporation of preventative mechanisms at the various levels (Hollnagel, 2009, p. 8).

The concept of risk is frequently operationalised as a quantifiable mathematical quotient, where risk is a measure of “probability of occurrence” multiplied by an “expected consequence” and related to “human, economic and/or environmental loss” (Kristiansen, 2013, p. 12). This concept is consistent with the terminology for maritime safety systems proposed by the International Maritime Organization’s (2018b), where risk is defined as “the combination of the frequency and the severity of the consequence” (International Maritime Organization, 2018b, p. 4). Consequently, the risk principle encompasses an assessment of both a quantifiable measure espoused with a determined outcome. In order to achieve this objective, the International Maritime Organization (2018b) recommends the utilisation of the "Formal Safety Assessment" (FSA) methodology to assess the tolerable level of risk and safety, and establishing the acceptability of risk or safety through the implementation of specific methods or measures (International Maritime Organization, 2018b, p. 3). The FSA approach comprises a series of interrelated steps, including “identification of hazards, risk analysis, risk control options, cost-benefit assessment, and recommendations for decision-making” (International

Maritime Organization, 2018b, p. 5). The resulting assessment of risk and the level of acceptable adverse consequence can be formulated in a matrix and categorised as "low, medium and high risk" (International Chamber of Shipping, 2022, pp. 70–71). The measures to be implemented are based on the identification of a hazard and include substances, situations or practices that have the potential to cause harm, in essence, both the frequency and severity of the consequences are taken into account (International Association of Classification Societies, 2021).

In the operational context, the concept of risk and safety is implemented through the ISM Code (International Chamber of Shipping, 2022, p. 71), which necessitates the integration of a “risk assessment matrix” system into the preparation and execution of a range of shipboard tasks (International Chamber of Shipping, 2022, pp. 71–74). These include working at heights and in spaces with potential physical or health hazards, as well as voyage planning, which requires consideration of factors such as shallow water, safe distances and safe speed, in addition to potential machinery or equipment failures (International Chamber of Shipping, 2022, pp. 71–74). The risk mitigation strategy in the maritime context involves the implementation of "permits to work," a measure stipulated by the ISM Code (International Chamber of Shipping, 2022, p. 71). This entails the implementation of the requisite steps in the operational work context with the objective of promoting a safe working environment and the execution of requisite tasks in accordance with the pertinent regulations (International Chamber of Shipping, 2022, p. 71). The responsibility for conducting risk assessments for the associated tasks on board ships is that of the managing company, as stipulated by Article 1.2.2.2 of the ISM Code, which states that a company should "assess all identified risks to its ships, personnel, and the environment and establish appropriate safeguards" (International Maritime Organization, 2018a). Nevertheless, the necessity for conducting risk assessments does not prescribe a specific methodology (International Association of Classification Societies, 2021).

Manuel (2017) proposes that the overreliance on the established methodologies suggests that risk and safety are subject to “rational and objective” analysis, and furthermore that the reliance on quantifiable methodologies, coupled with structured logic, is purported to contribute to a desired state of safety (Manuel, 2017, p. 22). However, while it is recognised that compliance is the foundation of safe shipboard operations, compliance alone is not sufficient to ensure safety and mitigate risk (International Association of Classification Societies, 2021). A comprehensive approach

to the advancement and sustainability of an effective safety system should encompass practices and behaviours that influence the concept of safety (Kristiansen, 2013, p. 361) and recognise the perception and assessment of risk and safety in a context-dependent view (Kristiansen, 2013, p. 12).

Perrow (1987) examines the interdependencies and complexities within the shipping industry, which collectively contribute to the inherent risk aspect and notes, that economic pressures, time constraints, compliance with national, international, and industry regulatory standards, and technical system operation, all contribute in this regard (Perrow, 1987, p. 222). All of these contributing factors further reinforce the interdependencies of ship safety operations, with the master, as the human element, deemed the "sharp end" operator, held ultimately responsible (Hollnagel, 2009, p. 127). The design and application of complex and sophisticated technical systems over the last few decades aimed at supporting human users in achieving compliance with safety, efficiency and effectiveness requirements (Man et al., 2018, p. 795). Nevertheless, while the utilisation of technical systems enhances operational efficiency, it also stimulates an enhanced perception among operators of increased control over risk (Perrow, 1987, p. 226). The complexity of maritime trade has contributed to an increased risk tolerance, argues Perrow (1987), and further explains that the willingness of operators on board ships to take risks and neglect danger is derived from their perception or belief of being in control of the technical equipment (Perrow, 1987, p. 226). According to Luhmann (1991), risk tolerance is directly correlated with the degree of controllability of a process and objectively increases with the incorporation of technical aids (Luhmann, 1991, p. 123). Consequently, the necessity for precautions is negated in a reciprocal manner (Luhmann, 1991, p. 123). The willingness to take risks is also influenced by psychological assumptions about the likelihood of potential economic damage having serious consequences, for example through insurance coverage (Luhmann, 1991, p. 123).

Recent research in the maritime field emphasises that an understanding of risk perception and the subjectivity of individual risk assessments can influence the manner in which individuals engage in "risk-taking" behaviour in the context of daily operations (Grech, 2018, p. 92). This acknowledges that “the maritime industry is characterized as high risk” (Oltedal and Lützhöft, 2018a, p. 1) and “seafaring is seen as a high-risk occupation” distinct from other occupations in terms of the mental and physical constraints associated with it (Oltedal and Lützhöft, 2018b, p. 3). The findings of Bailey

et al. (2007) resulting from extensive research into seafarers' perceptions of risk indicate that risk perceptions vary considerably between individuals (Bailey et al., 2007, p. 1). In order to gain a comprehensive understanding of the factors influencing seafarer behaviour, it is essential to consider individual attributes such as nationality, age, and the hierarchical rank on the vessel (Bailey et al., 2007, pp. 13–23), but also the context related to the specific task involved and the type of ship where seafarers are employed (Bailey et al., 2007, pp. 28–33). These findings highlight that perceptions of risk control and observed risk-taking behaviour require flexible approaches to the application of safety and risk management methods (Bailey et al., 2007, pp. 72–73).

The “subjective nature or risk perception” is a fundamental aspect of the concept of safety (International Association of Classification Societies, 2021). The perception of risk shared by an individual or team is related to their familiarity with a task (Edmondson, 2002, p. 2), and based on their level of knowledge and skills that influence the process of making sense of a situation and the decisions that are made at that time and context (International Association of Classification Societies, 2021). In the context of safety and risk assessment, an understanding of the complexities of human behaviour emphasises the importance of developing responses to demands that result in reflexive and adaptive safety performance (Hollnagel, 2009, p. 129). Hollnagel (2018) concludes that “safety is about how to facilitate the activities that are necessary for acceptable outcomes on all levels of an organisation” (Hollnagel, 2018, p. 7). This perspective recognises the importance of understanding the individual behaviour of all actors involved in promoting safety, a view that lies at the heart of a comprehensive safety system.

5.4 Human Error

The focus on the concept of human error in shipping has been significantly shaped, reinforced and accelerated by major accidents where the investigation reports have confirmed the human error perspective and contributed to this conviction (International Maritime Organization, 2019f). The United Kingdom government agency, the Marine Accident Investigation Branch (MAIB), argues that “human error is a retrospective label assigned to categorize human behaviour that led to or contributed to adverse outcomes” (Marine Accident Investigators' International Forum, 2014, p. 62). Furthermore, Reason (1997) asserts that in accident investigation “it has become fashionable to claim that human error is implicated in 80-90 per cent of all major accidents” (Reason, 1997, p. 61).

This facilitates a sufficiently simple yet accepted explanation for failures or shortcomings in safety systems (Hollnagel, 2018, p. 7), which has been conveniently associated with "bad seamanship" on part of the seafarer (Sachers, 1995, p. 158). Therefore, the concept and understanding of human error is reviewed in order to elaborate and reveal the foundations of this belief and its relevant dependencies.

James Reason's continuing studies have attempted to analyse and provide insight into the concept of human error (2008). Reason (2008) defines the different types of human error in terms of their scope into "slips, lapses and mistakes" and further divides these mistakes into associated categories of "skill-based", "rule-based" and "knowledge-based" mistakes (Reason, 2008, pp. 38–46). Slips and lapses are failures occurring as a part of daily routine and considered "execution failures" (Reason, 1990, p. 55), resulting "from the unintended activation of largely automatic procedural routines", mainly due to lack of attention or inadequate memory (Reason, 1990, p. 54). These skill-based errors are associated with a failure to apply progressively acquired practical knowledge (Reason, 2008, p. 14). Mistakes are the result of established patterns of "habits" and their execution in an unconscious or "automated" mode, leading to omissions and errors (Reason, 2008, p. 14). Errors transpire when an individual becomes distracted in the execution of a task or unintentionally misses a step while striving to accomplish the task, for reasons of high-workload, and missing or deficient knowledge of a task (Reason, 2008, p. 39). Mistakes, as opposed to slips and lapses, are considered "planning failures" (Reason, 1990, p. 53), which "arise from failures of the higher-order cognitive processes involved in the judging the available information, setting objectives and deciding upon the means to achieve them" (Reason, 1990, p. 54). Rule-based mistakes follow the misapplication of learned and stored information, derived from rules or procedures, in a specific context or situation, also referred to the application of an "*if (state) "then" (remedial action)* [original emphasis]" response (Reason, 1990, p. 43). Both skill-based and rule-based errors relate to some form of human control related to previously acquired and retrievable knowledge at the skill level as a reflection of a "flexible and efficient dynamic internal world model" (Rasmussen, 1986, p. 101 quoted in Reason, 1990, p. 57). This process refers to an undue assessment of a situation and therefore an unsuitable decision making process that leads to an undesirable outcome of a situation (Reason, 1990, p. 43; Strauch, 2017, p. 20). Errors may occur when known rules are applied to unfamiliar or new situations, hence accommodate a way of identifying a perceived "familiar pattern" and applying available knowledge to the apparent familiarities in the situation encountered (Reason, 2008, p. 45). The error is derived from

a misinterpretation of meaning, which is the failure to understand the representation of the actual situation and its implications (Reason, 1990, p. 57). While “mistakes” include also “violations”, and both are the result of an inappropriate or incorrect assessment of a situation and the subsequent decision making process and actions taken (Strauch, 2017, p. 20), a violation refers to deliberate actions, as a consciously taken deviation from known standard practices or established procedures (Strauch, 2017, p. 20). Knowledge-based errors are the result of new experiences and situations with a lack of relevant knowledge and skills (Reason, 1990, p. 43). In this context the individual does not have the opportunity to refer to previous experience, hence when faced with an unfamiliar situation, the “trial-and-error” method is employed (Reason, 2008, p. 45). Recognising this type of error depends crucially on the sharing of information and the collective interpretation and application of knowledge (Reason, 1990, p. 57).

These definitions and classifications of errors, as Resaon (2008) concludes, are widely used and applied in different work-related contexts (Reason, 2008, p. 29). However, the “intentions, actions, outcome or context”, that defines the concept of error is predominantly determined by the interest of the individual’s application being sought (Reason, 2008, p. 29). Moreover, the categorisation of human error in accident investigation is primarily influenced by psychological rather than objective factors and aims to explain known causes with the possibility of applying possible solutions (Reason, 2008, p. 47). Reason (1997) posits that the underlying causes and mechanisms behind accidents cannot be fully understood without acknowledging the role of human contribution, which is an inherent element of any system (Reason, 1997, p. 61).

An oversimplified explanation that involves the appropriation of blame or disciplinary measures fails to acknowledge the necessity of a more holistic approach to comprehending the underlying reasons for various actions leading to an accident outcome (Forster, 2019). This approach must take into account the complexity of the interdependencies encompassing both situational and psychological aspects in order to identify potential strategies to prevent the recurrence of similar errors (Reason, 2008, p. 32) and to address these adequately in order to improve or change the underlying causes or behaviours (Reason, 1997, p. 61). Furthermore, the human contribution is reinforced in other dimensions, including the design of equipment, the creation of technology, and the managerial level with the establishment of operational procedures and of a safety culture (Marine Accident Investigators' International Forum, 2014, p. 62).

Accordingly, the human contribution, and the concept of human error, is pervasive at all levels of the maritime industry. Therefore, it is essential to consider an open and comprehensive understanding of system elements and their dynamic interdependencies and contexts in order to enhance effective safety measures and behaviours.

5.5 Safety Models

Maritime safety involves the application of various concepts and practices aiming to protect life, property and the ecosystem (International Maritime Organization, 2019f). Hollnagel (2009) asserts that knowledge is a prerequisite for the comprehension of safety, and for the identification of the 'what,' 'why,' and 'when' of actions (Hollnagel, 2009, p. 7). The relevant answers to these questions may rely on assumptions, opinions, beliefs or statistical data that reflect a “pragmatic” solution, but do not provide a true account of a system failure or malfunction (Hollnagel, 2009, p. 8). Accident investigations have found that in complex work environments such as shipping, aviation, nuclear and medical, the perception of a safety culture is reflected in the observable behaviour of individuals and teams and their understanding of safe operation (Dekker, 2012, p. 87; Hollnagel, 2009, p. 7; United States Department of Homeland Security, 2005, p. 3).

The definition of culture as a “collective programming of the mind” suggests a contextualised classification of a group's learned behaviour based on shared norms and values, which are conceived as “*desired”* [original emphasis] or *“desirable*” [original emphasis], resulting from an established or favoured “ideology” (Hofstede, 2001, p. 6). However, the expected 'ideal' or actual performance is motivated or constrained by the values and norms of the defined system (Hofstede, 2001, p. 6). Thus, the concept of safety culture encompasses the dynamics and traditions of relationships and their conflicting interests associated with functions and power relations in an organisational and sociotechnical structure (Barmeyer, 2018a, pp. 32–33).

The importance of implementing a safety culture within safety management was first emphasised by the nuclear power industry following the Chernobyl incident in 1986 (Håvold and Oltedal, 2018, p. 53). Subsequently, the concept of safety culture was increasingly developed and introduced into other industries, including the maritime environment, where the requirement for safety management was formulated through the ISM Code (International Maritime Organization, 2019f). One way of understanding or explaining social systems, including organisational or sociotechnical, is through models,

which aim to show the functions, connections and interdependencies of system elements, thus may serve as a desired or “pragmatic” explanation of the system’s inherent “mental programming” (Hofstede, 2001, p. 2).

The SHEL model, first developed in the 1970s, has been widely used in the aviation and maritime industry (Grech et al., 2008, p. 20; International Civil Aviation Organization, 2018; Marine Accident Investigators' International Forum, 2014, p. 66). The model has been employed by the International Maritime Organization as a potential tool to enhance the comprehension of the system dynamics in maritime accident investigations (Grech et al., 2008, p. 20), aiming to apply a holistic systems perspective, and avoiding the single-cause view on human error (Wiegmann and Shappell, 1997, p. 282). The model embraces a sociotechnical system view on the safety-related interdependencies and their impact of the technical and human elements involved (Grech et al., 2008, p. 20).

The four elements of the SHEL model are illustrated in Figure 6 below (Marine Accident Investigators' International Forum, 2014, p. 66):

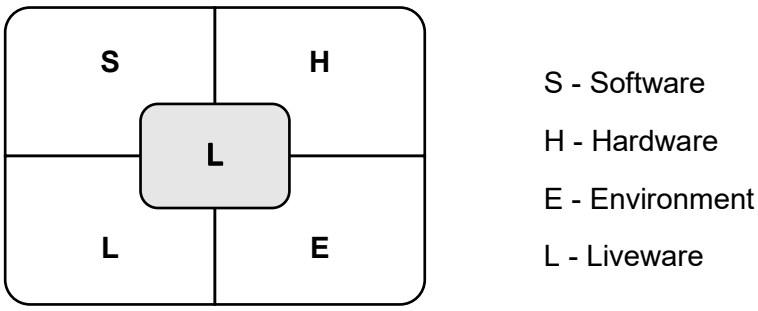

Figure 6: The SHEL model (adapted after Marine Accident Investigators' International Forum, 2014, p. 66)

The system's software, 'S', includes the organisational and regulatory framework affecting the human operator, such as an established safety management policy, but also the essential computer software used in work processes (International Civil Aviation Organization, 2018; Marine Accident Investigators' International Forum, 2014, p. 67). Hardware, 'H', refers to the physical components of a ship or system, including machinery, equipment, ergonomics and their design, all of which are necessary for, or affect, a human operator to perform a task (Marine Accident Investigators' International Forum, 2014, p. 67). The environment, 'E', refers to external influences such as weather conditions and the physical motion of the ship, but also to the economic or political

context (Marine Accident Investigators' International Forum, 2014, p. 67). Liveware, 'L', refers to both the human actor on the ship, placed at the centre of the model, and to the humans placed at the periphery of the model, referring to the management or the organisation responsible for establishing and actively maintaining a safety culture, through reflective lines of communication and the formulation of safety management policies and procedures (Marine Accident Investigators' International Forum, 2014, p. 66). The human actor at the heart of the model is considered the “most valuable and flexible component in the system” representing the interface of all interactions and system components (Marine Accident Investigators' International Forum, 2014, p. 67). The functioning of the overall safety of the system depends on the ability of the operator to know, understand and manage the dynamics of the interrelated elements as required (Kristiansen, 2013, p. 384; Marine Accident Investigators' International Forum, 2014, p. 67). In addition, considerations in regards to human limitations must be recognized, including physical and mental well-being, social deprivation, workload and the effects of shift work and fatigue (Grech et al., 2008, 57ff; Marine Accident Investigators' International Forum, 2014, p. 66).

While the application of a systems model such as SHEL provides a simplified approach to illustrate valuable insights into understanding the dynamics of interdependencies (Grech et al., 2008, p. 20), it may challenge the prevailing approach to accident analysis in the maritime industry, which places the human element or human error at the centre of the analysis, but in a linear view (Franca et al., 2022).

5.6 Just Culture

Establishing a safety perspective or a safety culture in a dynamic sociotechnical system, such as a ship, cannot be achieved by applying a definitive measure between safe and unsafe or 'right and wrong’ (Dekker, 2012, p. 80). While the regulatory framework provides an essential structure and basis for the safety practices, the strict adherence to rules and regulations does not necessarily improve safe practices or a safety mindset (Dekker, 2015, p. 99). Human behaviour and safety go beyond the application and constraints of regulatory measures, which are valuable and effective only in very specific circumstances, however are not suited to the multitude of variables in dynamic situations (Dekker, 2015, p. 103).

Judgments of wrongdoing are motivated by different interests at the individual, professional, organisational and public levels (Dekker, 2012, p. 6), and create power relations between those who judge and those who are accused of wrongdoing (Dekker, 2012, p. 74). When human contribution in a sociotechnical system is directly linked to compliance with documentation requirements and deviations, the hindsight bias resulting from linear thinking becomes apparent (Dekker, 2015, p. 102). This approach portrays a safety culture that consciously examines human behaviour as a strictly regulated function (Dekker, 2012, p. 43). In this sense, holding a sharp-end actors accountable for failures serves the idea of eradicating the causes of failure, a response that provides a perceived solution to the problem (Dekker, 2012, p. 84).

Errors in complex systems can be an indication of a weakness in a system and a reason to reflect upon and change 'what' went wrong rather than to inculpate 'who' acted (Dekker, 2012, p. 84). Any work or professional environment is subject to human error, and most people are motivated to perform tasks and achieve goals, not to fail or break rules (Dekker, 2012, p. 99). Identifying the underlying processes associated with failures and recognising them as valuable learning opportunities leads to dynamic system improvement (Dekker, 2012, p. 38).The application of a just culture aims to balance compliance with rules and commitment to an organisation, thereby integrating people and systems (Dekker, 2012, p. 80).

Encouraging responsible behaviour is facilitated by the establishment of open lines of communication, where individuals are assured of protection from punitive action, with the exception of deliberate errors, which are considered unacceptable and thus not tolerated (International Chamber of Shipping, 2022, p. 30). The motivation for individuals to report errors or “near misses” is based on trust and open communication (International Chamber of Shipping, 2022, p. 30). Strict accountability can limit responsible decision-making and lead to a defensive approach, where actions deemed appropriate in a given context are replaced by defensive measures, potentially leading to the concealment of errors or evidence (Dekker, 2012, p. 13). A system of self-reporting of incidents, without fear of punitive consequences involved not only encourages a just culture but also recognises that strict adherence to rules and regulations does not necessarily promote the dynamic of a flexible safety culture and the necessary organisational learning process (Dekker, 2012, p. 52). This can promote a systematic learning attitude and motivation to take responsibility for safer working practices (International Chamber of Shipping, 2022, p. 30), however also relies on a process of integrating the various

horizontal and vertical levels of an organisation's safety system (Dekker, 2012, p. 9). Human actions and behaviours at all levels of an organisation contribute to the achievement of a goal, driven by different motivations and interests, and human error is part of reinforcing this broader understanding and holistic approach to improving ship safety when applying a comprehensive just culture.

5.7 Economic View on Safety

Ships and maritime transport have been instrumental in the development of wealth and in facilitating the functioning of world trade (Parsons and Allen, 2018, p. 17). The seaborne trade is characterised by a high cost-effectiveness in terms of the total goods shipped, compared to other modes of transport (Biebig et al., 2008, p. 57). Competitive interdependencies with other modes are related to freight rates, capacity, and time efficiency (Biebig et al., 2008, p. 56). However, the industry has been criticised for its historical neglect in implementing inappropriate safety standards and the dominant concern for competitiveness and profit orientation in the trade (Kristiansen, 2013, p. 9; Parsons and Allen, 2018, p. 16). The different interests of the stakeholders are subject to the prescribed standards and regulations (Kristiansen, 2013, p. 4). Consequently, the underlying motivations that imply decisions and requirements in ship operations are influenced by these competing interests and implications, adding to the overall complexity of safe operations (Kristiansen, 2013, p. 4). Shipowners' decisions on the implementation of safety standards, which are closely linked to the investment in the design and construction of the ship, the equipment installed and the cost of crew training and wages, are influenced by market forces (Kristiansen, 2013, p. 5; Morrison, 1998, p. 5).

A shipowner's overriding objective of economic efficiency and compliance with prescribed safety measures may conflict with regulations and with customers' cost expectations (Stopford, 2009, p. 655). Return on investment calculations, the application of industry standards, economic performance targets and the efficient operation of a vessel can all influence safety standards (Kristiansen, 2013, p. 5). This view emphasises that the economic interests of shipowners may take precedence over safety measures and concern for human life (Kristiansen, 2013, p. 6). Arguably, "the ship and its crew have been sacrificed for profit in the context of maritime accidents" (Kristiansen, 2013, p. 20), where the implementation of safety measures is seen as a reactive step following

accident investigations and public pressure, rather than initiating proactive practices (Parsons and Allen, 2018, p. 16).

However, economic and profitable interests must align with with the international safety standards and are subject to rigorous administrative and governmental regulatory control (Kristiansen, 2013, p. 9). Therefore, both national control standards and economically motivated decisions are strongly related to the choice of flag for registering a vessel (Kristiansen, 2013, p. 5). Furthermore, a ship's commercial costs are affected by the flag State under which it is registered (Morrison, 1998, p. 5), determined by the associated national taxes, fees and legislation (Stopford, 2009, p. 669). A ship's flag represents its nationality (Mandaraka-Sheppard, 2009, p. 277). The legal system applicable to the ship remains with the State in which the ship is registered, from both a commercial and a criminal perspective (Mandaraka-Sheppard, 2009, p. 277). In accordance with national legislation, it is possible to have a ship registered in a country of choice (Mandaraka-Sheppard, 2009, p. 277), which may differ from the owner's country of residence (Kristiansen, 2013, p. 5). This is known as “flagging out” (Kristiansen, 2013, p. 5) with *flags of convenience* [original emphasis] (Stopford, 2009, p. 669). The practice of ship registries using 'flags of convenience' dates back to the 1930s and has become a widespread and well established commercial practice among shipowners in recent decades (Morrison, 1998, p. 17), and may involve the transfer of entire fleets to countries that offer a flexible approach to the cost-effective operation of ships (Morrison, 1998, p. 17). The practice of flagging out has been associated with the application of inadequate safety standards and has been identified as a contributing factor to incidents and accidents (Mandaraka-Sheppard, 2009, p. 279).

The decision to change a vessel's flag is influenced by the benefits offered by national regulations, which determine the savings in taxes and fees, the minimum number and nationality of crew to be employed on board, and the crew's wages (Morrison, 1998, p. 5). These considerations have a direct impact on crew costs, which are the most significant expense in ship operations (Biebig et al., 2008, p. 267), since wage levels vary significantly depending on the nationality of the seafarers recruited and the relevant national minimum wage legislation (Biebig et al., 2008, p. 57). Crew-related costs have been recognised as a key factor in the decision to flag out (Biebig et al., 2008, p. 57). This decision implies the ability to attract labour from countries with lower wages (Stopford, 2009, p. 667) such as the Philippines, the most important seafaring nation in world trade (Turgo, 2021, p. 9). These factors have also been a catalyst for the

development of open registries (Buiser, 2021, p. 177; Stopford, 2009, p. 667). Historically, the most significant open registries have been those of Liberia, Panama, the Bahamas, Singapore, and Cyprus (Biebig et al., 2008, p. 268; Gekara, 2021, p. 39). The concept of flagging out in the global business serves the interests of both flag State economies, which strive to attract shipowners to register their vessels under their flag, and shipowners, who seek to benefit financially from the legal system of the State (Stopford, 2009, p. 671). The economic benefits gained are directly related to profit and competitiveness (Biebig et al., 2008, p. 267). However, since the flag States and the shipowners both rely on the benefits to promote a business model in compliance with internationally recognised maritime regulations, and the maintenance of the minimum safety standards, the predominant attractiveness of open registries lies in the reduction of tax incentives and the enforceability of corporate laws (Stopford, 2009, p. 669).

According to Hollnagel (2009), the goal-based approach of achieving an acceptable level of safety while maintaining an efficient process is achieved through a “trade-off between efficiency and thoroughness” (Hollnagel, 2009, p. 14). As a basic economic business principle, Hollnagel (2009) explains, that “it is never possible to maximise efficiency and thoroughness at the same time. Nor can an activity expect to succeed, if there is not a minimum of either” (Hollnagel, 2009, p. 29). This principle is based on the idea that economic demands and safety concerns, as a function of compliance cannot be continuously combined or satisfied to meet both objectives (Dekker, 2015, p. 113; Hollnagel, 2009, p. 14). Individuals and organisations often face a trade-off between available resources, including manpower and time constraints, as well as personal attitudes and preferences (Hollnagel, 2009, p. 17). Decisions on safety or efficiency are motivated by the desired outcome, which may be dominated by economic performance or a high demand for quality (Hollnagel, 2009, p. 28). The application of the principle is related to both technical equipment and human behaviour, which is motivated to perform or act purposefully in order to achieve a specific goal (Hollnagel, 2009, p. 17) and bound by the demands of efficiency, even when violating rules or legal parameters (Hollnagel, 2009, p. 35). Hollnagel (2009) argues, that performance is defined by the outcome rather than the process (Hollnagel, 2009, p. 123). Subsequently, Gale (2016) emphasises the economic pressure on the crew and master to comply with the regulatory framework and ensure the efficient operation of the ship, stressing that “ship's navigation teams know what the procedures are, but trade off full compliance with getting other tasks done because they will be judged on quantity and not quality” (Gale, 2016, p. 6). Thus, while the responsibility and enforcement for both legal compliance and commercial interests

for the efficient operation of the ship rests with the master, who supervises and manages all technical and human resources, established safety procedures, training, maintenance and emergency preparedness on board (Vandenborn, pp. 80–81), this accountability and responsibility enforces the focus at the sharp-end of the maritime safety system (Hollnagel, 2009, p. 127).

5.8 Sociotechnical System Ship

When accidents occur without apparent technical issues, the cause is often attributed to human error, a perspective rooted in linear analysis of cause and effect (Dekker, 2015, p. 36). The integration of scientific methods, rooted in the eighteenth century, promoted an understanding of cause-and-effect thinking based on the isolated analysis of matters, a perspective that continues to shape processes today (Vicente, 2003, p. 33). This perspective approach to problem solving involves breaking down the whole system into individual elements and ultimately attributing failures to human error, with the cure being the application of a technical “fix” (Grech et al., 2008, p. 15).

This linear method, often employs “defences and barriers” as essential control measures to manage component failures and errors (Strauch, 2017, p. 15), with the goal of achieving a measurable level of acceptable safety, or the ‘freedom from unacceptable risks’ [original emphasis] (Hollnagel, 2009, p. 8). Reason's "Swiss Cheese Model", as previously discussed in Chapter 5.2 provides a representation of the linear safety measures implemented at different levels and to potential hazards associated with "latent conditions" that penetrate the barriers and allow an unsafe condition to occur (Reason, 2008, p. 93). The separate analysis of technical and human aspects (Strauch, 2017, p. 16), supported by the introduction of layers, focuses on the importance of addressing unsafe conditions, defects and violations as an example of poor decision making and management failures (Dekker, 2015, p. 49). Thus, the effective management of safety at the "sharp end" requires thoroughness in methods and controls to mitigate and avoid errors (Dekker, 2015, p. 49). The approach is challenged by a perspective that recognises that the pervasive influence of human decision-making at all levels of the human-machine interface and impact on system interdependencies (Dekker, 2015, p. 36; Kristiansen, 2013, p. 364; Sachers, 1995, p. 160).

The interconnectedness of linear systems has been technologically enhanced to such an extent that occurrences cannot be verified within simple linear methods of analysis

(Luhmann, 1991, p. 99). Modern technical and industrial systems are highly automated and the need for human intervention in routine operations is minimal, reduced to the role of monitoring processes when necessary (Ramussen, 1979, p. 7). However, the functioning of the system still relies on human interaction to address and cope with exceptional, non-routine and unexpected conditions (Ramussen, 1979, p. 7).

The human actor previously used to "monitor and control" operations, has shifted to the management of the system functions (Strauch, 2017, p. 15). The required management of highly dynamic human-machine systems, referred to as "sociotechnical systems" [original emphasis] illustrates the implications of social and technical elements in an environment where accidents can have significant consequences for society (Strauch, 2017, p. 16). Perrow (1987) further argues, that the operation and management of sociotechnical systems has become so complex that failures should be accepted as “normal accidents” (Hollnagel, 2009, p. 7). According to Perrow (1987) , the implications of the "tight couplings" of system elements lead to greater efficiency, but also increase time dependency and their potential for multiple, dynamic interactions (Perrow, 1987, p. 131). The tight interdependence of system elements operates to limit variation and adhere to a defined logic (Perrow, 1987, p. 131). Thus, the human task and capability is employed to “monitor” the technical components, the so-called 'automatics' [original emphasis] according to an established protocol (Reason, 1997, p. 43). Luhmann (2018) explains that ensuring or improving the safety of a system also depends on its boundaries and the characteristics that distinguish it from its environment (Luhmann, 2018, p. 222). Hollnagel (2009) concurs that the perception and extent of a system depends on its structure, its function and its defined purpose, and suggests that a sociotechnical system involves “the intentional organisation or arrangement of parts (components, people, functions, subsystems) that makes it possible to achieve specified and required goals” and (Hollnagel, 2009, p. 19). The correct functioning and performance outcome therefore depends on the correct interaction between the human and technological components, which permeate all facets of the defined system (Hollnagel, 2009, p. 19).

The operation of a ship involves “complex” and “safety-critical” elements (Grech et al., 2008, p. 178) as well as “complicated technology” (Perrow, 1987, p. 268). This view emphasizes the abundance of ship components and the implications of tightly coupled systems (Perrow, 1987, p. 131). Efficient management is based on human knowledge, skills and competence to monitor and control technical elements in a dynamic decision-

making process and to form a safety culture as an integral aspect in the complex safety management (Kristiansen, 2013, p. 384). Both Grech et al. (2008) and Kristiansen (2013) translate the sociotechnical systems understanding to the maritime context by incorporating a holistic systems view, which can be based on the outlines of the “SHEL model” (Grech et al., 2008, p. 20; Kristiansen, 2013, p. 384). According to Grech et al. (2008) the key elements of the sociotechnical system ship are “individuals, practices, technologies, groups, physical environment, organisational environment, society and culture” (Grech et al., 2008, p. 24). The main elements and their association are as follows (Grech et al., 2008):

- “individual”: the shipboard operator (Grech et al., 2008, p. 24),
- “practice”: regulations defined in the legal and organizational framework, with an impact on reflective learning processes (Grech et al., 2008, p. 24),
- “technology”: the hardware and software of ship’s equipment, including design, functions and ergonomics (Grech et al., 2008, pp. 110–113),
- “organization, society, and culture”: embrace the micro-macro level view of the industry (Grech et al., 2008, p. 129).

The sociotechnical systems approach to ship operations examines the interrelationships of the human operator and the various elements and components within this dynamic context (Grech et al., 2008, p. 30), considering the individual and social behaviours, actions and their impact and interdependencies (Grech et al., 2008, p. 30). Grech et al. (2008) further explain that the interactions and behaviours and actions of individuals are conditioned by the circumstances, following hierarchies espoused with the applications of technology (Grech et al., 2008, p. 26). These relationships extend to organisational communication and compliance requirements (Grech et al., 2008, p. 57) which shape individual safety and risk perception (Grech et al., 2008, p. 59). Human performance is associated with “senses, perception, situation awareness, and decision making” and conditioned by the physical and mental state of seafarers (Grech et al., 2008, p. 58). For seafarers, this means that human behaviour, influenced by the physically and mentally demanding work and life, is conditioned by the perspective of the sociotechnical system ship (Grech et al., 2008, p. 57). While the application of the sociotechnical systems approach can be used to define and analyse the relationships, communication and actions involved, the understanding is based on cognitive processes and constraints and the permeability of the defined system needs to be assessed in the situational context (Grech et al., 2008, p. 32).

Shipboard work is efficiently organised through “machine-human interaction” (Grech et al., 2008, p. 19), task-oriented and time-dependent (Grech et al., 2008, p. 61), where the high workload is not sufficiently recognised (Grech et al., 2008, p. 72). The skills required to operate complex technology at the sharp end are inherent to human capabilities and limitations (Grech et al., 2008, p. 110). The physical aspects of design and ergonomics impact the operator’s task performance (Grech et al., 2008, p. 113). These include “over-reliance” on system functions and automation, the plethora of designs, models and equipment manufacturers and their software functioning, with the potential for poor skill application and operator complacency (Grech et al., 2008, p. 111). The abundance of technology, its functions and design characteristics render the overall technical equipment available as "complicated", which is considered a core aspect in the maritime environment (Grech et al., 2008, p. 113). Moreover, the variety of systems available and integrated into maritime operations requires extensive training in system functions and their skilful and efficient operation (Grech et al., 2008, p. 114). The functions of sophisticated technical systems are arguably designed to perform specific, programmed tasks, but may fall short when cognitive and adaptive problem-solving skills are required to respond to unforeseen or novel circumstances (Huntington, 1999ch. 14-2). Nevertheless, the design and functionality of the ship's technical equipment has become a crucial aspect in the maritime safety perspective, supporting the operator's dynamic working environment to achieve a desired safety status (Witolla et al., 2016, p. 1647).

The comprehensive sociotechnical systems approach needs to consider aspects of technology application, compliance and appropriate task performance and take into account the experience, skills and needs of system operators (International Association of Classification Societies, 2021). This entails to empower individual action, which permeates all levels of the maritime industry (International Association of Classification Societies, 2021). Dekker (2015) declares that, safety results from “people’s insights into the features of situations that demand certain actions and people being skilful at finding and using a variety of resources” (Dekker, 2015, p. 103). In addition, valuable knowledge from the industry, including aviation can be incorporated into the learning process to promote the human performance (Grech et al., 2008, p. 178), rather than the “task performance” (Grech et al., 2008, p. 160).

The established trainings in the maritime field have focused on the development of non-technical skills, communication, teamwork and leadership in the bridge resource management training, and moreover on the establishment of an organizational safety

culture (Grech et al., 2008, p. 176). However, the lack of integration of both technological and cognitive elements, and of the human operator's perspective in technology and design needs to be considered in systemic skills training (Grech et al., 2008, p. 176). As Reason (1997) explains, this poses a dilemma since complex and highly automated systems rarely require human intervention and therefore provide a minimum of training and learning opportunities, leaving the human in the role of a "deskilled" operator (Reason, 1997, p. 43).

The overall sociotechnical aspects of ship operation, including organisation, technology, working practices and the regulatory environment, are constantly changing, as are the dynamic contextual demands for the operator (International Association of Classification Societies, 2021). The characterisation of human error in the context of accidents, based on the application of various models and the collection of statistical data, still prevails, however limited the insights gained (Strauch, 2017, p. 32). This common approach fails to take into account the specific dynamics of the context (Strauch, 2017, p. 32) and serves to establish and maintain structures of power and control and as a measure for assigning responsibility for " unacceptable risk" (Hollnagel, 2009, p. 8) that shape human behaviour and actions (Dekker, 2012, p. 74). However, safety is developed through a social mindset that is the result of learning and a motivation to adapt (Rochlin, 1999, p. 1550). Improving safety in the face of sociotechnical complexity depends on the training and application of skills to act as needed, and the integration of comprehensive technical, human and organisational resources to support and enhance the competence on the sharp end (Dekker, 2015, p. 107).

5.9 Autonomous Shipping

The technological advances of the last decades have permeated various aspects of life, including the maritime industry and the design and operation of ships (Theotokatos et al., 2023, p. 6). The advancement of autonomous ship technology has become a core topic in the global maritime industry, with the aim of improving efficiency, sustainability, and safety in maritime transport, while incorporating aspects of the human element (Theotokatos et al., 2023, pp. 15–22).

The future developments in automated ship operations and the role of seafarers are driven and defined by the comprehensive global interests under the umbrella of the IMO and the expert input of the industry stakeholders (Küchle et al., 2022, p. 12).

The automation of seagoing ships, designated as "Maritime Autonomous Surface Ships (MASS)," is associated with varying degrees of technical system autonomy, which is further categorised into the following four stages according to the extent of human interaction involved (Küchle et al., 2022, p. 12):

1. Semi-Automated Ship: seafarers control, and monitor some automated processes;
2. Remote-Controlled Ship: seafarers assist the automation process;
3. Remote-Controlled Ship: no seafarers onboard;
4. Fully Autonomous Ship: all systems onboard function without human interaction.

The advances resulting from the changing characteristics of the operation of autonomous ships require adaptation to encompass the considerations arising from the operation in terms of legal aspects (International Relations and Defence Committee, 2022), and the implementation and impact of the evolving technologies and methodologies, as addressed by the International Maritime Organization in its "Revised Strategic Plan for the Organization for the six-year period 2018 to 2023" (International Maritime Organization, 2022). The implications for the safet operation and applicability on the overall legal framework are rooted in a pre-autonomous shipping era (Theotokatos et al., 2023, pp. 15–22). The approaches and concepts developed so far for the integration of autonomous systems have primarily been concerned with the technical aspects of the system functions (Küchle et al., 2022, p. 12). Further concerns for aspects of system complexity, inherent in system communication, responsibilities and liabilities of human contribution need yet to be defined, elaborated and translated into feasible solutions in the future of ship operations (Dekker, 2015; International Relations and Defence Committee, 2022; Srinivasan, 2022).

A recent study by Theotokatos et al. (2023) aims to identify maritime stakeholders' perspectives on concerns related to the evolution towards MASS (Theotokatos et al., 2023, pp. 15–22). The findings reveal that the evolution of autonomous shipping is widely recognised as a necessary step in the context of current and future technological developments and is expected to enhance environmental sustainability, operational safety and efficiency (Theotokatos et al., 2023, pp. 15–22). Nevertheless, concerns have been raised that the operation of MASS will entail a decrease of skilled seafarers, while simultaneously necessitating the provision of additional and specialised training and the development of such provisions in MET (Theotokatos et al., 2023, pp. 15–22).

Dekker (2015) critically explains that the integration and increasing dominance of technological solutions involves more profound changes than the substitution of human for technical components, but requires adjustments in the defined interdependencies of system elements (Dekker 2015, pp. 207-208). The idea of seamlessly substituting human work with automation, and consequently achieving greater safety and efficiency, is rooted in the Taylorist principle of linear division of tasks, which Dekker (2015) refers to as the "substitution myth" (Dekker, 2015, p. 207). Dekker (2015) additionally posits that this perspective on human-machine substitution fails to acknowledge the fact that automation alters tasks and gives rise to new system complexity (Dekker, 2015, pp. 207–208). Consequently, it becomes necessary to pursue transformation and adaptation of human practices and behaviour within the complex safety system management (Dekker, 2015, p. 207).

5.10 Resilience

Safety is often associated with the quantification and measurement of events deemed detrimental to an anticipated goal, and the subsequent reduction of undesirable events, referred to as ‘freedom from harm’ [original emphasis] (Hollnagel, 2018, p. 2). This suggests that organisational efforts to establish a safe working environment involve the complete elimination of risk, as reflected in the statistical results (Hollnagel, 2018, p. 3).

Ships are susceptible to environmental factors and the perils of the sea, which can evolve into unforeseen incidents or accidents as part of daily operations and safety management. Hollnagel (2018) elaborates on the concept of safety, highlighting that accidents are exceptional events and do not reflect the typical performance or daily working environment of an organisation (Hollnagel, 2018, p. 4), and further argues that a comprehensive understanding of safety cannot be achieved by evaluating isolated events and applying a linear cause-and-effect analysis (Hollnagel, 2018, p. 5).

This traditional view of achieving safety as a means of avoiding errors and failures and focusing on a measurable or predefined quantity is challenged by the concept of “resilience engineering” (Hollnagel, 2018, p. 7). This concept aims to understand the correct functioning of complex systems and to proactively improve safety by learning from daily activities and promoting adaptability to prevent incidents (Hollnagel, 2018, p. 7). The application of resilience perspectives as an approach to safety management focuses on an organisation's dynamic ability to anticipate, adapt and learn from

disruptions and failures (Hollnagel, 2018, p. 7). This approach is built on principles of “anticipation, comprehension, preparation, enhancement, and reflection of present performance”, including the analysis of the numerous variables relevant to the present and future context of a sociotechnical environment, as opposed to the conventional focus on a static condition and outcome (Hollnagel, 2018, p. 7). According to Hollnagel (2018) building resilience means “that an organisation can perform effectively in everyday condition”, recognising the dynamic interdependencies of system elements with the admission to anticipate future interferences (Hollnagel, 2018, p. 7). Furthermore, the core concept of a resilience system is that it is distinct from a static measure of "performance", rather, performance or outcomes should be regarded as "potentials," which are context-dependent measures that may vary with situations (Hollnagel, 2018, p. 16).

The four system potentials of resilience system performance are to “respond” “monitor”, “learn” and “anticipate” (Hollnagel, 2018, pp. 26–27). This describes a system behaviour that “can sustain required operations under both expected and unexpected conditions by adjusting its functioning prior to, during, or following events (changes, disturbances, and opportunities)” (Hollnagel, 2016). The four “potentials for resilient performance” include (Hollnagel, 2016):

1. “the potential to respond”: the capacity to act in routine and exceptional circumstances;
2. “the potential to monitor”: the ability to make sense of a situation based on available knowledge and information, and considering external factors;
3. “the potential to learn”: the capacity to retrieve pertinent insights and to transform them into knowledge;
4. “the potential to anticipate”: the capacity to predict and adapt to the existing system requirements.

Hollnagel (2018) posits that the four potential solutions are proposed options that can be integrated into established system analysis, rendering them applicable to both routine and exceptional situations and contexts (Hollnagel, 2018, p. 47). The adaptations should incorporate new knowledge and insights (Hollnagel, 2018, p. 48), in order to facilitate a continuous and flexible learning process, contingent upon the incorporation of the potential to learn and respond, which is perpetuated and enforced by the incorporation

of new knowledge and insights (Hollnagel, 2018, p. 49). Effective communication is an essential aspect for conveying information in any system or context, including the learning process, thus communication is not considered a specific potential of an organisation's resilient performance (Hollnagel, 2018, p. 48). Nevertheless, it is essential to promote trust and open communication lines in order to identify potential opportunities within the complex system dynamics and to encourage a learning approach, which in turn will facilitate active participation across organisational levels (Dekker, 2015). The performance of individuals, what is understood as the actual “practice” and established norm in a work environment, is defined and constrained by economic demands and legal compliance (Dekker, 2015, p. 112). In this context, the application of a resilience perspective suggests that compliance and adherence to procedures are not the sole measure applied, as arguably “procedures are not the job” (Dekker, 2015, p. 103). Rather than being viewed as constraints, regulations and "checklists" should be regarded as adaptable aids, enabling the implementation of flexible adjustments to situations and decisions that extend beyond the prescribed standards (Dekker, 2015, p. 103).

A comprehensive, thus resilient understanding of the system's interactions cannot derive from the isolated examination of the individual components (Hollnagel, 2018, p. 128), but rather requires a thorough understanding of the entires system's functioning (Hollnagel, 2018, p. 91). Common organisational safety concepts, ranging from “simple flow chart models” to comprehensive models (Hollnagel, 2018, p. 91), are derived from process reviews that identify linear relationships across horizontal and vertical dimensions of functions and associated responsibilities and performance (Kristiansen, 2013, p. 364). However, the evaluation of a system’s performance necessitates the formulation of a measure for a specific “condition” achieved, and defined as a measure of “quality, safety, productivity, satisfaction” (Hollnagel, 2018, p. 91). The assessment of this condition or measure does not provide an absolute value; rather, it may represent an individual perception related to the individual and particular involvement (Hollnagel, 2018, p. 128). This comprehension challenges the traditional views of an established "safety culture", which associates responsibilities of actors and functions with a measure of safe performance and compliance (Hollnagel, 2018, p. 92). The integration of resilience potentials in safety presents both opportunities and challenges related to the acknowledgement and appreciation of the inherent dynamic interdependencies and their potential to understand, adapt and improve system performance (Hollnagel, 2018, p. 92).

5.11 Coleman’s Bathtub

The interaction between individuals, observed at the micro-level, and the broader social structures that represent the macro-level, represents a fundamental study of the dynamics of social developments in the micro-macro perspective. The classical sociologists, Émile Durkheim and Max Weber, stimulated and influenced the thinking of the work of James Coleman, who increasingly embraced methodological individualism (Ritzer, 2011, p. 445). The theory of methodological individualism posits that phenomena occurring on the macro-level must be considered and understood in the context of individual actions on the micro-level (Hirschle, 2015, p. 22). Coleman's approach to the understanding of social systems is to explain social phenomena at both the micro- and macro-levels of society (Ritzer, 2011, p. 224), rather than isolated actions and individual behaviour (Coleman, 1990, p. 2). Coleman’s concept of social developments and interdependencies is based on Max Weber's thesis on Protestantism (Voss, 2017, p. 224), which explains the correlation between religious ethics beliefs and the expansion of capitalism (Coleman, 1990, p. 6).

Coleman's sociological research was motivated by scientific and mathematical motivation, as well as the development of a socio-technological conceptual framework (Braun & Voss, 2014, p. 103), concerned with the explanation of empirical sociological questions and elaboration of models (Braun and Voss, 2014, p. 110). A system is comprised of actors whose behaviour is the result of an aggregate of interdependent actions, and which constitute the system (Coleman, 2000, p. 58). The behaviour of individuals or corporate actors is attributed as a system element, rather than being equated with common behaviour (Coleman, 2000, p. 58). Coleman (2000) argues that the purposeful actions of individuals can lead to the emergence of a collective system behaviour, which is influenced by the constraints within the system (Coleman, 2000, pp. 58–59). This theory of social systems attempts to explain the causal relationships between the interconnected elements of a system and to provide an understanding of the recurring equilibria (Coleman, 2000, p. 59). The theory considers changes at both the micro and macro levels of a system (Coleman, 2000, p. 68) and reflects on macrosocial systems and their relationship with other levels (Coleman, 2000, p. 70).

The elaboration of a micro-macro model, initially depicted as a linear dependency with a sole macro-level system view was subsequently enhanced into an exemplified bathtub espousing the dynamics of micro-to-macro level social theory (Coleman, 1990, p. 8).

The theory of Coleman's social theory defines actors, resources, interests and the exchange of control or power as system elements (Voss, 2017, pp. 225–226):

- **actors***,* are individuals, or corporate entities such as groups or organizations that are recognized as independent actors, and possess the right to act and control events or resources;
- **resources***,* are defined as goods or services that are controlled and can be divided within social relationships;
- **interests,** describe the motivations of actors in events or resources, driven by the pursuit of the realization of those interests, and
- **the exchange of control**, which can lead to a new equilibrium in the system and to an improvement in the situation of the actors involved.

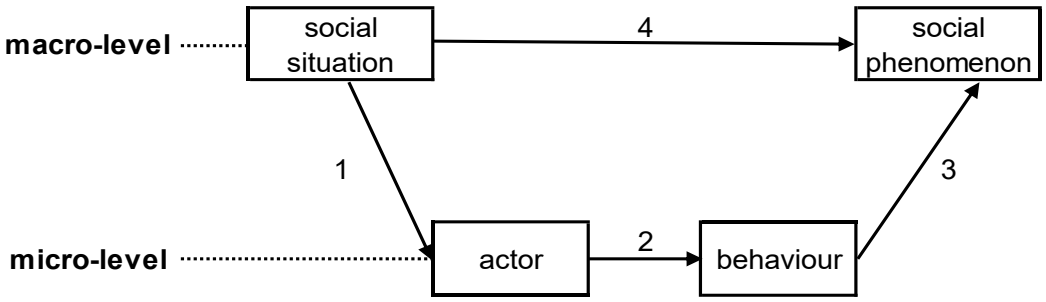

Figure 7: Micro-macro Model (adopted after Hirschle, 2015, p. 20)

Figure 7 illustrates the micro-macro level system and its inherent interdependencies. The initial societal macro-level situation is proposed as a catalyst for individual actors' behaviour, which affects the macro level, where change is driven by a common interest and based on the effort at the individual level, resulting in societal change (Coleman, 1990, pp. 8–9).

In accordance with Coleman's conceptualisation of macro-level dynamics resulting from the aggregation of behaviour and action at the micro-level, an illustrative brief outline is provided in the context of applying a comprehensive understanding of safety in relation to the establishment of working conditions and the human element in the maritime safety system, linked to the previous chapter. The elements of the system that correlate with Coleman's bathtub are as follows: a social situation, namely the condition of unsafe overloading of ships with the resultant accidents and losses of life and property; the

protests of workers and the actions of organisations; and the formulation of rules entailing the adaptation of the safety concept at the macro level. The social context at the macro level in relation to maritime safety and the working conditions of seafarers in the late nineteenth and early twentieth centuries demonstrates a lack of concern for the safe operation of ships and the wellbeing of those employed. In the pursuit of profit, investment in safety measures is often overlooked, with examples including the maximum allowable loading capacity of ships and the care for crew wages and working hours (Parsons and Allen, 2018, p. 19). The social situation is exemplified by major accidents with significant loss of life and property, which served to raise awareness of worker safety and the general perception of safety in the maritime industry. The standards of safety in ship operation are subject to public scrutiny, with the involvement of political interests, business organisations and labour initiatives. The actors, including seafarers and dockworkers, appear to lack the capacity to improve their working conditions and to enforce labour rights (Crandall et al., 2014, p. 266). The actors interested in the establishment of a safety system and the control of power and resources include individuals and organisations such as ship insurers, classification societies and individual workers. As a social phenomenon, the behaviour of seafarers includes protests and strikes to address the safety and risks associated with the profession and thus to protect the economic interests of the property. This behaviour subsequently gives rise to the formation of trade unions in support of workers' rights (Crandall et al., 2014, p. 266; Geffken, 1988, p. 32), as well as the call for the establishment of standardised safety measures by insurance companies and ship management organisations. The social phenomenon at the macro level is introduced in the concept of safety and risk, which is laid down in requirements for shipbuilding standards, personal safety equipment, minimum safe working conditions, workers' rights and regulations, and the framework of MET, under the auspices of UNLOS, IMO, and ILO.

6 The Development of Knowledge

Böhme and Stehr (1986) argue that knowledge is a fundamental and consistent aspect of human societies (Böhme and Stehr, 1986, pp. 8–9). Across epochs, the acquisition and containment of knowledge have been shaped by prevailing social paradigms, their governing principles, and recognized limitations (Schülein and Reitze, 2005, p. 238). Given its omnipresence and function "one could justifiably speak of an anthropological

constant: human action is knowledge based" (Böhme and Stehr, 1986, pp. 8–9). The interrelations and dependencies among different types of knowledge resources are crucial in order to understand the role of knowledge in the establishment of power structures in societies (Böhme and Stehr, 1986, p. 9). Consequently, the process of knowledge acquisition has become a crucial aspect of modern societies (Schülein and Reitze, 2005, p. 238), exerting a profound influence on human behaviour and the advancement of social processes (Böhme and Stehr, 1986, p. 8). The evolution of technology and the division of labour have transformed knowledge into a primary catalyst for enhancing efficiency and productivity (Schülein and Reitze, 2005, p. 239).

The process of transformation from conservative structures and traditional methods of knowledge containment towards the increased technological integration and specialisation also necessitates the development of specialised competencies (Schülein and Reitze, 2005, p. 239). Consequently, individuals substantially need to apply scientific knowledge in production processes to reinforce the relation between science and practical application (Schülein and Reitze, 2005, p. 240). Accordingly, (Böhme and Stehr, 1986, p. 8) posit that “contemporary society may be described as a knowledge society based on the penetration of all its spheres of life by scientific knowledge” (Böhme and Stehr, 1986, p. 8), characterising the interdependence of specialisation with the dynamic processes of knowledge exchange (Schülein and Reitze, 2005, p. 241).

6.1 Sociological Knowledge

The emergence of sociology represents a profound societal transformation, from the dominance of clerical and military structures towards an era increasingly focused on materialistic and economic aspects (Kruse, 2012, p. 35). The foundations of sociology were established during the Enlightenment era, as secularism began to gain traction (Henecka, 2009, p. 44). In particular, following the French Revolution, scientific development concentrated on the individual consciousness and thought processes, which exerted a pervasive influence on the educational system (Keller, 2011, p. 25). This is in line with Weber’s (1947) definition of sociology as “a science which attempts the interpretive understanding of social action in order thereby to arrive at a casual explanation of its course and effects” (Weber, 1947, p. 94).

The application of sociology as a science is based on the work of August Comte (Kruse, 2012, p. 17). Comte's thoughts on the denomination of *social physics* [original emphasis] (Ritzer, 2011, p. 15) were derived from the natural sciences with the intention of differentiating the science of society from other established natural sciences, such as biology and physics (Elias, 2006, p. 45). The objective was to examine and develop social laws (Elias, 2006, p. 18), as well as to systematize, organize, and structure science (Elias, 2006, p. 45). The focus is on the individual situated within a generational and local context, where knowledge is a product of the social context rather than the individual assumed to be a subject of knowledge (Elias, 2006, p. 46). Comte established sociology as a scientific discipline founded on the methods of “observation, experimentation and comparative historical analysis” (Ritzer, 2011, p. 18) in the pursuit of societal change (Ritzer, 2011, p. 18). These views significantly influenced later sociologists, including Emile Durkheim (Ritzer, 2011, p. 15). Classical thinkers such as Max Weber, Georg Simmel, and Emile Durkheim employed a range of methodologies, including experience, observation, systematic comparison, and experimentation, to examine contemporary issues such as poverty, capitalism, and economic development (Henecka, 2009, p. 58). Early German sociological developments were shaped by Georg Simmel, Max Scheler and especially by Max Weber (Knoblauch, 2010, p. 78), whose work includes both historical and theoretical aspects of sociology (Ritzer, 2011, p. 156). Further sociological developments were shaped by the ideas of Hegel, Feuerbach and Marx (Ritzer, 2011, p. 23), who are considered to have had a greater influence on political and sociological developments than the classical sociologists (Henecka, 2009, p. 51). Marx's explorations of social and economic structures were dominated by the ideas of idealism and ideology (Knoblauch, 2010, p. 50). The concept of capitalism emphasises the importance of belonging to a social class in shaping the consciousness of individuals and groups as well as their ideologies and behaviours conditioned by constructs of authority in societies (Knoblauch, 2010, p. 51). Authority in this sense refers to the control of the means of production and the enforcement and shaping of evolving ideas in society (Knoblauch, 2010, p. 51). Ideology is defined as a product of social consciousness that evolves through social interactions and shapes behaviour and action across all social classes, regardless of socioeconomic status (Knoblauch, 2010, p. 52).

Influenced by Hegel, Marx challenged the traditional “linear, cause-and-effect” thinking and argued for reciprocal, circular processes driven by idealism and ideology (Ritzer, 2011, p. 18). The ideology of socialism and the division of labour, as well as the

importance of social bonds as the basis of relationships and the role of collective behaviour in maintaining social order, shaped the work of Emile Durkheim (Ritzer, 2011, p. 97). Durkheim, who was installed as the first professor of sociology at the University of Bordeaux and later at the Sorbonne University in Paris (Henecka, 2009, p. 63), recognised the need for social reform (Ritzer, 2011, p. 19). In contrast to Marx's revolutionary pursuit (Ritzer, 2011, p. 18), he considered long-term developments in society rather than disruptive upheavals (Ritzer, 2011, p. 87) and disseminated sociological ideas to a wider audience in public journal publications (Ritzer, 2011, p. 21). During this time, the differentiation and specialisation of the workforce continued to evolve, leading to an increased emphasis on efficiency and the establishment of control and authority structures (Knoblauch, 2010, p. 70).

According to Durkheim's perspective, knowledge is the result of a social collective process absorbed by the individual (Knoblauch, 2010, p. 70), and consequently knowledge reflects the structures and conditions of societies (Knoblauch, 2010, p. 71). Sociological considerations shifted from a mere philosophical discourse to a more structured and empirical research (Ritzer, 2011, p. 77), investigating “material and non-material social facts” (Ritzer, 2011, p. 79) which include “rules, norms and values”, and attempts to explain societal structures and interrelationships (Ritzer, 2011, p. 77) of “collective consciousness” (Ritzer, 2011, p. 81). Durkheim's work includes studies of religious and moral aspects, labour and suicide, all of which relate to the notion of social “health” [original emphasis] (Ritzer, 2011, p. 80). In Durkheim’s conceptualisation, the classroom environment functions at the core of a “small society” that affects attitudes and shapes collective behaviour (Ritzer, 2011, p. 106).

Max Weber associated the ideas of the humanities and the natural sciences by establishing the field of interpretive sociology, which he called “Verstehende Soziologie” [original emphasis] (Henecka, 2009, p. 59). This concept encompasses the objective of comprehending the individual's consciousness and motivation for action (Henecka, 2009, p. 60), and to provide an explanation as the foundation for the generation of knowledge (Knoblauch, 2010, p. 84). Consequently, an understanding of the processes involved in the construction of meaning is essential for an understanding of the conditions for individual action (Knoblauch, 2010, p. 85). Weber's theories emphasise the influence of ideas, including religious forces, in shaping and explaining material forces (Ritzer, 2011, p. 27). In contrast to Marx, who attributed social forces to materialism (Ritzer, 2011, p. 23), Weber believed that ideas determine material interests and shape the

environment, emphasising the significant role of ideology (Ritzer, 2011, p. 27). Weber made significant contributions to the understanding of modern organizations through his analysis of the characteristics of bureaucracy, including hierarchy, specialization, rules, and their impact on social life (Ritzer, 2011, p. 115). He introduced the concept of “verstehen”, the understanding (Ritzer, 2011, p. 116), emphasising the importance of the subjective meanings and motivations behind human actions, while emphasising on the distinctions between action and behaviour (Ritzer, 2011, p. 126). Weber's work in understanding social phenomena is based on a structured, sociological analysis at the individual level, which serve as a basis for examining how individual actions collectively shape society (Ritzer, 2011, p. 117). The ideas of Weber were consequently incorporated in the work of the Hungarian born sociologist Karl Mannheim, who significantly contributed to the development of contemporary sociological knowledge (Ritzer, 2011, p. 213). Mannheim aimed to comprehend the impact of societal factors in the creation and interpretation of knowledge (Kruse, 2012, p. 192), and explored the evolution of social context from individual perspectives and from ideas to ideologies (Kruse, 2012, p. 193).

Elias (2003) posits, that the contemplation of social development in terms of historical linear causality represents a significant impediment to the comprehension of social processes and developments (Elias, 2003, p. 37). Any attempt to comprehend or explain developments must acknowledge that unpredictable inherent processes and conflicts result in changes that are not predetermined by coherent factors (Treibel, 2008, p. 74). The advancement of knowledge at the micro-macro level is frequently the consequence of the unintended individual actions, despite the limited control that individuals have over subsequent events (Treibel, 2008, p. 74), however affect the development of specialised knowledge, functions, and professions pervasive in all areas of social life (Elias, 2007, p. 39). Cultivating and advancing sociological knowledge through teaching and research involves understanding of social frameworks, delineating the intricacies of power dynamics that influence cognition and communication, and adapting knowledge to contextual needs (Elias, 2006, pp. 19–20). Elias (2006) refers to the inherent interdependencies in society as "figurations" (Elias, 2006, p. 22). This understanding posits that the various processes are significantly shaped by the interactions and relationships between individuals (Kahlert, 2009, p. 263), and lead to dynamic processes of individual and collective adaptation and transformation in society (Treibel, 2008, p. 17).

Thus, sociological knowledge seeks to understand and explain the implications of the ongoing changes within society and their complex interrelationships in the micro-macro perspective (Henecka, 2009, pp. 34–66). The "understanding of social action in order thereby to arrive at a casual explanation of its course and effects" (Weber, 1947, p. 94) must consider individual and collective actions in shaping social transformations in the context of the wider societal environment (Henecka, 2009, p. 34).

6.2 Scientific Knowledge

The concept of "knowledge" has become the key driver of social wealth, founded in complex historical, spatial, economic, professional, and social developments within societies (North and Kumta, 2018, p. 2). The advancement of sociological and scientific knowledge has been an inextricable and perpetual force, evidenced by the economic and societal dynamics of social change (Knoblauch, 2010, p. 69). The transition from an industrial society to a knowledge society has resulted in a redefinition of knowledge as a valuable resource and the primary economic impetus (Willke, 2011, p. 36). Knowledge accumulation is a social process that takes place within a specific environmental context and is associated with derived "meaning" (Wenger, 1998, p. 4).

Wilke (2011) posits that the advancement of knowledge is predicated on the following tenets (Willke, 2011, p. 37):

- data is the raw material for all knowledge,
- information is processed into relevant data, and
- knowledge is the result of processed data through practical application.

Consequently, all knowledge is contingent upon practical experience, which is derived from the application of contextual meaning, involving both "tacit" or "explicit" knowledge and processes (North and Kumta, 2018, p. 36). The distinction between tacit and explicit knowledge has derived from the work of Michael Polanyi, who proposed that individuals possess implicit knowledge through experience and practice, even if they are not aware of it (Willke, 2011, p. 43). Explicit knowledge is defined as knowledge that is articulated, formulated, and documented, thereby making it commonly available (Willke, 2011, p. 44). The transition from implicit to explicit knowledge is a crucial process that occurs in various contexts and environments, including those involving teachers, students, and employees in organisations (Willke, 2011, p. 44). This process is contingent upon the

capacity of individuals to articulate and document their implicit knowledge in a manner that renders it accessible (Willke, 2011, p. 44).

North and Kumta's (2018) "knowledge ladder", see Figure 8, illustrates the progress, interdependencies and levels of knowledge management (North and Kumta, 2018, p. 35).

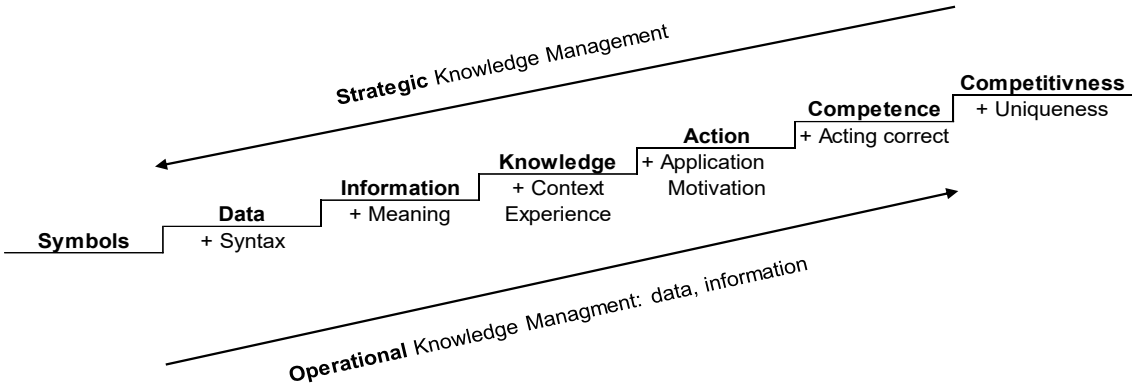

Figure 8: The knowledge ladder (adapted after North and Kumta, 2018, p. 35)

An understanding of the various levels of the ladder, which range from symbolic representation to competitiveness, is essential for the development of proficient knowledge management (North and Kumta, 2018, p. 34). Symbols, such as numbers, speech, and images, represent basic concepts of knowledge acquisition (Danesi and Perron, 1999, p. 46). Symbols convey information through an associated meaning and context, known as 'syntax', which then becomes data (North and Kumta, 2018, p. 34). To convert "symbols" into meaningful "data" and hence understand their significance, relevant tools or equipment may be necessary (Willke, 2011, p. 37). The "information" obtained also depends on the individual's perception of the relevance of the available data (Willke, 2011, p. 40). Thus, "knowledge" is relevant to experience and the context (Willke, 2011, p. 40). The following "action" is based on the understanding of "what" [original emphasis] and reasons for "why" [original emphasis] a relevant information is gained, and to consequently make knowledgeable decisions and to solve problems effectively (North and Kumta, 2018, p. 36). Bainbridge (2021) explains that skills are "the efficient use of appropriate behaviour which develops with experience", hence incorporate the successful application of knowledge, resulting in skilled, observable behaviour (Bainbridge, 2021) and the willingness to act appropriately to complete a task

successfully (North and Kumta, 2018, p. 36). “Competence” is defined by North and Kumta (2018) as “the right choice of knowledge at the right moment” (North and Kumta, 2018, p. 37), thus describes an individual ability to apply the knowledge and skills needed in a situation, based on the comprehensive application of acquired knowledge and experiences made, as the further prerequisite for “competitiveness” (North and Kumta, 2018, p. 37). Competitiveness is the ability and motivation to effectively share knowledge in a strategic process (North and Kumta, 2018, p. 38) through the engagement in research initiatives and the subsequent dissemination of knowledge at all stages of the process (Sames and Köpke, 2012, p. 11).

Essentially, effective knowledge management facilitates the creation, sharing and utilisation of knowledge within individuals, teams and organisations, thereby enhancing operational efficiency, innovation and a competitive advantage (North and Kumta, 2018, p. 10). The objective of translating information into measurable goals is contingent upon the dissemination of information and knowledge in an appropriate manner and the implementation of a flexible learning process that aligns with current needs and requirements (North and Kumta, 2018, p. 10). Subsequently, effective knowledge management is the foundation for achieving sustainable competitiveness and establishing power structures in society through the continuous transformation of the knowledge society (Willke, 2011, p. 36).

6.3 Nautical Knowledge, Skills and Competence

In the context of MET, competence is evaluated and based on the demonstration of effective knowledge (International Maritime Organization, 2017b, p. 59). In essence, competence-based education and training is the combination of knowledge, skills and attitudes based on an educational framework structure (Schaperunter, 2012, p. 28).

The concept of designing a competency-based curriculum has been a widely applied principle in the international academic landscape since the 1970s, originating from the Anglo-Saxon system (Schaperunter, 2012, p. 31). The aim is to develop professional skills and to promote the “employability” [original emphasis] of graduates (Schaperunter, 2012, p. 32). The development and assessment of a graduate's professional skill portfolio is typically achieved through expert input and industry feedback (Schaperunter, 2012, p. 32). The competency-based framework has been adapted to allow for national

or regional variations, and subsequently “in German-speaking countries”, competencies are denominated as: “*Fachkompetenz”* [original emphasis]*, “Methodenkompetenz”* [original emphasis]*, “Personalkompetenz”* [original emphasis] and *“Sozialkompetenz”* [original emphasis] (European Commission, 2008, p. 5). The German framework incorporates subject-specific, domain-combining, and generic competencies into these four categories in the university curriculum design (Schaperunter, 2012, p. 27). These competencies are related to the determined learning outcomes, which include problem-solving as a discipline of “Fachkompetenz”, the application of learning and working techniques as a discipline “Methodenkompetenz”, social interaction, teamwork, and communication as a discipline of “Sozialkompetenz” and individual capabilities in decision-making and self-organized learning concepts as a discipline of “Personalkompetenz” (Heyse, 2010b, p. 62). The structuring of key competences, which are considered crucial for professional, social, and personal development, involves the integration of methodological, social, and personal competences (Schaperunter, 2012, p. 28). However, these categories and levels can be interpreted and applied flexibly to assess competencies and learning outcomes in the curriculum (Schaperunter, 2012, p. 28).

The MET competency-based approach adheres to the European Qualifications Framework (EQF) as a valid method for defining, structuring, and categorising the quantification and qualification of learning outcomes (European Commission, 2008, p. 3; Heyse, 2010b, p. 63). The subject modules assess the students' individual ability to demonstrate the knowledge, skills, and competencies they have achieved, using “Bloom's Taxonomy” (International Maritime Organization, 2017b, p. 59; Kalnina and Priednieks, 2017, p. 141), which was first published in 1956 as “Taxonomy of Educational Objectives”, with the aim of structuring cognitive learning objectives through the concept of a classification system (Bloom, 1956, p. 18). The category system is organized in six domains, including “knowledge, comprehension, application, analysis, and synthesis” and later revised by Krathwohl (2002) in categorical hierarchies and sub-categories utilizing verbal terms such as “remember, understand, apply, analyse, evaluate, create” (Krathwohl, 2002, p. 215). These taxonomy terms are integrated into the German higher MET curricula, and the learning outcomes are linked to the qualification objectives of the nautical profession (Hochschule Emden/Leer, 2023b; International Maritime Organization, 2017b, p. 59). The curriculum of the MET aligns with the “outcome-based” assessment of competencies and skills in accordance with the STCW framework (International Maritime Organization, 2014a, p. 3, 2017b, p. 59;

Kalnina and Priednieks, 2017, p. 140). Competency, according to STCW 78 and the STCW Code is defined as “the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner” (International Maritime Organization, 2014b, p. 43). The successful and appropriate application of knowledge in a contextual manner is the outcome of training and serves as the foundation for the assessment of competence (International Maritime Organization, 2014a, p. 44).

Therefore, competency-based training and assessment in MET refers to individual behaviours required to perform work safely and effectively, assessed against a specified standard (International Maritime Organization, 2014a, p. 3). The necessity to assess the level of performance in tasks within the operational context of navigation and ship operations encompasses a wide range of activities, from the performance of watchkeeping duties on the bridge to the handling of cargo and the implementation of emergency response procedures (International Maritime Organization, 2014a, p. 41). The various tasks are further subdivided into the three major functions of “navigation, cargo handling and stowage, and controlling the operation of the ship and care for persons on board”, reflected in the requirements of the STCW Code (International Maritime Organization, 2014a). Furthermore, the International Maritime Organization (2014a) states that the actions of an individual certified as competent through a successful “competency-based training and assessment system” include the ability to act in accordance with the role or 'rank' held in the day-to-day work environment (International Maritime Organization, 2014a, p. 3). The exemplary process of achieving the desired outcome in terms of competence in nautical leadership and teamwork involves the extraction of raw data from legal frameworks and human resource management, followed by its adaptation to the specifics of workload and fatigue, and the adaptation and contextualisation of appropriate human resource coordination (International Maritime Organization, 2014a, p. 23). The ability to effectively apply theoretical knowledge is demonstrated through the acquisition of information, subsequent communication to and with the crew, and the correct application in observable practices and behaviours, as outlined in Table A-II/1 of the STCW Code (International Maritime Organization, 2014a, 2017a).

However, Smith and Hancock (1995) argue, that “competence directs behaviour but is independent of the situation” (Smith and Hancock, 1995, p. 140). As such, applying knowledge and skills enables the actor to perform a task as required in the context (Smith

and Hancock, 1995, p. 140), provided that “performance is action situated in the world, a momentary phenomenon that is guided by competence but must be distinguished from it” (Smith and Hancock, 1995, p. 140). Consequently, the application of foundational knowledge and the practice of skills serve to enhance the processing and analysis of information, and facilitate sense-making and decision-making, particularly in unfamiliar or emergency situations (Strauch, 2017, p. 241).

7 The Process of Learning

Humans are engaged in a constant process of learning, whether consciously or unconsciously, in order to adapt to their environment and its challenges (Herold and Herold, 2011, p. 43). Consequently, the individual employs cognitive processes in a self-organised, reciprocal interaction with the environment, which is a matter of survival and effectiveness (Herold and Herold, 2011, p. 43). In contrast to the developments that occurred following the Industrial Revolution during the 19th century, contemporary advancements in society and technology evolve at a rapid pace and affect numerous operations and functions simultaneously (Drucker, 2014, p. 336). This understanding subsequently necessitates a continuous and accelerated learning process to enable the adaptation of fundamental assumptions and change of mindsets (Drucker, 2014, pp. 109–110). The process of learning is employed as a holistic concept across a range of disciplines, including pedagogy, sociology, psychology, anthropology (Wenger, 1998, p. 12) and various interdisciplinary approaches (Herold and Herold, 2011, p. 25). Furthermore, the contemporary knowledge society is predicated on the concept of the educated individual, in an interdependence to the global nature of the economy, trade, finance and, above all, knowledge and information (Drucker, 2014, p. 336). The efficacy of the knowledge worker is contingent upon their capacity to perform specific tasks in alignment with the complexity of activities within a work environment (Drucker, 2014, p. 252). This capacity is fundamentally dependent upon the application of interpersonal skills, such as communication, teamwork and self-development (Drucker, 2014, p. 229). However, according to Drucker (2014) these skills are often applied ineffectively (Drucker, 2014, p. 229).

The reason for this inability can be attributed to the historically established emphasis on efficiency, on increasing productivity, on doing things ‘the right way’ and in a quantifiable way, also perceived as quality, rather than ‘doing what is right’ (Drucker, 2014, p. 230).

In the contemporary era, however, an individual's "career" may involve a multitude of professional trajectories, where the significance of the knowledge acquired during their educational pursuits is subject to significant change (Drucker, 2014, p. 375). Drucker (2014) posits that an individual's educational attainment is correlated with their willingness to confront and adapt to the evolving demands of the worklife (Drucker, 2014, p. 375). This implies that individuals have to integrate diversity into their work practices with the objective of enhancing effectiveness and accommodating the complexities of a dynamic context (Drucker, 2014, p. 244), based on distinct methods for continuous learning (Drucker, 2014, p. 261).

7.1 Learning as a Social Responsibility

From a global perspective, the concept of lifelong learning, derived from the guidelines established by the UNESCO Institute for Lifelong Learning over seven decades ago, is seen as a social responsibility to equip the future workforce at regional, national and global levels (Baril, 2023, p. 2). Lifelong learning promotes economic prosperity at both individual and collective levels in a dynamic context (Atchoarena, 2023, p. 3). The strategies aim to create learning opportunities that are inclusive, flexible, and accessible (UNESCO Institute for Lifelong Learning, 2023, p. 21), and moreover acknowledge the shortage of skilled educators and the support needed to establish learning programmes (UNESCO Institute for Lifelong Learning, 2023, p. 27). Learning, and in particular the process of lifelong learning, has become a pervasive principle of the knowledge society, seen as a prerequisite for personal development and “employability” (European Commission, 2008), thus, bridging the relationship between education and continuous development of skills and adaptation to the evolving demands of work and life (Drucker, 2014, p. 230). A continued focus on skills development enables societal resilience and adaptation to technological advances, while preparing for the educational needs of the next generation from a social and professional perspective (Schwab, 2018, p. 1). This also recognises that all life contexts are affected by learning (UNESCO, 2021, p. 4). Global institutions, workplace organisations, universities and individual private environments all require a comprehensive and sustainable social infrastructure to enable a learning process (Wenger, 1998, p. 225). The different environments need to embrace different forms and approaches to learning, including formal, informal, structured and experimental, and recognise the importance of individual personal growth through

practice and skill development (Wenger, 1998, p. 225), which are “designed” as the “systematic, planned, and reflexive colonization of time and space in the service of an undertaking” (Wenger, 1998, p. 228). Education is distinct from learning, and is understood as “a formal mechanism for acquiring skills and knowledge” (World Economic Forum, 2018, p. 22). However, UNESCO (2021) emphasises that the efforts of “higher education […] can equip learners with the values, attitudes, knowledge, skills and motivation to engage in society [..] and build a stronger presence in society through proactive engagement” (UNESCO, 2021, p. 45). This confirms that the process of lifelong learning is an inherent process of society, beyond the formal approaches of education, and permeates the micro-macro levels in horizontal and vertical perspectives, influencing the change of mindset and adaptation to societal changes (UNESCO, 2021, p. 4).

The Bologna Process represents a European strategy for lifelong learning and personal development (Bredl et al., 2018, p. 1), incorporating strategies for the harmonisation of national and European higher education systems (Bredl et al., 2018, p. 1). The Bologna Declaration, which initiated the Bologna Process within the European Higher Education Area, established the system of comparable academic degrees, including Bachelor's and Master's degrees, and facilitated the validation of degrees through the European Credit Transfer and Accumulation System (ECTS) (German Rectors’ Conference, 2013). The concept focuses on the adaptation of education for the knowledge society in a learner-centred approach and the transformation of higher education towards the knowledge society (Bredl et al., 2018, p. 1), while promoting the mobility of both students and academic staff between higher education institutions in Europe (Federal Ministry of Education and Research, n.d.). It represents a collaborative learning environment that reflects the increasing interconnectedness of global processes and their impact on personal and societal growth (Eurydice, 2018, p. 50). The transition from an institutional orientation to a learner-centred approach (European Commission, 2008), has led to a wider recognition of different forms of learning processes and contexts, including informal, self-directed, formal and non-formal method (Schrader and Berzbach, 2006, p. 10). Both individuals and organisations learn through interactions and in the context of their environment and its elements, functioning as self-organised and reflective systems (Herold and Herold, 2011, p. 40).

Within an organisation, learning is typically seen as a function of delivering specific content (Wenger, 1998, p. 249). There, training and learning programmes typically

prioritise the enhancement of economic growth, performance, motivation, quality, or other identified ‘problems’ within an organisation, however mainly fail to consider the individual needs of the participants (Messer, 2019, p. 14). The conventional approach to learning and training, which is commonly used in the initial training of newcomers, tends to neglect the potential for reflection and integration within the learning process, and consequently does not deliver the anticipated impact (Wenger, 1998, p. 249). The primary objective of this educational initiative is to ensure that all members of an organisation adhere to the established norms and organisational value system, thereby complying with policies (Schein, 2004, p. 26). Organisations are responsible for the structuring of processes that enable individuals to acquire and possess the critical skills related to their work, and to ensure that they can apply these skills effectively (Drucker, 2014, p. 240). Nevertheless, it is not feasible to compel individuals to fulfill the requisite performance standards set by the organization through the imposition of more rigorous standards and punitive measures (Drucker, 2014, p. 240). Instead, it is essential to integrate individual perspectives (Manuel, 2017, p. 65). Wenger (1998) posits that in order to achieve comprehensive organisational development, initiatives must be both complementary and integrative (Wenger, 1998, p. 249). The objective of learning and training is to fulfil the compliance requirements of the organisation while also enabling active engagement of participants and newcomers (Wenger, 1998, p. 249). Consequently, a learning organisation must endeavour to maintain a continuous engagement with the dynamics of its environment and to adapt to the context as a learning opportunity, with the objective of enhancing its economic strengths (Schneider et al., 2007, p. 209).

Wenger (1998) proposes an integrative approach to organisational learning, advocating for the following (Wenger, 1998, p. 249):

- encouraging active engagement from trainees within the organisation.
- emphasising learning and practice over teaching.
- integrating the input of the trainees into the development of training programmes.
- establishing a communication structure to enhance negotiation and connectivity.

Argyris (2002) defines learning in an organizational context as 'the detection and correction of error' (Argyris, 2002, p. 206). This definition emphasises the importance of identifying weaknesses and responding to them, a perspective further elaborated in “*single-loop learning*” [original emphasis] and “*double-loop learning*” [original emphasis] principles (Argyris, 2002, p. 206). “Single-loop learning” refers to a process where errors

are identified and corrected without enquiring or altering the underlying organizational norms or principles (Argyris, 1977, p. 116). Consequently, the implementation of corrective actions and reactive responses ensures the continued viability of the established structures (Argyris, 1977, p. 116). In contrast, the approach known as "double loop learning" involves a more comprehensive and introspective examination of errors (Argyris, 1977, p. 116). The review encompasses a comprehensive examination of processes and system elements, thereby prompting reflection, adaptation, and transformation of structures within the learning process (Argyris, 1977, p. 116; Schein, 2004, p. 349). This, in turn, promotes the development of an active “learning culture” (Schein, 2004, p. 349). Additionally, Argyris (2002) posits that although the concept of reflective and adaptive iterative processes in “double-loop learning” is widely known and applied, it is not effectively implemented due to a lack of awareness or ability to do so (Argyris, 2002, p. 206). Furthermore, the principle of double-loop learning, which emphasises the importance of reflection, adaptation and critical evaluation of actions and processes, is of fundamental importance for individuals and organisations to participate and remain relevant in societal progressions (Argyris, 1977, p. 125). The active encouragement of individuals to observe, analyse and improve their actions, both independently and collectively, contributes to the continuous improvement of the organisation and nurtures change and growth (Egloff, 2005, p. 42). This aspect is of particular relevance to knowledge workers, who contribute to the processes of continuous development throughout their working lives and thereby affect the organisation's ability to adapt to changing circumstances (Drucker, 2014, p. 257). The development and nurturing of personal strengths over time is contingent upon the provision of feedback, which is essential to the understanding and improvement of skills (Drucker, 2014, p. 258). However, as Manuel (2017) explains, effective feedback necessitates the capacity for critical evaluation rather than consistent positivity, which lead to a diminution or even reversal of the learning effect, thereby creating a "learning paradox" (Manuel, 2017, p. 65). This means, that the stimulus for a process improvement is compromised (Manuel, 2017, p. 65). From the perspective of an external observer or an investigator in an accident investigation, the observed behaviour could be evaluated as a destructive process (Willke, 2011, p. 60).

Kristiansen (2013) argues that the learning process in the maritime industry and the establishment of safe work practices depend on three fundamental factors: "motivation, knowledge, and methods" (Kristiansen, 2013, p. 362). However, the fundamental principle of nurturing learned behaviours and maintaining established processes (Herold

and Herold, 2011, p. 57) is reflected in the maritime industry as reactive and resistant to change (Manuel, 2017, p. 164). Manuel (2017) claims that the principles of education and training in the maritime industry frequently adhere to the process of “single-loop learning” (Manuel, 2017, p. 164). Oltedal and Lützhöft (2018c) posit that in order to enhance the economic efficiency and competitiveness of the ship operation, training initiatives are primarily designed to ensure compliance and to enhance economic performance (Oltedal and Lützhöft, 2018c, p. 87). Despite the incorporation of advanced technology and compliance with stringent regulatory frameworks, the human interaction within the ship organisation has not the been incorporated into the increased complexity of these interdependencies (Oltedal and Lützhöft, 2018c, p. 87). The objective of training is to reduce the likelihood of human error (Oltedal and Lützhöft, 2018c, p. 87). The maintenance of conventional qualification standards aims primarily to maintain existing standards without encouraging substantial change, innovation, or an “inquiry mindset” (Manuel, 2017, p. 164). Manuel (2017) further observes that the principles of double-loop learning, particularly the mindset of those involved in the process, are not effectively applied in the maritime context (Manuel, 2017, p. 84). Despite the revelations gained from recurring accident patterns, the MET system, persists in perpetuating established practices rather than challenging underlying paradigms (Manuel, 2017, p. 84). Focus is put on “how” [original emphasis] rather than on “why” [original emphasis] in the evaluation of established education and trainings (Manuel, 2017, p. 84). Manuel (2017) challenges this approach and explains that the safe operation of ships in the complex and dynamic work environment depends on the ability to accommodate changes across various levels of the industry, including technical, regulatory, and societal contexts (Manuel, 2017, p. 84).

7.2 Self-organized Learning

The individual mental processes of the human brain as a system, shape the individual acquisition of knowledge, skills and insights, which are reciprocally transmitted, contained, transformed and permeated at the micro-macro level in communities, organisations and society (Herold and Herold, 2011, p. 31). Individual interaction with the environment stimulates change based on different individual approaches, reflexively shaping their understanding of the world and contributing to personal and societal growth (Herold and Herold, 2011, p. 55). The primary function of human learning, as outlined in

Maslow's theory of survival, is related to the satisfaction of basic human "needs" (Deci and Ryan, 1985, p. 36). The steps in the self-development process are associated with motivation and the growth and fulfilment of the individual (Deci and Ryan, 1985, p. 36). While this universal applicability has been acknowledged, particularly in the workplace, it has also been acknowledged as limited due to the implicit standardisation of individual behaviours and motives (Wilson, 2004, p. 146). Furthermore, individual learning processes aim to maintain stability and equilibrium within an individual's life system (Herold and Herold, 2011, p. 56). This implies that the observable, learned behaviours that have developed over time as a result of evolutionary processes are characterised by a resistance to alteration (Herold and Herold, 2011, p. 57). The learning process is comprised of several key elements, including communication, the individual's confidence in their abilities, the context in which learning occurs (Herold and Herold, 2011, p. 86), and the individual's empowerment to meet personal needs (Herold and Herold, 2011, p. 88). The concept of satisfying needs can be defined as the natural adaptation of humans to their environment, an inherent aspect of human experience, and a systematic evolutionary process (Herold and Herold, 2011, p. 30). Consequently, human action is contingent upon contextual interrelationships, with the brain serving as the central motor that drives all functionalities and subsequent learning processes (Herold and Herold, 2011, p. 55). Furthermore, these processes are inherently unique to each individual, in terms of both method and application (Drucker, 2014, p. 261). This fundamental comprehension posits that learning is an inherently individual phenomenon, comprising personal perceptions and experiences.

The process of learning is an individualised, self-organised, conscious or unconscious phenomenon that necessitates adaptation and change of cognitive processes in relation to the situational context (Herold and Herold, 2011, p. 43). Consequently, the individual may be conceptualised as a self-organised learning system, engaged in mutual interaction with its environment in the endeavour to survive and adapt, with the objective of achieving effectiveness (Herold and Herold, 2011, p. 43). Arguably, "learning cannot be designed" (Wenger, 1998, p. 225), as it involves an individual adaptation to an environment, based on an intrinsic human experience, as part of a systematic evolutionary process (Herold and Herold, 2011, p. 30), and extends beyond the acquisition of information (Herold and Herold, 2011, p. 59).

Therefore, learning cannot be standardised; it involves the processing of information as an individual experience and the formation of a unique, individual understanding (Herold

and Herold, 2011, p. 59), which reiterates the need to enable self-organised learning processes (Herold and Herold, 2011, p. 58). Learning occurs through external interactions between learners and their socio-cultural context, which is aligned with internal psychological processes and integrates new information with prior experiences (Illeris, 2006, p. 29). These processes entail the interaction of cognitive, emotional, and social dimensions within a socially contextualised environment (Illeris, 2006, p. 29). In order for the specification of learning goals to be meaningful, it must relate to the cognitive dimensions, be measurable (Messer, 2019, pp. 132–133), and promote reciprocal motivation and progressive skill enhancement (Nerdinger et al., 2018, p. 481). The learning content and outcome must be personalised to the individual's proficiency level, with the objective of both shaping the content and the formulation of a determined goal that effectively serves the learning objectives (Messer, 2019, p. 132). The method of information processing is significantly influenced by the cognitive dimensions (Nerdinger et al., 2018, p. 515). Therefore, when when devising learning processes and objectives, it is essential to integrate the learner's prior knowledge, the mechanisms of human information processing (Nerdinger et al., 2018, p. 515), and to allow for the satisfaction of individual needs based on motivation (Herold and Herold, 2011, p. 76).

Motivating and facilitating effective learning is directly related to mindset, a concept that is integral to both personal and organisational development (Dweck, 2016). "The fixed mindset," as described by Dweck (2016), represents a state of stagnation where a focus on the present and overreliance or complacency inhibits and prevents development and growth (Dweck, 2016). A “growth mindset” aims to encourage exploration and trust in one's capabilities, even when “taking risks” (Dweck, 2016). The key to actively promoting a growth mindset is to empower individuals to learn and develop from their experiences, which may challenge established rules and structures and requires a reliance on core values (Dweck, 2016). Dweck (2016) explains that individuals and organisations frequently adopt a combination of growth and fixed mindsets, given that it may not always be feasible to maintain one or the other in every context (Dweck, 2016). The ability to change learned behaviour with new experiences has become a prerequisite for employability and organizational adaption to the global dynamics, which involves to “practice growth mindset thinking and behaviour, such as sharing information, collaborating, innovating, seeking feedback, or admitting errors” (Dweck, 2016).

The motivation for learning and personal development is often hindered by an individual’s “comfort zone”, which is a state of balance between exerting effort and experiencing

stagnation (Herold and Herold, 2011, p. 82). The concept of a comfort zone can be defined as an individual's effort to establish equilibrium between stimuli and stability (Herold and Herold, 2011, p. 82). The advancement of an individual along an educational path necessitates the provision of individual, measurable parameters and structure (Herold and Herold, 2011, p. 83). The key factors to be considered are those related to personal experiences, knowledge, needs, goals, and the recognition of development (Herold and Herold, 2011, p. 83). The transition from a comfort zone to a “growth zone”, as described by Dweck (2016), is most successful when individuals are intrinsically motivated to develop their skills and feel empowered to pursue their personal needs (Dweck, 2016).

7.3 Social Theory of Learning

According to Willke (2011) learning is a process that results in knowledge (Willke, 2011, p. 59). In complex systems, learning is understood as an inherent process that is subject to communication or the absence of communication among the system elements and with the system environment (Willke, 2011, p. 59).

Wenger’s (1998) theory of learning emphasises on the interaction, communication and the interdependences of participants within a learning system and highlight that the social aspect of learning permeates the micro-macro level perspective, from the individual to the global scale (Wenger, 1998, p. 228). Wenger (1998) defines learning as a process of accumulating knowledge through social interaction and acquiring “meaning” from the activities involved in this process (Wenger, 1998, p. 4).

The process of learning is subject to four core elements (Wenger, 1998, p. 5):

- meaning - learning from experience,
- practice - learning by “doing”, involving active engagement,
- identity - learning as an individual development in becoming, and
- community - learning from a sense of belonging.

Wenger (1998) proposes a model of learning theory in which horizontal and vertical elements are linked axially, with the “social theory of learning” at the core, see Figure 9 (Wenger, 1998, p. 12).

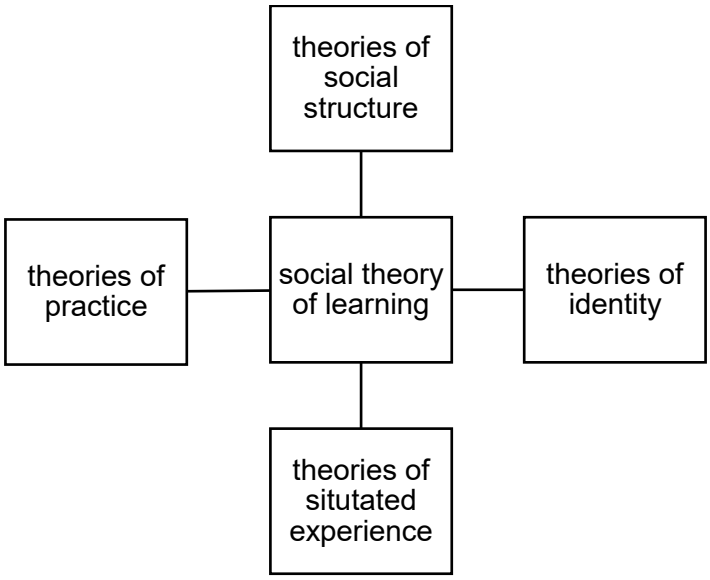

Figure 9: Social theory of learning (Wenger, 1998, p. 12)

The vertical axis connects the “theories of social structure” at the top with the “theories of situated experience” below (Wenger, 1998, p. 12). This refers to the interconnection between established organizational structures and norms, and their reflexive impact on individual behaviour in the daily work environment (Wenger, 1998, pp. 12–13). The “theories of practice" and the "theories of identity" on the horizontal line connect the repetitive actions in the work environment with individual physical characteristics of “identity" which include “gender, ethnicity, class and age” (Wenger, 1998, p. 13). The core element connecting all system elements, the “social theory of learning”, involves communication and reflective learning processes that can either facilitate or inhibit forms of connectedness, integration and action as well as the motivation for the development of transformative processes in collective and individual learning practices (Wenger, 1998, p. 13). The acquisition of new knowledge processes should allow for mistakes and failures, thus creating an encouraging environment for individual engagement and perspectives, supporting the forming of "identity" (Wenger, 1998, p. 215). Social engagement and participation promote the exploration of new insights that challenge conventional paradigms and the “*creation* [original emphasis] of knowledge” (Wenger, 1998, p. 214). The core position of 'learning' in the model is to emphasize the importance of connecting and integrating evolving social processes of shared and individual aspects (Wenger, 1998, p. 9). This necessitates a continuous and flexible system view with the

assessment and reflective adaptation across established frameworks, levels and disciplines of social learning (Wenger, 1998, p. 9).

Wenger (1998) concurs that learning is “life-sustaining and inevitable” for the individual (Wenger, 1998, p. 3). However, the meaning and process of learning in a social perspective permeates and affects all micro-macro level activities in society, as summarised below (Wenger, 1998, pp. 226–228):

- creating new, shared understanding and meaning through reflection of situations and emerging information, skills and behaviours;
- espousing individual and collective competences, bound to the values and norms of specific communities,
- initiating growth, advancement and transformation of identities, affecting the wider interdependencies in society.

Sfard (1998) agrees that learning new things is inherently impossible, emphasizing the importance of social interactions and collaborative environments in higher education to facilitate meaningful knowledge development (Sfard, 1998, p. 7). Therefore, in the context of higher education, Sfard (1998) utilizes two distinct metaphors to conceptualise the process of learning: first, the “acquisition metaphor” for the attainment of knowledge, meaning, and skills, and secondly, the “participation metaphor”, which embraces the “process of becoming a part of a greater whole” (Sfard, 1998, p. 5). The process of acquisition primarily concerns an individual's cognitive abilities, specifically their capacity to process information and their ownership of “knowledge, concept, conception, idea, meaning, sense, fact, […] and contents” (Sfard, 1998, p. 5). The educator's role is to facilitate the transfer of knowledge (Sfard, 1998, p. 5), which can then be applied, and transferred to another context and shared with others and in another social environment (Sfard, 1998, p. 6). The acquisition metaphor posits that individuals are owners of both knowledge and material assets that shape their identities and relationships, dependent on the social context (Sfard, 1998, p. 8). In contrast, the participation metaphor refers to social processes that affect individual ideas and social relationships, a sense of “togetherness”, and collaborative action (Sfard, 1998, p. 8). The activities entail communication and reflection within the community, in accordance with the established values of that community (Sfard, 1998, p. 6). In essence, the concepts of the acquisition and participation metaphors highlight how individual learning behaviors are shaped by social interactions, reflecting wider interdependencies in society. Edmondson (1999) concludes that the application of a “learning behaviour” is reflected in “seeking feedback,

sharing information, asking for help, talking about errors, and experimenting" (Edmondson, 1999, p. 351). These forms of social interaction and active communication encourage individuals and organisations to learn and promote a collective mindset that includes flexibility to adapt to new situations or contexts (Edmondson, 1999, p. 351). Hence, the social concept of learning and improving knowledge and skills depends on circular and iterative processes in work organisations or educational institutions. However, frameworks and structures may not allow for adaptation or flexibility to support the individual needs of both trainers and learners (Herold and Herold, 2011, p. 75). Moreover, when knowledge is linked to individuals and social status, it can contribute to the creation and reinforcement of power relations between individuals and organizations (Sfard, 1998, p. 8). However crucially, the learning experience often goes unnoticed and the learning process fails to be fully realized (Edmondson, 1999, p. 351).

In essence, knowledge is communicated through social learning processes that individuals, teams and communities adapt and apply to meet contextual requirements. This process requires embracing diversity and openness to new learning opportunities, as well as incorporating technological advances and aspects of formal education methods that are relevant to the effectiveness of learning and, moreover, to the satisfaction of individual needs and thus to future employability.

8 Knowledge Transfer in Nautical Sciences

The qualifications of a nautical officer are defined by their ability to perform a wide range of shipboard operations in accordance with predetermined standards, and to achieve the desired results in both routine and exceptional circumstances (International Maritime Organization, 2014a, p. 3). The demonstration of the ability to apply the appropriate knowledge effectively in the given context is the basis for the assessment of competence (International Maritime Organization, 2014a, p. 44; North and Kumta, 2018, p. 37).

The transfer of knowledge, the application of skills and the acquisition of competencies in MET are aligned with the international regulations and guidelines within the STCW structure and are reflected in the content of the curriculum (International Maritime Organization, 2014b, pp. 153–155). This competency-based approach is contextualised through theoretical lectures and practical training on board (Hochschule Emden/Leer, 2023b). The acquisition of practical skills at sea is documented in the "On Board Training

Record Book” in accordance with Reg. II/1, STCW 78 (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 9; Hochschule Emden/Leer, 2021c; International Maritime Organization, 2017a), under the supervision of the master and an assigned officer on board, as well as by a university lecturer (Bundesamt für Seeschifffahrt und Hydrographie, 2006, p. 9; Hochschule Emden/Leer, 2021c; Morrison, 1998, p. 111).

The transfer of knowledge is associated with emotions, values and motivation, and therefore goes beyond the learning of principles and theories (Heyse, 2010a, p. 63). Consequently, competencies can only be acquired through the combination of personal experience gained through practising and intrinsic processes (Heyse, 2010a, p. 63). The integration of diverse methodologies and theoretical and practical tools and technologies is a fundamental aspect of the effective transfer of knowledge in the MET curriculum (Hanzu-Pazara et al., 2010, p. 177). MET employs a combination of traditional and modern techniques, including the use of simulators, computer-based learning, and the incorporation of experiences from the aviation industry, which have evolved over time to become the current methods of education and training in the field of nautical sciencies (Hanzu-Pazara et al., 2010, p. 179; International Maritime Organization, 2014b, 2017b).

The regulatory framework for the transfer of knowledge and assessment of competence established in the MET is essentially derived from the “practice and custom of seaman” (Mandaraka-Sheppard, 2009, p. 533). However, the challenges of achieving effective knowledge transfer are recognised as a significant issue in education (European Commission, 2022, p. 23). The process of learning is reflective and connected to personal experiences. Consequently, teachers and their methods are based on their own learning experiences and their familiar methods (Herold and Herold, 2011, p. 191). In examining the roles of educators and students in the context of MET, Valionienė (2016) suggests that the evolving communication dynamics between lecturers and students require a redefinition of their roles and the exploration of more efficient knowledge transfer methods (Valionienė, 2016, p. 76). Furthermore, it has been proposed that an individual learning perspective should be encouraged in order to facilitate personal and societal growth (Valionienė, 2016, p. 72). The teaching methods employed should facilitate the development of self-organised and cooperative learning skills in learners, while also integrating advanced technologies and conducting critical system analysis (Valionienė, 2016, p. 76). Moreover, the various forms of knowledge transfer are not regarded as mutually exclusive, but rather as ideally complementary in terms of the learning process and objective (Keller, p. 56).

8.1 Excursus: Aviation

Statistical analysis of accidents in the maritime and air transport industries frequently reveals a similar pattern, with human error identified as the primary contributing factor (Galieriková, 2019, p. 1319; Helmreich and Foushee, 2010, p. 6). Both the maritime and aviation industries are acknowledged as complex, sociotechnical and high-risk industries, characterised by dynamic interdependencies of system elements (International Air Transport Association, 2023b, p. 27; Manuel, 2017; Oltedal and Lützhöft, 2018b, p. 3; Perrow, 1987; Proske, 2010, p. 260; Thomas, 2004, p. 207). Safety in aircraft operations is based on the three fundamental principles of “aviate, navigate, communicate” (United States Department of Transportation, 2018). Firstly, to aviate, means controlling the altitude of the aircraft; secondly, to navigate, means controlling the position and course of the aircraft; and thirdly, to communicate, which involves monitoring and managing the internal and external communication, for instance with air traffic control (United States Department of Transportation, 2018). These fundamental principles emphasise the need to establish and maintain priorities in achieving safe operating conditions (United States Department of Transportation, 2018). This understanding is contingent upon the active ability of the cockpit crew to manually operate the aircraft, apply crew resource management skills, and anticipate and efficiently manage incidents (International Air Transport Association, 2022). The majority of human error assessment and mitigation concepts in the aviation industry are attributed to “interpersonal communications, decision making, and leadership” (Helmreich et al., 1999, p. 19), and focus is on the performance of the flight crew, both as individuals and as a team (Salas et al., 1999, p. 162).

Analysis conducted in aviation accident investigations indicate that although the crew possesses a high level of technical competence, human behaviour in a dynamic context has a tendency to oversimplify processes (Proske, 2010, p. 260) and exhibit inadequate social and communication skills, which lead to inappropriate decisions and actions (Proske, 2010, p. 262). In order to address these issues in a comprehensive and long-term manner, it is of a core interest to achieve a clear understanding of the capabilities and limitations of the equipment in use, as well as the organisational procedures and the cognitive and physical capabilities of the operating crew in the given environment (International Air Transport Association, 2023b, p. 27). Furthermore, an assessment of the perception of human error requires a comprehensive examination of the "tightness of [...] component coupling" of interdependencies within the dynamics of the aviation

system (International Air Transport Association, 2023b, p. 27). This understanding recognises that incidents are rarely the result of a single cause or action (International Air Transport Association, 2023b, p. 28). The analysis of failures seeks to develop and predict the strengths and weaknesses of actions and components, as well as the overall interdependencies of variables within the industry (International Air Transport Association, 2023b, p. 28).

8.1.1 Crew Resource Management

The implementation and training of bridge resource management in the maritime industry, as required by the STCW Code, is based on the experience and research of the aviation industry, where the application and evaluation of crew resource training and the use of human factors science was established before the maritime industry (O'Connor, 2011, p. 358). The formal training in human factors in aviation dates back to the 1970s, then developed in collaboration with NASA, academic and government researchers, and affiliated industry partners (Helmreich and Foushee, 2010, p. 30). The concept of crew resource management was originally known as “Cockpit Resource Management” (Helmreich et al., 1999, p. 19).

The initial training initiatives were designed to examine the human factors involved in aviation accidents, with the objective of understanding and adapting the attitudes of the crew (Helmreich and Foushee, 2010, p. 30). These initiatives primarily focused on the communication and decision-making processes within the cockpit (Helmreich and Foushee, 2010, p. 30). One of the principal training objectives was to enhance the assertiveness of junior crew members, regarded as a crucial aspect contributing to effective teamwork (Helmreich and Foushee, 2010, p. 30). The development of assertiveness is understood as the capacity to articulate conflicting opinions, to recognise conflict resolution, to consider different points of view, and to adopt a methodical approach that prioritises the ‘right decision’ rather than appropriating authority to ‘who is right’ (Helmreich and Foushee, 2010, p. 30). At the time, simulator-based training was undergoing a period of evolution, with psychological and interpersonal assessment factors gradually being incorporated into the simulation training programme, which became known as 'Line-oriented Flight Training' (LOFT) (Helmreich and Foushee, 2010, p. 27). The training programmes that were subsequently developed focused primarily on improving management effectiveness (Helmreich and

Foushee, 2010, p. 31). The concept was met with criticism and opposition from the pilots, who perceived the training as some form of psychological testing and as “an attempt to manipulate their personalities” (Helmreich et al., 1999, p. 21). Despite the emphasis on leadership and teamwork skills, the trainees were not enthusiastic about the training sessions due to the fact that the exercises were not aviation-specific and the lack of suitable feedback on the trainees’ behaviour (Helmreich et al., 1999, p. 21).

Over time and with the extensive knowledge gained through industry feedback, a more comprehensive understanding and integration of the aircraft crew into training programes was developed, which led to the more holistic concept of "Crew Resource Management” (Helmreich et al., 1999, p. 21). This concept of understanding is attributed to the evolving human factors perspective, defined as “the applied science of people working together with devices” (Helmreich and Foushee, 2010, p. 4).

8.1.2 Threat and Error Management

The lessons learnt from the aviation accidents and the subsequent training approaches have highlighted the importance of a systematic approach and the need to recognise failures as inherent elements of a wider system view (Helmreich and Foushee, 2010, p. 51). This encompasses the concept of *“threat and error management”* [original emphasis] which has been integrated into CRM (Helmreich and Foushee, 2010, p. 51), as a “process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired states” (International Air Transport Association, 2023a, p. 6). Threats are further subdivided into environmental or organizational “events or errors that occur beyond the influence of the flight crew, increase operational complexity, and which must be managed to maintain the margins of safety” (Maurino, 2005, p. 2). Errors are “actions or inactions by the flight crew that lead to deviations from organizational or flight crew intentions or expectations” (Maurino, 2005, p. 3), and are also associated with environmental and organizational aspects (Maurino, 2005, p. 3). Environmental threats involve external factors that may be beyond the control of the flight crew, such as weather or traffic conditions (Maurino, 2005, p. 3), as an imperative to these potential hazards are identified and considered during the planning stage of a flight, in order to minimise the risk of occurrence and to enhance flight safety (Maurino, 2005, p. 3). Organizational threats are concerns related to commercial factors such as flight scheduling and time constraints that can be proactively managed and minimized during the planning stage

(Maurino, 2005, p. 3). Errors are associated with threats, wether as causal or isolated events, and may occur within the context of experienced threats (International Air Transport Association, 2021, pp. 14–15). The development of conditions involving “latent threats” may be related to inherent technical or design conditions (Maurino, 2005, p. 2) resulting from a “trade-off between efficiency and thoroughness” (Hollnagel, 2009, p. 14). As a goal-based approach to balancing safety and economic aspects, this matter may go unnoticed by the flight crew, nonetheless it still requires an effective response (Maurino, 2000, p. 956). Consequently, the effective management of threats necessitates meticulous planning and an adequate real-time response (Maurino, 2000, p. 956).

In essence, threat and error management emphasises the effective, and integrated application of both technical and interpersonal skills, with a particular focus on the contextualised and successful application of the skills (Thomas, 2004, p. 209). It has been postulated that the increased utilisation of automation and digitalisation has not diminished the necessity for human interaction, which reiterates the necessity for the adaptation of human interaction and the management of the dynamics between technical and social systems in order to effectively manage threats and errors (Proske, 2010, p. 261). In order to implement control measures and barriers that take into account the operator's ability to evaluate situations and support the decision-making process, it is necessary to establish an active learning culture that incorporates experience, feedback, and a sense of togetherness and belonging for all involved (International Air Transport Association, 2023b, p. 28). The key to effective threat and error management goes beyond a proactive behaviour, but requires the ability to “predict” and mitigate errors while maintaining a safe level of operation during a flight (International Air Transport Association, 2023a, p. 4). This necessitates a comprehension of errors that extend beyond the detection and rectification of errors, as a continuum of cause and effect (Maurino, 2005, p. 3), and embraces the potential for explicating individual and collective conduct and learning (Dekker and Lundström, 2006, p. 5). The ability to objectively evaluate behaviours and decision outcomes encourages the use of “self-critique” as a tool for analysing mistakes in a safe learning environment that promotes desired learning outcomes (Helmreich and Foushee, 2010, p. 24). Consequently, the concept of active safety and risk assessment encompasses the consideration and managment of all potential implications associated with “patterns of failure, procedures, training and competence, organizational culture, fatigue management, mental health and wellbeing” (International Air Transport Association, 2023b, pp. 27–31). While recognising that the

complete elimination of human error is an unattainable goal, it is crucial to assess human error in the context of a complex sociotechnical system where interdependencies create opportunities for various vulnerabilities (Dismukes et al., 2007, p. 303). Applying this understanding from aviation recognises that the skills and capabilities of individuals and organisations provide an opportunity for iterative learning and training in active safety management (Maurino, 2005, p. 3).

8.1.3 Competency-based Training in Aviation

In the aviation industry, competency is defined as “a dimension of human performance that is used to reliably predict successful performance on the job […] manifested and observed through behaviours that mobilize the relevant knowledge, skills, and attitudes to carry out activities or tasks under specified conditions” (International Air Transport Association, 2021, p. 14). However, the observable behaviour in this context specifies (International Air Transport Association, 2023a, p. 5), that the appropriate attitude of an individual in a given environment is provided when the person “*knows how to be*” [original emphasis] (International Air Transport Association, 2023a, p. 4), whether or not “measurable” (International Air Transport Association, 2023a, p. 5). Competency-based pilot training recognises the complexity of flight operations and the human tendency to simplify decision-making, which can lead to inappropriate decisions and actions (Proske, 2010, p. 261). Essential skills in this context involve early recognition of situations that may compromise safe operations and a willingness to constructively resolve conflicts and involve crew members in the decision-making process, in order to reach an unbiased decision, free from personal and subjective views (Proske, 2010, p. 269). Consequently, conflict management training is regarded as a fundamental aspect of a dynamic work environment (Proske, 2010, p. 268). The prediction of behaviour is a fundamental aspect of competency-based aviation training, which aims to enhance the behaviour and resilience of crews, and to activate the necessary knowledge and skills in the context (International Air Transport Association, 2021, p. 14). The resilience potential of the crew is contingent upon the active management of threats and errors, which may be evaluated on a scale from reactive to active to proactive behaviour (International Air Transport Association, 2021, p. 14).

A competency-based training model for Lufthansa captains consists of three parts (Proske, 2010, p. 269):

- Face-to-face seminars focusing on leadership skills, sharing experiences and information with colleagues;
- Individual counselling on personal competencies;
- Intensive training and development opportunities for personal competence development.

The importance of the information exchange process, which is a core value in the construction of knowledge and competences, is emphasised in the communicative aspect of face-to-face seminars (Proske, 2010, p. 269). Individual counselling and intensive personal training and development support the aviation industry's competency-based training approach (International Air Transport Association, 2023a, p. 15). Although some of the training content is standardised for all participants, personalised training and refresher courses are an essential part of the programme in a long-term perspective of the acquisition of competences (Proske, 2010, p. 270). This enables and supports an iterative learning process focusing on individual awareness, reflection and improvement of strengths and behaviours.

8.2 Simulation-based Learning

Simulation trainings have been widely used across industries and professions, including the maritime and aviation industry (Carson-Jackson, 2010, p. 18; Singh, 1997, p. 89). Simulators have facilitated the shift from a teaching-focused approach to a learning-focused perspective in education (Singh, 1997, p. 89), and serve as an effective tools for knowledge transfer and the acquisition and development of skills within a structured, safe, and guided environment (Carson-Jackson, 2010, p. 2).

The level of complexity in a simulation, including the tools and equipment used, and is determined by the desired learning outcomes (Carson-Jackson, 2010, p. 7). This can include a variety of tools or aids, ranging from simple, self-designed equipment to sophisticated technical tools, all of which support the process of acquiring new knowledge and strengthening existing knowledge, as well as developing skills and contextualised behaviours (Carson-Jackson, 2010, p. 7). Simulators can be categorised according to the complexity of the equipment involved, ranging from a paper-based business plan simulation to the interaction with sophisticated equipment (Singh, 1997, p. 89).

Following Carson-Jackson (2010), simulators can be categorized in three levels (Carson-Jackson, 2010, p. 20):

1. “Full mission simulators”: a replication of a complex work environment, such as the navigation bridge on board a vessel;
2. “Part task simulators”: containing equipment associated with a specific aspect of a job or training objective, involving computer-based systems;

“Low level simulators”: designed for training a specific task or acquiring knowledge in a field, involving class room exercises or electronic aids.

The simulator itself serves as the facilitator of the learning and teaching process (Carson-Jackson, 2010, p. 18) and as such “provides a working representation of reality, but the experience in the simulator is real” (Carson-Jackson, 2010, p. 58). Thus, the simulator serves as a tool to replicate behaviour in an assumed environment (Heyse, 2010a, p. 63). However, the experiences and associated feelings of the participants within the simulation are genuine, which is essential for converting knowledge into lasting competencies (Heyse, 2010a, p. 63).

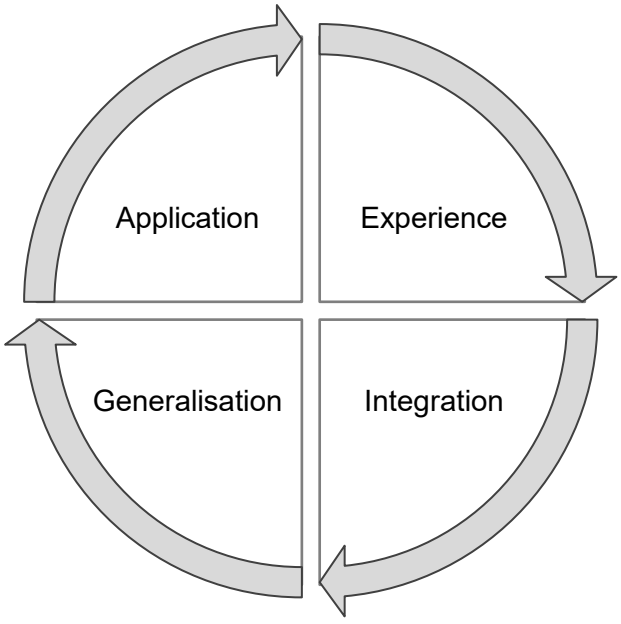

Figure 10: The experiential learning cycle (Carson-Jackson, 2010, p. 40)

The four steps in the experiential learning cycle, as illustrated in Figure 10 are as follows (Carson-Jackson, 2010, pp. 40–41):

1. **Experience** involves integrating past experiences and gaining practical knowledge through participation in specific activities or scenarios. Individual motivation is essential for achieving learning outcomes, both individually and collectively.

2. **Integration** pertains to the sharing of information and experiences among participants. In effective communication it is crucial to observe and comprehend behaviours, internal thought processes, and motivations that lead to decisions.

3. **Generalisation** acts as a bridge between simulated experiences and the real work environment and utilises acquired knowledge and practiced skills as a foundation and enhancement for future simulation exercises.

4. **Application** builds upon the previous steps and enhances knowledge transfer by introducing additional complexity and variations of the learning objective, thereby reinforcing knowledge and skills. The use of case studies and real-life scenarios from previous experiences is beneficial for strengthening competencies.

Thus, the simulation exercise enables an "experiential learning cycle," comprising of "experience, integration, generalization, and application" (Carson-Jackson, 2010, p. 39). Its purpose is to enhance a theoretical foundation of knowledge and to stimulate analytical and problem-solving processes through interactive experiences (Carson-Jackson, 2010, p. 39). This stimulation occurs through role-playing and the associated emotions and observable behaviour revealed as part of the simulation (Carson-Jackson, 2010, p. 8). In effective competency-based training that incorporates the experimental learning cycle of simulators (Carson-Jackson, 2010, p. 42), the instructor holds a core role (Carson-Jackson, 2010, p. 24). The instructor's primary role is that of a coach (Carson-Jackson, 2010, p. 24) whose demeanour sets the atmosphere for the learning experience and the acquisition of competencies (Carson-Jackson, 2010, p. 42). The instructor is responsible for possessing comprehensive knowledge and skills in both technical and didactic matters (Carson-Jackson, 2010, p. 31). This includes the equipment handling and the design of an exercise, the determination of learning outcomes and the creation of an ongoing open atmosphere with an allowance for mistakes and emotions where participants can share personal experiences, and engage in discussions with peers and the instructor (Carson-Jackson, 2010, p. 31). Based on

this understanding, errors along with the comprehensive feedback, and encouragement for objective self-critique (Carson-Jackson, 2010, p. 41), contribute to the improvement of knowledge transfer and the acquisition of competencies (Strauch, 2017, p. 17). The instructor's primary responsibility is to maintain focus on the learning objectives and to provide an assessment that promotes intrinsic motivation in the course of the training dynamics (Carson-Jackson, 2010, p. 31).

The role of the instructor's core responsibilities in "delivering, planning, conducting, and supervising" the training according to Section A-I/12, STCW Code, include the following (International Maritime Organization, 2017a):

- Setting and communicating the learning objectives of an exercise in a briefing;
- Explaining and familiarising the simulator;
- Adapting the exercise according to the individual's experiences;
- Evaluating observed behaviours with structured and specific feedback;
- Confirming the training objectives and skills gained in a debriefing;
- Stimulating peer-review;
- Testing the technical equipment of the exercises beforehand.

The assessment of the skills and competencies observed during the simulation is a crucial stage for the trainees' learning experience and their subsequent transfer into the work environment (Carson-Jackson, 2010, p. 59). The methodology for evaluating simulator training can incorporate a taxonomy system commonly used in education (Carson-Jackson, 2010, p. 46). This system aligns with the evaluation system of the skills and competencies included in the MET curriculum for the nautical officer's study programme and formal certification according to the STCW Code (Hochschule Emden/Leer, 2023b).

8.3 Bridge Resource Management

The Crew Resource Management (CRM) model, derived from the aviation industry, was adopted by the maritime industry in the 1990s (Patraiko, 2014, p. 2), initially as a tool to improve the relationship between master and pilot, and eventually established as bridge resource managment (BRM) (O'Connor, 2011, p. 358). BRM was introduced in the 2010 amendments to STCW 78 as a mandatory tool for a more holistic approach to safety

management, from looking at individual human performance to addressing team performance in the safe operation of ships (Oltedal and Lützhöft, 2018c, p. 78). BRM is a structured teamwork approach to the efficient management and utilisation of human and technical resources as a bridge team (Patraiko, 2014, p. 2). BRM training is applicable to the master, officers and crew to enhance operational aspects of safety (Penn, 2012, p. 9). Competency at the operational level applies to the nautical officer in the function of navigation, and is outlined in Table A-II/1, STCW Code, and includes the "allocation, assignment, and prioritization of resources, effective communication, assertiveness and leadership, obtaining and maintaining situational awareness, and the consideration of team experience" (International Maritime Organization, 2017a). At the management level, applicable to masters and chief mates, the application of leadership and teamwork skills includes the management of personnel and workload and the effective application of resource management in the function of "controlling the operation of the ship and care of persons" as set out in Table A-II-2, STCW Code (International Maritime Organization, 2017a). This requirement for "applying leadership and managerial skills", as defined in Table A-II/2, STCW Code, includes the knowledge and application of elements of personnel management and training, the principles of workload management, resource allocation and effective resource management, decision-making techniques and the implementation and monitoring of ship-specific operational procedures (International Maritime Organization, 2017a).

The bridge team and the ability of the team to carry out its assigned tasks in a safe and coordinated manner are supported within the environmental and situational context, the regulatory framework, including the ISM Code, which requires the company's established safety management system, environmental regulations and the dynamic parameters of the voyage, including weather and traffic conditions, and the response to potential hazards and associated risks (International Chamber of Shipping, 2022, 23, 27-28). The resources available to a navigator to assist in his decision-making process and to reduce the possibility of human error include technical equipment, charts, publications and electronic aids, the human element, which recognises the support provided by the lookout, helmsman, officers, master, pilots (International Chamber of Shipping, 2022, p. 28) and external communication with authorities or vessel traffic services (Patraiko, 2014, p. 2).

Elements of BRM include the following aspects (International Chamber of Shipping, 2022, p. 28; Patraiko, 2014, p. 2; Penn, 2012, pp. 15–25):

- Internal and external communication, information sharing;
- Appropriate use of the English language;
- Leadership and management;
- Briefing and debriefing, constructive feedback, active listening and observation;
- Situational awareness and decision making;
- Emergency preparedness and stress management;
- Promotion of a just culture recognizing mistakes as a necessary part of the collective learning experience;
- Clear role assignment and instructions on tasks and responsibilities;
- Care for crew's health, mental and physical fitness;
- Skilled use of technical equipment, checklists and organisational procedures.

Training and assessment methods include structured and documented, written forms, using checklist, self-learning manuals, videos or computer-based training, and the familiarization process for new team members (International Chamber of Shipping, 2022, p. 33). Training in BRM, leadership and management skills may be provided by one or a combination of approved training, on-the-job experience or practical demonstration in accordance with Tables A-II/1 and A-II/2, STCW Code, demonstrating the observed competence in supervising and evaluating the working behaviour of the crew and in accordance with operational requirements and in compliance with applicable regulations (International Maritime Organization, 2017a). Regular BRM training and assessment, although not mandatory, has been recommended as industry best practice during shipboard navigation audits (Patraiko, 2014, p. 2). This recommendation recognises that systematic and regular training and reflective feedback are essential for the continuous improvement of organisational learning aspects, both in ship and shore management (Dakic et al., 2014, p. 5). Moreover, effective learning from real life experiences, evaluation and feedback are considered to be key elements of an organisational learning culture (Dakic et al., 2014, p. 5).

Reiterating the essential value of collective and real-life experience, Edmondson (1999) states that "team learning behavior consists of activities carried out by team members through which a team obtains and processes data that allow it to adapt and improve", and further explains that observed behaviours associated with an active learning environment include "seeking feedback, sharing information, asking for help, talking about errors, and experimenting" (Edmondson, 1999, p. 351). However, Edmondson (1999) argues, that "these valuable outcomes are often overlooked in organisations"

(Edmondson, 1999, p. 351). The active application of all these elements enable a team to understand, change and improve (Edmondson, 1999, p. 351). As a condition for effective performance, teams also require a supportive organisational context and the availability of essential material resources that are critical to the intended or desired performance (Hackman, 1987, p. 331). Therefore, for systematic training and development to have a valuable impact in an organisation, the physical and mental needs of individuals and teams must be considered and addressed, and the necessary resources must be provided and reassessed at an organisational level (Hackman, 1987, p. 328).

8.4 Intercultural Training

Culture is “an abstraction” (Schein, 2004, p. 4), and “organizations are cultural constructs” defined by their actors (Trompenaars, 2012, p. 117). The association and definition of culture and its perceptions are associated to various societal levels and contexts, forming collective, organisational, national and global structures, understandings and perceptions (Schein, 2004, p. 9). In an era of globalisation and international interconnectedness, the ability to understand and effectively apply intercultural communication and social interaction has become an essential requirement in work and life (Foster, 2012, p. 331).

As a historic driver of global trade, maritime industry organisations are redefining the boundaries and meaning of traditional national concepts and their associated definitions (Barmeyer, 2018b, p. 18). The dynamics of connectivity within international organisations do not automatically lead to a better understanding of cultures and nations (Foster, 2012, p. 332), but involve personal presuppositions based on beliefs and ideas inherent in the cultural background (Foster, 2012, p. 332). However, culturally derived values emerge in different contexts and manifest themselves in dynamic processes of adaptation to a multicultural social environment, including the organisation of personal management, teamwork and the establishment of practices (Barmeyer, 2018b, p. 12). A lack of understanding of intercultural dynamics can lead to behaviours and forms of communication based on misconceptions, and resulting in interpersonal conflicts that are both challenging and detrimental to social and working relationships (Schein, 2004, p. 9).

Intercultural management is seen as constructive design, effective collaboration and teamwork that supports the diverse dynamics of a multicultural environment (Barmeyer,

2018b, p. 14). Barmeyer (2018b) emphasises that an understanding of theoretical intercultural concepts is essential (Barmeyer, 2018b, p. 13). Essential knowledge about a culture or nation encompasses “history, geography, traditions, language, religion habits, political system or even fairy tales” (Belbin et al., 2012, p. 355).

Barmeyer (2018b) proposes the following three crucial steps for establishing a framework for intercultural understanding (Barmeyer, 2018b, p. 14):

- Gaining an understanding of theoretical concepts, and cultural differences;
- Engaging in practical experiences with organisations and elaborating on case studies;
- Implementing proactive behaviours to cultivate and enhance intercultural skills.

Although it is widely recognised that cultural models cannot encompass all aspects of difference and meaning, their impact on hierarchical, social and communicative relationships remains essential (Trompenaars, 2012, p. 118). Understanding is derived from contextualised approaches and individual perceptions of the actors, their roles and their respective cultures, all of which have a significant impact on understanding and managing situations (Barmeyer, 2018b, p. 13).

In an educational setting, the dynamics of lectures are influenced by the individuals attending the course, as much as individuals influence the dynamics of their learning, training and working environments (Schein, 2004, p. 10). Establishing a basic understanding of working and living in a multicultural work environment can be achieved through methods such as studying relevant cases, stories or fairy tales, involving and initiating discussion and self-reflection, acting in communication scenarios, simulations and role-plays (Belbin et al., 2012, xv, xxvii; Hofstede et al., 2002), all of which contribute to building a foundation of knowledge about cultural aspects of meaning (Hofstede et al., 2002, p. xv). Crucially, the incorporation of teaching methods and the course context need to take account of individual backgrounds and experiences, organisational differences and cultural models, while recognising the interdependencies of organisational norms in relation to the overall framework (Schein, 2004, p. 10).

8.5 Problem Based Learning

Contemporary learning concepts take a holistic approach, supporting teachers and teaching methods as well as students and learning outcomes in a comprehensive approach that encompasses the cognitive processing of information and stimulates behavioural change based on acquired knowledge (Hoidn and Kärkkäinen, 2014, p. 8).

The concept of problem-based learning originated from medical education, where traditional textbook and theoretical teaching methods were deemed inadequate for a successful application in the profession (Hoidn and Kärkkäinen, 2014, p. 18). Thus, the understanding shifted to an emphasis on increasing students' motivation to actively participate and acquire interpersonal and cognitive skills through active and collective experiences (Hoidn and Kärkkäinen, 2014, p. 18).

Problem-based learning in contextualised learning processes is characterised by several elements (Kazi et al., 2017, p. 331):

- Engagement with case studies associated with the professional context;
- Alignment of learning needs with the application of suitable learning methods;
- Interactive involvement of individuals in concise teams;
- Facilitation of the decision-making process by an instructor, without control; and
- Integration of interdisciplinarity to arrive at feasible, contextualised outcomes.

Essentially, the application of problem-based learning places fundamental emphasis on student engagement, while promoting specific work-related thought processes in analytical and critical thinking (Hoidn and Kärkkäinen, 2014, p. 28). This interaction in small teams serves to understand and develop interpersonal and social skills considered essential in the contemporary and future work environment (Hoidn and Kärkkäinen, 2014, p. 28). The potential of problem-based learning in education, especially in professional training and skills application, lies in the importance of a thorough assessment of the feasibility and potential of integrating problem-based learning methods into existing curricula (Kazi et al., 2017, p. 334). Assessing learning objectives against the use of training techniques, and training trainers in appropriate methods, is key to determining the impact, outcome and overall effectiveness of this approach in education (Kazi et al., 2017, p. 334).

8.6 Interdisciplinary Education

Interdisciplinarity in higher education has become a crucial element of global learning and teaching strategies, in the preparation of future generations for adapting and coping with the dynamic workforce requirements (Hoidn and Kärkkäinen, 2014, p. 13). The ubiquity of the term in economic, scientific, public and political contexts underlines the importance of lifelong learning, understood as an individual's resilience potential to adapt to technological advances and flexible approaches to working practices, all of which have become essential for a successful career in the future (Lerch, 2017, p. 15). The openness to lifelong learning and the flexibility to adapt are driven by the processes and evolving norms established in work and educational environments (Lerch, 2017, p. 15), but also by the interests and motivations of individuals seeking self-realisation of their interests and ambitions in the workplace (Lerch, 2017, p. 15). These developments in economic conditions and the subjectivisation of the work process are reflected on the one hand in individualisation and specialisation, but also in the division of labour and the resulting interdisciplinary collaboration that is applied in project-based work (Lerch, 2017, p. 15). The acceleration of processes is a major influencing factor to interdisciplinarity, therefore adhering to conservative norms in science and knowledge transfer is futile (Lerch, 2017, p. 15). Collaborative working involves the ability to reflect as a means of engaging and involving all individuals and applying different methods, understandings, and content to develop a personal understanding of interdisciplinarity (Lerch, 2017, p. 15). Thus, the evolving discourse around interpersonal and soft skills has become an ongoing concern in all contexts of work and learning, across disciplines and in a global perspective (Reichenbach, 2014, p. 40).

In education, the involvement of various disciplines and levels of students allows for the exploration of different aspects of the professional perspective and the adaptation of specialised tasks through the application of appropriate methods (Lerch, 2017, p. 15). Interdisciplinarity also involves a flexibility to disciplines as well as to a spatial approach (Brandt and Bachmann, 2014, p. 18). While the choice of a study subject is related to individual motivation and supported by a sense of belonging to the group and subject, the need for socialisation and the opportunity to interact with other disciplines, peers and lecturers is essential (Brandt and Bachmann, 2014, p. 19). This need can be addressed in both physical and virtual forms, and across the organisational levels of the university environment (Brandt and Bachmann, 2014, p. 22).

The understanding of interdisciplinarity is more often related to the subject and its competences than to the professional context (Lerch, 2017, p. 93). It is therefore associated with informal and social processes in which specific individual competences are adopted and internalised “en passant” [original emphasis], outside formal educational institutions or workplaces, in social interactions and during leisure activities (Gaylor et al., 2015, p. 12). This innate motivation to learn en passant has become a central element in a career perspective where technological and social skills have become not only crucial but a prerequisite for both personal and professional advancement, and where the ability to learn informally and continuously in different life contexts is highly significant (Rarrek and Werner, 2012, p. 44). Accordingly, competences are related to an individual's abilities and skills that result in observable behaviour based on self-reflection and social communication processes (Lerch, 2017, p. 15). Interdisciplinary competences include a range of requirements embedded in job-specific competences, with interpersonal skills as a core element, and subsequently increase personal drive in view of the career ahead (Lerch, 2017, p. 15). Acquisition and development of the skills required for job-related competences depend on both individual motivation and organisational provision of a structured and appropriate learning approach, and require contextualised application and assessment (Lerch, 2017, p. 109). The mere consolidation of different academic disciplines and an informal conceptualisation of interdisciplinarity in the curriculum that applies to cross-programme, cross-disciplinary and cross-curricular collaboration (Lerch, 2017, p. 101) does not necessarily promote interdisciplinarity (Lerch, 2017, p. 152). True interdisciplinarity requires a profound openness across specific disciplines and a deep understanding of the issues involved, coupled with deliberate action that involves the awareness and commitment of all actors (Lerch, 2017, p. 153). It is therefore an ongoing process that requires careful planning and the active participation of all stakeholders, an approach that can be realised in the form of seminars and in collaboration with economic stakeholders from different perspectives (Lerch, 2017, p. 109). Learning progress and outcomes need to be documented and structured, with scope for improvement and development (Lerch, 2017, p. 138). An evaluation serves as a qualitative and contextual assessment that provides evidence of the skills applied (Lerch, 2017, p. 138). Suggested forms include purposeful and task-specific self-reflection, communicative discussion and peer review (Lerch, 2017, p. 141). However, the accuracy of an assessment is a qualitative rather than a quantitative perspective, and a combination of different forms of assessment seems to be preferable (Lerch, 2017, p. 141).

The acceleration of processes, in particular globalisation and digitalisation are driving forces that permeate all levels, from micro to macro, affecting work and educational organisations, individuals and entities (Lerch, 2017, p. 15). In order to adapt and cope with these accelerating changes in the working and social environment, individuals need to be familiar with and adept at applying interdisciplinary skills in order to thrive socially and professionally (Lerch, 2017, p. 15).

8.7 Mentoring

Mentoring has been a part of the demanding training and working environment of the maritime industry for centuries (Krishnamurthi, 2012, p. i). The MET system consists of a combination of theoretical classroom training at the university and the acquisition of real-life skills at sea (Hochschule Emden/Leer, 2023a), which requires an understanding of living and working in an environment that is considered physically and mentally isolated and challenging (Sampson, 2021, p. 93).

Mentoring is distinct from a formal trainer position, which is defined by global and national regulatory frameworks in terms of professional qualifications (Hoffmann, 2015, p. 37). The mentoring relationship is personal and informal, with the willingness to share professional knowledge and openness between mentor and mentee at its core (Le Goubin, 2012, p. 1). A mentor's role extends beyond a willingness to facilitate the transfer of technical expertise and job-specific skills; it relies crucially on the engagement of interpersonal and soft skills, including “communication, empathy, flexibility, adaptability, teamwork and an ability to provide connections between theory and operational practices in a holistic manner” (Carson-Jackson, 2010, p. 24). According to this, a mentor is not defined by an official position or rank in an educational or workplace organisation, but by a responsibility and inherent attributes (Le Goubin, 2012, p. 1). However, not everyone has the ability or aptitude to take on the role of a mentor (Le Goubin, 2012, p. 73). Nevertheless, knowledge transfer activates a cyclical dynamic, and being a mentor involves being open to the possibility of reverse learning, as a form of learning benefit across diverse life experiences, generations and cultures (Le Goubin, 2012, p. 63). The establishment of a mutually beneficial and motivating relationship depends on the foundation of trust (Le Goubin, 2012, p. 55) which influences the learning experience, where mistakes are treated as an element of experiential learning and enhance individual

motivation to develop personal and professional competencies (Le Goubin, 2012, p. 53), as a basic principle of a just culture (Dekker, 2012, p. 99).

A crucial aspect of maritime education and working life revolves around the concept of safety and compliance with regulations and performance standards, provided by global, national and company-specific standards (Krishnamurthi, 2012, p. i). It is a well-established concept that a learning and training process is primarily dependent on the motivation and attitude of the trainees, an aspect that has been systematically addressed in various forms, including policies, statements and the provision of a line of communication between shore and ship (La Holder, 1997, p. 54). This aspect of safety training and education refers to compliance or failure to comply (Dekker, 2012, p. 98). The form of personal face-to-face interaction or training with a mentor goes beyond the outlines of formal standards and appeals to a deeper understanding, emotions and an associated behaviour, supporting the establishment of a holistic safety culture (Krishnamurthi, 2012, p. i). This is in line with the argument of Kristiansen (2013), who argues that the establishment of safe working practices in the maritime environment depends on three fundamental factors: "motivation, knowledge and methods" (Kristiansen, 2013, p. 362).

Building on the fundamentals of safety, the organisation's role in supporting the concept of mentoring relates to the consideration and accommodation of work schedules, fatigue, manning levels, the production of educational material or computer-based training, and the promotion of open communication and effective teamwork, both on board and ashore (Le Goubin, 2012, p. 59). In educational institutions, the inclusion of mentoring, supported by guidance from industry experts, provides an opportunity to translate real-life experiences into fundamental knowledge (Le Goubin, 2012, p. 52). This practice of combining theory with interpersonal skills is particularly important for cadets and trainees as a quality of their professional reality (Le Goubin, 2012, p. 52). Furthermore, according to Le Goubin (2012), mental well-being is an integral part of seafarers' lives, but is not inherently integrated into the formal educational training, although it can be effectively integrated into a mentoring framework (Le Goubin, 2012, p. 10).

In conclusion, mentoring in maritime education and in the seafaring profession remains a key to nurturing the diverse generations of seafarers. It enhances not only the technical skills, but also the motivation and the mental and physical well-being that are required to succeed in a challenging career at sea. As the maritime industry continues to evolve, the role of mentors in motivating and training seafarers and providing a deeper

understanding of career prospects constitutes an important aspect of the maritime education and work environment.

8.8 Model Training Courses

Knowledge transfer and the promotion of the human element aspects are at the core of the global efforts in MET and the development of training and course materials (Sekimizu, 2014, p. vii). In response to the implementation of STCW 78, the need to facilitate and enhance knowledge transfer in training institutions and universities has been addressed through the creation of model courses (Sekimizu, 2014, p. vii). The initiative to develop model training programmes recognises the need to enhance the implementation of harmonised levels of knowledge and skills in MET and to promote the crucial learning process in the maritime profession (International Maritime Organization, 2019d). The courses cover a wide range of maritime topics and have been developed in collaboration with industry stakeholders, government bodies, and the World Maritime University (Sekimizu, 2014, p. vii). The IMO publishes and disseminates the course programmes which incorporate industry best practice and reflect relevant developments in the industry, which is essential to support the instructors and the knowledge transfer system in MET (International Maritime Organization, 2017b, p. 1; Sekimizu, 2014, p. vii).

The objective of the model courses in strengthening the development of the human element aspects embraces the support to the facilitators and personnel involved in training processes (International Maritime Organization, 2017b, p. 1). The structure and content provided includes the evolving needs of the industry to adapt or modify it to the needs of the trainees and the context of the lectures provided in different education or training programmes (International Maritime Organization, 2017b, p. 2). In essence, the courses provide a comprehensive resource aimed at enhancing and supporting knowledge transfer in the field (Sekimizu, 2014, p. vii).

The IMO model courses for the education and development of nautical skills, knowledge and competence within the scope of this research include the following extract with references to STCW 78 and the STCW Code (International Maritime Organization, 2024a).

Table 3: IMO Model Courses applicable to general MET (extract from International Maritime Organization, 2024a)

Model Course number, name, latest edition	**Contents focus**	**STCW reference[+]**
7.01 Master and Chief Mate, 2014	Certification at the management level	STCW 78, Reg. II/2, STCW Code Table A-II/2
7.03 Officer in Charge of a Navigational Watch, 2014	Certification at the operational level	STCW 78, Reg. A-II/1 Reg. VIII/2, STCW Code Chapter VIII
1.07 Radar Navigation, Radar Plotting and use of ARPA Radar Navigation at Operational Level, 2017	Basic principles of operation and technical configuration	STCW 78, Reg. I/12, STCW Code Tables A-II/1, A-II/2
3.17 Maritime English, 2015	General and job specific language training	STCW Code, Tables A-II/1, A-II/2, Section A-IV/2
1.08 Radar, ARPA, Bridge Teamwork and Search and Rescue, Radar Navigation at Management Level, 2019	Equipment utilization as part of the decision-making process in safe navigation, for master and chief mate	STCW Code, Tables A-II/1, A-II/2
3.19 Ship Security Officer, 2012	Duties and knowledge of security measures on ships and in ports	STCW 78, Section A-I/14, STCW Code, Section A-VI/5, ISPS Code[17]
3.26 Security Training for Seafarers with designated Security Duties, 2012	Specific knowledge in security tasks and measures on board	STCW Code, A-VI/6, SOLAS 74, Chapter XI-2, ISPS Code
3.27 Security Awareness Training for all Seafarers, 2012	Knowledge and duties in relation to security measures	STCW Code, A-VI/6-1, SOLAS 74, Chapter XI-2, ISPS Code
1.22 Ship Simulator and Bridge Teamwork, 2002	Theory in simulator handling, either interactive or CBT[18]	STCW 78, Section A-I/6
1.39 Leadership and Teamwork, 2014	Application of effective resource management and decision-making for officers	STCW Code, Table A-II/1
1.40 Use of Leadership & Managerial Skills, 2018	For masters and chief mates, techniques and management of leadership skills	STCW Code, Table A-II/2
1.27 Operational Use of Electronic Chart Display and Information Systems (ECDIS), 2012	Knowledge and use of electronic charts in navigation	STCW Code, Tables A-II/1, A-II/2

[17] International Ship and Port Facility Security Code, incorporated in Chapter XI-2, SOLAS (International Maritime Organization, 2020c).
[18] Computer Based Training

1.34 Automatic Identification Systems (AIS[19]), 2019	Equipment knowledge and application	STCW-Code, Tables A-II/1, A-II/2
1.13 Elementary First Aid, 2000*	Basics in personal survival at sea	STCW Code, Section A-VI/1, para.2, Table A-II/1
1.14 Medical First Aid, 2000*	First aid knowledge and application	STCW Code, Section A-VI/4, Table A-VI/4-1
1.15 Medical Care, 2000*	Treat injured and sick persons	STCW Code, Section A-VI/4, Table A-VI/4-2
1.19 Proficiency in Personal Survival Techniques, 2019*	Safety Familiarization and survival at sea	STCW Code, Table A-VI/1
1.21 Personal Safety and Social Responsibilities, 2016*	Survival at sea	STCW Code, Tables A-II/1, A-VI/1, A-VI/1-4
1.20 Fire Prevention and Fire Fighting, 2000*	Basic application of fire fighting	STCW Code, A-VI/1-2
2.03 Advanced Training in Fire Fighting, 2000*	Application of techniques and tactics to control fire on ships	STCW Code, I/3, Table A-VI/3
1.23 Proficiency in Survival Craft and Rescue Boats (other than Fast Rescue Boats), 2000*	Theory and practical skills in operating boats when abandoning the ship or in rescue of persons	STCW Code, Tables A-II/1, A-II/2,Section A-VI/2, Table A-VI/2-1
1.38 Marine Environmental Awareness, 2011	Motivation to act responsibly in the marine environment	STCW Code, Tables A-II/1, A-II/2
1.10 Dangerous, Hazardous and Harmful Cargoes, 2014	Handling of hazardous and harmful substances as cargo	IMDG Code[20] SOLAS, STCW Code, Tables A-II/1, A-II/2
1.25 General Operator's Certificate for GMDSS, 2015	Communication using radio equipment including VHF and satellite services	STCW Code, Tables A-II/1, IMO Assembly resolution A.703(17), ITU Radio Regulations
3.15 SAR On-Scene Coordinator (IAMSAR Manual Volume III), 2014	Guidance in Search-and-Rescue operations	STCW Code, Tables A-II/1, A-II/2
6.09 Training Course for Instructors, 2017	Guidance for training facilitators	STCW 78, Sections A-I/6, A-I/12
6.10 Train the Simulator Trainer and Assessor, 2012	Delivery of simulator pedagogy, and psychology	STCW 78, Sections A-I/6, A-I/12

[+] references to STCW Code Table A-II/1 apply to officers, STCW Code Table A-II/2 to masters and chief mates, see also Chapter 3.3

*refresher courses are mandatory every five years according to STCW Code VI/1 to VI/4-2 (International Maritime Organization, 2017a)

[19] Electronic equipment used to enhance safe navigation and identification of ships based on the calculation of parameters of movement, technical requirements and limitation are outlined in IMO Resolution A.917(22), the carriage requirement on sips is defined in Chapter V, SOLAS (International Maritime Organization, 2020c).

[20]IMDG Code refers to the "International Maritime Dangerous Goods Code", mandatory under Chapter VII, SOLAS (International Maritime Organization, 2019g).

The optional courses in specialized trainings offered to students at the university of Leer (Hochschule Emden/Leer, 2023a), are associated with the below model courses (International Maritime Organization, 2024a).

Table 4: IMO Model Courses applicable to specialized MET (extract from International Maritime Organization, 2024a)

Model Course number, name, last edition	**Contents focus**	**STCW reference[+]**
1.01 Basic Training for Oil and Chemical Tanker Cargo Operations, 2014	Basic safety and duties for officers, and ratings on tankers	STCW Code, Section A-V/1-1, para.1, Table A-V/1-1-1
1.02 Advanced Training for Oil Tanker Cargo Operations, 2015	Specific safety and duties on tankers	STCW Code, Section A-V/1-1, para.2, Table A-V/1-1-2
1.03 Advanced Training for Chemical Tanker Cargo Operations, 2016	Specific safety and duties on chemical tankers	STCW Code, Section A-V/1-1, para.3, Table A-V/1-1-3
1.04 Basic Training for Liquefied Gas Tanker Cargo Operations, 2014	Safety and duties on liquefied gas tankers	STCW-Code, Section A-V/1-2, para.1, Table A-V/1-2-1
1.05 Advanced Training for Liquefied Gas Tanker Cargo Operations, 2015	Specialized safety and duties on liquefied gas tankers	STCW Code, Section A-V/1-2, para.2, Tables A-V/1-2-1, A-V/1-2-2
1.29 Proficiency in Crisis Management and Human Behaviour Training Including Passenger Safety, Cargo Safety and Hull Integrity Training*, 2000	Safety of passengers and cargo on passenger and ro-ro[21] ships	STCW Code,Section A-V/2, Tables A-V/2-1, A-V/2-2

[+] references to STCW Code Table A-II/1 apply to masters and chief mates, STCW Code Table A-II/2 to officers, see also Chapter 3.3
*refresher courses are mandatory every five years according to STCW Code VI/1 to VI/4-2 (International Maritime Organization, 2017a)

Harmonisation in a global perspective is fundamental to MET, however the International Maritime Organization (2013) has reiterated that the “educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country” (International Maritime Organization, 2013, p. 4). Therefore, the outlines of the model training programmes serve as a basic foundation that needs to be modified and adapted to the context of the trainees and institutions in order to motivate and promote

[21] Ro-ro passenger ship, is defined in Reg. 3.42, Chapter II-2, SOLAS as “a passenger ship with ro-ro spaces or special category spaces” (International Maritime Organization, 2020c).

awareness of the knowledge and skills requirements of the maritime industry (International Maritime Organization, 2013, p. 4).

More recently, the validation of a wide range of model training courses has been scrutinised and found to "require significant changes […] owing to amendments to IMO instruments and/or significant industry/technological changes" (Annex, p.1, International Maritime Organization, 2023b). Issues of concern to the maritime industry include the review of the "Model Course 1.21 on Personal Safety and Social Responsibilities" which incorporates "the human element, including mental wellbeing, harassment and gender-based sexual harassment and bullying" and the subsequent incorporation of the required competencies into the STCW framework (International Maritime Organization, 2024c). The MSC Committee, with the support of the "ILO/IMO Tripartite Working Group", a forum of governmental and non-governmental entities on maritime labour, has been assigned the responsibility of developing new education and training standards in this area (International Maritime Organization, 2024c).

8.9 Norbert Elias' Concept of 'Figurations'

Sociology seeks to understand individual behaviour and power dynamics, as well as developments and changes in social structures, by analysing interdependencies and their impact on a micro-macro perspective of society (Kahlert, 2009, p. 256). Over the millennia, maritime trade has had a prominent role in the establishment of global standards, techniques, rules and regulations, which are reflected today in the development of nautical education, evolved through traditional structures and the need to incorporate and reflect the socioeconomic interdependencies and constraints of trade, which has become a "tightly knit business community" (Stopford, 2009, p. 45), with "around 90 percent of everything we see around us has traveled by sea at some point in its life" (The European Community Shipowner's Association, 2018). Rooted in such perspective, and seen over time across the micro-macro levels of society, seafarers have significantly formed and fostered today's "standard of life", which Durkheim (1956, p. 56) expresses as "the minimum below which it does not seem to us that we can consent to descend, varies infinitely according to conditions, milieux, and the times" (Durkheim, 1956, p. 56). Therefore, the theoretical outlines of the maritime safety and education systems, their interdependencies, constraints and contexts are illustrated through the application of sociological theory, which aims to tie individual and societal aspects, their

power relations, dynamics and structures, and the wider implications and developments in society.

Elias's concept of 'figurations' constitute a sociological theory that synthesises and aims to explain socially significant processes while effectively bridging micro and macro perspectives within society (Kahlert, 2009, p. 262). The concept encompasses the comprehensive consideration of divergent perspectives and theories, while effectively integrating empirical observation and traditional oppositions (Kahlert, 2009, p. 259). Various comprehensive disciplines, such as sociology, psychology, ethnology, anthropology, can be integrated into what Elias refers to as the theory of the "human sciences", promoting interdisciplinary connection and comprehension in this approach (Kahlert, 2009, p. 260), with an emphasis on the dynamic processes rather than a definite structure (Kahlert, 2009, p. 263). The nature of these processes is significantly shaped by the interactions and relationships between individuals (Kahlert, 2009, p. 263). Social order thus emerges from the iterative processes of individual and collective adaptation and transformation within their relational contexts (Treibel, 2008, p. 17).

Furthermore, Elias' concept emphasises the plurality of human beings existing within social interdependencies, where an individual's action is motivated by wider social relations rather than solely by individual motives (Treibel, 2008, p. 70). Relationships between people are affective, meaning that there is an emotional connection, which is referred to as “valence” to denote a relationship that is more than just interaction but creates an emotional bond (Treibel, 2008, p. 72). These relationships permeate all levels of society, from the level of family and school to the workplace and beyond (Treibel, 2008, p. 73). Affective relationships involve individuals who are inherently driven by emotions and who have learned to control their emotions through the process of socialisation (Frerichs, 2014, p. 26). Emotional fulfilment is linked to the creation of global interdependencies between human beings, which form the basis of the cohesion of societies (Frerichs, 2014, p. 26). Thus, the concept of figuration explains the social dependencies of the individual, where an individual has a certain degree of independence, but is still inherently bound to the relationships across different levels (Treibel, 2008, p. 73). Power relations manifest themselves from the smallest unit of the family to cross-national relationships (Treibel, 2008, p. 76). This means that power is not a static structure or an objective possession of a person or entity, but rather a relationship that exists between those involved (Treibel, 2008, p. 75). Power relations are a flexible process inherent to interdependencies and contexts, where individuals act within larger

structural connections of society (Treibel, 2003, p. 32). The challenge is to recognise the constantly changing and adapting power relations and context of the actors involved (Elias, 2006, 132). Power requires a counter-power and a "balance", a dichotomy that can also be found in the consideration of gender as a comparison between men and women (Treibel, 2008, pp. 76-77). Changes in the balance of power, as well as the suppression of changes in power, are conditioned by political and social causes (Treibel, 2008, p. 76). Interdependencies exist between individuals in the form of alliances, as well as in oppositions and adversaries (Elias, 2006, p. 173).

Elias (2006) illustrates the concept of 'figurations' through a game with four players, whose participation and actions are both independent and integral elements of the game (Elias, 2006, p. 172). Although it is possible to analyse and evaluate the behaviour, motivation, characteristics and actions of individuals, the game itself depends on the connections between the players, their common and conflicting interests (Elias, 2006, p. 173). This means that recognising all human actions, thoughts and feelings are subject to the wider social dynamic (Adloff and Farah, 2013, p. 108). Elias's theory of figuration thus combines historical, sociological, psychological and ethnological-anthropological considerations and supports a holistic, interdisciplinary argument of the process-related interdependencies of individuals and their behaviour as a result of the constraints of their environment (Kahlert, 2009, p. 260).

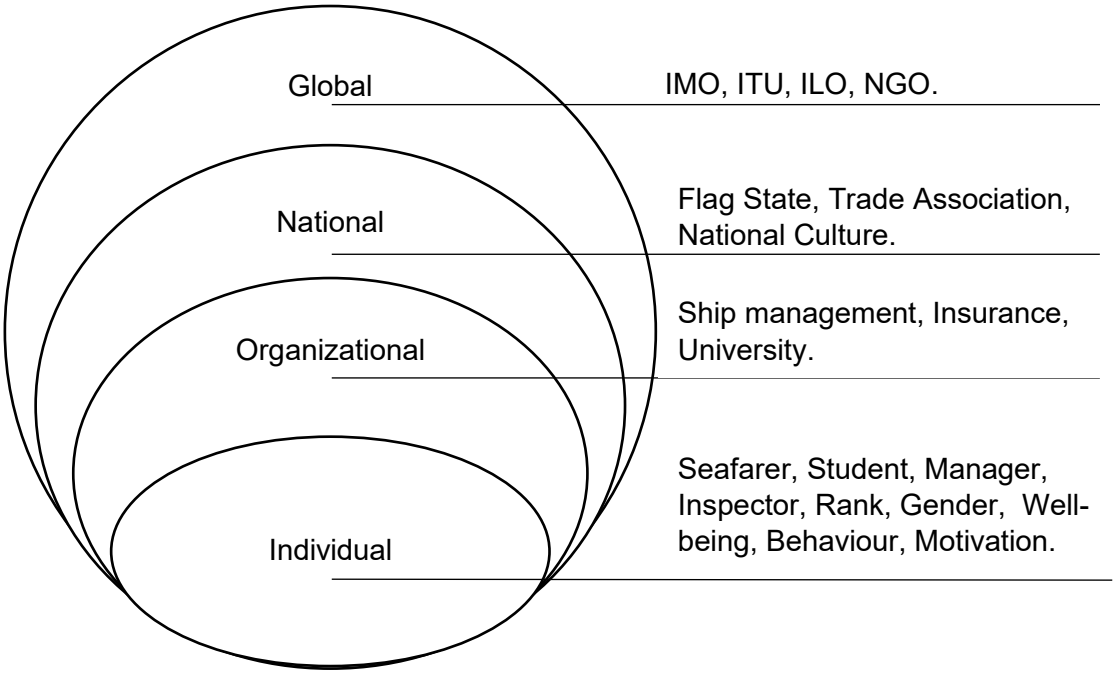

Figure 11: Micro-macro level model (adapted after Elias, 2006, p.13)

The application of Elias' concept of figurations, as shown in Figure 11 can therefore illustrate the wider dynamics and relationships of the human element in the various roles of the maritime industry, whose actions and behaviours shape and permeate all micro-macro perspectives of the industry. The individual “players" in the industry are the individuals in educational, economic, political or legal organisations or entities, ranging from students, lecturers, seafarers to those working in shipyards, equipment design, insurance and ship management companies. Despite their interdependence and interconnectedness in hierarchically and horizontally organised system levels, the individuals are motivated by their diverging interests, power relations, cultural, national or professional backgrounds, and conditioned by their level of knowledge, experience and authority in the industry. The individual interests and responsibilities are conditioned by the dynamic power relations, from political forces associated with national administrations, by economic competition and the social hierarchical organization on board involving aspects of culture, gender and rank. As elaborated and discussed in the theoretical chapters, these competing or corresponding interests in the implementation of safety, education and training permeate and influence the micro-macro perspectives, interdependencies and relationships between the “players” of the maritime industry.

9 Empiric Research

In the theoretical part of this study, the societal framework of nautical professional practice, as well as the key framework of nautical education, have been elaborated. Academic nautical education has been characterised by a focus on teaching a predominantly scientific perspective, with an emphasis on the use of mathematical and technical tools (Suhrcke, 2020, p. 16). The structure of the curriculum and the transfer of knowledge follow a historically established and maintained system based on the application of minimum standards (International Maritime Organization, 2017a). Students are prepared for the demands of their professional lives by providing a framework of compliance and conformity, a view where the human element becomes a system component aligned with technology (Hollnagel, 2014, p. 22; Rohlfs et al., 2014, p. 43). Due to the dynamically changing interdependencies of society and its impact on the learning and living structures, the provision of academic nautical education is considered insufficiently responsive to the demands of contemporary professional practice (International Maritime Organization, 2024c; Maritime Technologies Forum,

2023). In order to promote social-communicative skills in the curricula, the need to establish a flexible, adaptable and reliable relationship between teachers, students and stakeholder interests was reiterated as essential in order to develop approaches that enable methodologies for the transfer of knowledge essential to the demands of the profession (Dondi et al., 2021; Maritime Technologies Forum, 2023; UNCTAD, 2020, p. 19).

The empirical study examines the ways and means of knowledge transfer in a higher education environment and its incorporation into a curriculum and study programmes. For this purpose, interviews were conducted with experts in the field of maritime education and practice to identify the knowledge, skills and competences that are considered essential for a nautical officer now and in the future.

9.1 Key Research Questions

Research questions aim to explore specific questions that contribute to a broader scientific discourse (Gläser and Laudel, 2010, p. 65), and seek to explain social systems by understanding the individual and collective creation of order and meaning (Froschauer and Lueger, 2020, p. 30). This allows for the inclusion of numerous cases and the application of generalisations that are valid for a broader field of investigation (Gläser and Laudel, 2010, p. 65). Based on these considerations, the core characteristics of a sociological research question must be derived from existing knowledge and theories and seek to advance knowledge and understanding, explore relationships between theory and interdependent processes, and examine their societal implications (Gläser and Laudel, 2010, p. 65). This recognises that systems exhibit a level of diversity beyond the comprehension of the individual (Weick, 1987, p. 116), as the focus then extends from the analysis of a single process to encompass a wider range or types of processes (Gläser and Laudel, 2010, p. 65).

The study reviews and elaborates on educational methods for an integrated learning and training journey in maritime education with the aim of promoting a holistic safety culture in shipping. This approach considers bridging the perceived gap of human error as a critical element of safety in ship operations and effective knowledge transfer through the application of long-term knowledge transfer, hence espousing university education with professional performance. The human element aspects of maritime education are

explored with attention to the sociotechnical competences in the educational process and the methods to transfer knowledge appropriately and effectively to the complex working environment. The emphasis on sustainable teaching methods and skill development in maritime education stems from the continuing recognition of the human element as the weak link in improving safety in the maritime industry. Building on this recognition, this research seeks to provide insights to advance educational approaches and implement potential methods to promote knowledge transfer from an academic, long-term perspective within the micro-macro context of the industry.

The key research questions of the thesis scrutinise on the following considerations:

(1) The perception of the human element in international shipping as the problem to be addressed in order to promote safety. Ship safety and MET are governed by international regulatory frameworks, often established in response to accidents. Ship operations have been recognised as a complex safety environment in which an understanding of human capabilities plays a critical role in ensuring safe ship operations.

(2) The explication of the knowledge, skills and competences needed now and in the future by a nautical officer as the responsible operator in the sociotechnical system ship, recognising that the existing educational system has been developed as an approach to provide minimum standards of education with an emphasis on technical skills and compliance.

(3) The methods of incorporating learning and training elements into the academic nautical education to promote the human element perspective in the safe operation of ships. The implications of the current academic education in relation to the complex system management of the professional entity are elaborated on, promoting the learning abilities and skills of the individual to strengthen the overall focus of the development of the curriculum with elements of long term perspective to support young professionals and the quality of education as part of safety in the maritime environment.

9.2 Design of the Qualitative Study

Empirical social research is based on the ideas of Max Weber and follows the principles of systematically collecting, preparing and describing social phenomena and exploring and identifying social relationships through the analysis of empirical data, thereby contributing to scientific knowledge and providing a means of addressing social issues

(Döring and Bortz, 2016, pp. 4–5). Once the research problem is delineated, the researcher must assess its relevance and the associated interests (Strübing et al., 2016, p. 113). This process of assessment leads to the formulation of the research task, which is characterised by an exploration of ideas concerning the field (Strübing et al., 2016, p. 113). The significance and influence of the research design, data collection and analysis are conditional upon the planning of methods (Döring and Bortz, 2016, p. 183), which represent the initial step in the process of obtaining results (Strübing et al., 2016, p. 113). This first step is founded in a thorough literature review, which serves to predetermine the framework of existing knowledge in the research field (Flick, 2017, p. 74).

Furthermore, considerations pertaining to organisational matters must be taken into account (Froschauer and Lueger, 2020, p. 23) involving the decision for a qualitative or quantitative research design to be applied (Döring and Bortz, 2016, p. 184). The dichotomy between qualitative and quantitative research has been the subject of a continuous debate (Mayring, 2014, p. 6). While the application of methods revolves around the use of the appropriate method, the research question may justify a combination of both methods (Yin, 2011, p. 287). However, the literature review in qualitative research does not lead to direct hypotheses, but serves to contextualise and specify the research questions and scientific interests (Flick, 2017, p. 74).

The core concept of qualitative analysis is to build upon the methodological foundation of quantitative content analysis and assigning categories to large amounts of data and the further processing into an organized form, engaging a qualitative-interpretive approach, thus resulting in a mixed methods approach with qualitative and quantitative steps of analysis (Mayring, 2014, p. 10). Qualitative-interpretive analysis involves reference to a field of research that includes social situations, processes and institutions, and requires the collection and transformation of records, relevant extracts and data into permanent forms such as audio or video recordings and transcripts (Strübing et al., 2016, p. 246). Standardised methods focus on the interest in collecting and producing comparable information under identical contextual conditions, using a standardised questionnaire presented to all participants, or conducting an experiment with a larger number of participants in a reproducible form (Strübing et al., 2016, p. 247). The aim of qualitative-interpretive social research, however, is to use systematic data acquisition to gain a detailed understanding of individual cases from which comparative generalisations can be made (Strübing et al., 2016, p. 247). Qualitative-interpretive

empiric research strives for a dialogue with individuals in the research field and the exploration of contextual relevance of social systems (Strübing et al., 2016, p. 246), thereby understanding the meaning of the explicated data (Mayring, 2014, p. 7) and deriving possible knowledge for the future (Przyborski and Wohlrab-Sahr, 2009).

According to Froschauer and Lueger (2020) the conduct of social studies is based on the following elements (Froschauer and Lueger, 2020, p. 30):

- the creation of meaning through the contextual analysis of social processes and the subsequent provision of the content generated,
- communicative action by exploring the consequences of this process of meaning generation and cooperation in a social system, and
- system dynamics as an investigation of differentiations and unity as part of a social system structure.

Thus, the knowledge generated by interpretive social research aims to understand social systems in which individual and collective communication processes create order and meaning through information that is organised and contextualised into structured knowledge (Froschauer and Lueger, 2020, p. 30). The exploration of these elements aims to address explicit knowledge, an exploration that goes beyond what is said, but also the exploration of how things are said (Froschauer and Lueger, 2020, p. 30), hence, an attempt to “get inside of people’s heads” (Harris, 1976, p. 335). This ability to mentally put oneself in someone's head (Bourdieu 1999, p. 613) requires an emic approach to a field of research, therefore the application of an emic point of view (Pike, 1954, p. 8). Pike (1954) defined the emic approach as “structural”, with the aim to “discover and describe” from the researcher's point of view, as opposed to an etic approach where the researcher draws general abstractions from a previously unknown field (Pike, 1954, p. 8).

In this study, the researcher has a comprehensive professional background and understanding of the field, which reflects an emic approach. Nonetheless, the researcher possesses limited experience in the field of education and curriculum development in nautical science. Furthermore, the development and extraction of the data analysis focused primarily on the personal experiences and insights shared by the interviewees, an understanding that goes beyond the knowledge available through the contextual explanations extracted from the literature review.

9.3 Explication of Execution

Following the problem identification phase of this study, the specific research subject has been further defined and delimited, and the research design and methodology were established. The empirical data collection was based on semi-structured expert interviews applying a micro-macro level perspective to the maritime industry. The data contained in the interview transcripts form a crucial intermediate step in the production of data material and the progressive, analytical processing and refinement of the material (Strübing et al., 2016, p. 247). Subsequently, a circular-iterative approach was increasingly adopted, involving both an ongoing literature review and the implementation of the empirical data collection of the interviews (Flick, 2017, p. 74). The selection of the data to be analysed is always linked to meaning, thus provides a subsequent path and development of the research question (Strübing et al., 2016, p. 247). The refinement is done in the context of the core research questions (Strübing et al., 2016, p. 247).

9.3.1 Sampling

Sampling in empirical social research refers to the selection of cases, such as individuals, groups or events, to be studied in detail (Przyborski and Wohlrab-Sahr, 2009, p. 174). Sampling of a group of people or phenomena is linked to the context of the research (Przyborski and Wohlrab-Sahr, 2009, p. 174). Theoretical sampling is a method originally derived from Glaser and Strauss and the development of “Grounded Theory” [original emphasis], based on the idea that a sample is not necessarily determined at the beginning of the research study (Przyborski and Wohlrab-Sahr, 2009, p. 177), but evolves gradually based on the theoretical considerations that arise during the course of the empirical analysis (Glaser and Strauss, 2010, p. 64).

Theoretical sampling stresses on a prudent research concept with an emphasis on continuity in the conceptualisation and formulation of theories throughout the data collection process (Glaser and Strauss, 2010, p. 62), and the permanent alignment and adjustment of the sampling (Glaser and Strauss, 2010, p. 65). Eventually, this ongoing effort leads to the preliminary problem definitions and gradually to the development of theoretical categories (Glaser and Strauss, 2010, p. 62). Both minimising and maximising differences within groups are of interest in order to test hypotheses and theories, as well as variations within the research field (Glaser and Strauss, 2010, p. 67).

The principle of snowball sampling, involves the selection of new data collection based on existing ones, where for example, during an interview, the present interviewee refers to potential interviewees, and following these leads additional participants are possibly engaged (Yin, 2011, p. 89). However, careful reasoning for choosing subsequent interviewees and the prospect of gathering relevant insights must be applied (Yin, 2011, p. 89). A specific sampling procedure, therefore, determines the ongoing research and the amplification of findings in qualitative studies (Przyborski and Wohlrab-Sahr, 2009, p. 174). However, in applied research, the different sampling methods are not mutually exclusive and can be combined to complement each other effectively (Przyborski and Wohlrab-Sahr, 2009, p. 181).

In this study, the snowball sampling method was used as the predominant means of recruiting interviewees (Przyborski and Wohlrab-Sahr, 2009, p. 72). The initial contact to the interview partners was made via e-mail, based on internet research (Przyborski and Wohlrab-Sahr, 2009, pp. 72–73). Three different initial contacts were made (Przyborski and Wohlrab-Sahr, 2009, p. 180), who were considered to be experts in the research field. In principle, recommendations were followed in the chain of referrals from one interviewee to the next one or two interviewees. This process supports a continuous chain of interviews with the advantage of establishing contact quickly and effectively with a presumed expert in the field and, through the personal recommendation, and the presumed motivation of the recommended contact (Przyborski and Wohlrab-Sahr, 2009, p. 72). The determination of the number of interviewees remains a controversial criterion in qualitative research and is not based on an absolute number (Przyborski and Wohlrab-Sahr, 2009, p. 182). Different arguments are justified, including the need to gather new input to the study, the achievement of a level of saturation, or the organizational constraints in research time or economic resources (Seidman, 2019, pp. 60–61). The approach to the intended sample selection was based on considerations of the affiliation of individuals to the maritime network in micro, meso and macro contexts.

In February 2023, three initial contacts were made via e-mail, approximately one month prior to the scheduled commencement of the interviews. The time allowance for the initial contact to the commencement of the interview served to establish a preliminary contact with the interview partners and to permit both the researcher and the interview partner to implement a flexible planning strategy that could accommodate personal scheduling or delays due to the winter holiday season, or other personal planning adjustments (Przyborski and Wohlrab-Sahr, 2009, p. 74). After the initial introduction, a written

consent form was distributed to the contacts, outlining the general intention of the research topic. A date for an online interview was then arranged. Following the first agreed interview, the second contact was approached and interviewed after consent was obtained. The potential influence of the selection process on interviewees and its impact on the sample was considered with caution (Przyborski and Wohlrab-Sahr, 2009, p. 180). The initial three contacts were only vaguely acquainted with the researcher. The nature of the relationships between them varied. One contact had previously collaborated professionally with the researcher, but the last personal interaction occurred eight years ago. The second contact was established through a formal encounter at a maritime convention one year prior, though no personal communication was conducted at that time. The third contact was not interviewed directly, but served as a facilitator to identify a suitable subsequent interview partner. Although it cannot be entirely ruled out that the previous personal contact with two of the interviewees may have had some influence, a careful evaluation of the matter suggests that a potential impact on the research outcomes would have been negligible. This is because the focus of the research was on obtaining personal insights and expert knowledge, which would have made the probability of influence on the research outcomes insignificant.

The empirical phase of this study employed a qualitative approach, utilising a semi-structured interview guide that was composed during the literature research phase. In order to ascertain the efficacy of the chosen online video interviewing technique, a series of technical trials were conducted in order to ensure functionality (Przyborski and Wohlrab-Sahr, 2009, p. 78). The decision to conduct the interviews online was based on several factors. Although aspects of the study are viewed through the lens of a German perspective, it was considered essential to apply and reflect an international horizon in the data analysis and to emphasise the maritime industry focus and its educational context embedded in a global framework. In order to gain insights that encompass a broad perspective and diverse expertise from the field, it was crucial to invite views from a variety of nationalities and backgrounds to participate in the study. During the online interviews, participants were located in different time zones on three continents: Asia, South America, and Europe. Their nationalities include Germany, Norway, Sweden, Estonia, Italy, Brazil, and India, and a total of eight women and eleven men. The knowledge and insights of experts have been taken into account at various levels of the industry: at the macro level, legal, administrative and research experts; at the meso level, ship management, operation and inspection; and at the micro level, mainly direct involvement in training.

The first interview was conducted on 17 March 2023, and the final interview was conducted on 13 July 2023. When contacting the intended respondents, there were no active refusals to participate. However, out of the total of 29 persons contacted, six contacts did not respond for unknown reasons, and four persons who initially agreed to be interviewed were later unreachable or did not respond for unknown reasons, hence no further effort was pursued to contact these interviewees. A total of nineteen individuals were interviewed, aided by the outline of the questionnaire provided in Appendix 11.2.

The qualitative data interviews were initially analysed individually, and then accumulated into an overall analysis. During the evaluation process, specific categories were identified, and then subordinated codes made to the associated category. Subsequently, all the data was systematically organized based on its relevance to the research question, the transfer of knowledge, which was extracted and formulated as proposals to develop teaching methods and exercises.

The statistical data overview of interviewees is provided in Table 5 below.

Table 5: Statistical data overview of interviewees

Level			Years of Expertise	Gender	Nationality	Age
Macro	Meso	Micro				
		X	20-30	M	DE	40-50
	X	X	>30	M	DE	50-70
X	X		>30	M	IT	50-70
	X	X	10-20	M	DE	40-50
X	X	X	>30	F	DE	50-70
X		X	10-20	M	DE	30-40
	X		10-20	F	BR	30-40
X	X	X	>30	M	DE	50-70
		X	10-20	F	IN	40-50
	X	X	>30	F	SE	50-70
X	X	X	>30	M	DK	50-60
X	X	X	10-20	F	NO	30-40
X		X	20-30	F	LT	40-50
X		X	>30	F	LT	50-70
X		X	10-20	F	DE	40-50
X		X	>30	M	DE	50-70
X		X	20-30	M	DE	40-50
X	X	X	20-30	M	NO	40-50
	X	X	>30	M	DE	50-70

9.3.2 Qualitative Interviews

In empirical research, interviews serve as a communicative, expressive way of approaching a field of research and of producing specialised knowledge from the interviewees, which subsequently and uniquely shapes the research process (Froschauer and Lueger, 2020, p. 32). This allows an exploratory approach to capture variations in social reality (Onnen-Isemann, 2000, p. 68) and the inherent perspectives of individuals (Flick et al., 2004, p. 14), rather than relying on comparable measurement of data collected in the process (Strübing et al., 2016, p. 247). While systematic data are produced and compared, overall comparability is a secondary priority in qualitative research; the primary focus is on developing a comprehensive and detailed understanding of individual cases, which then serves as the basis for comparative typification and generalisation (Strübing et al., 2016, p. 247). The extracted knowledge is based on contextualized knowledge gained through experience (Luckmann and Schütz, 2003, p. 149), both from an individual's conscious and unconscious actions and through observation of others (Luckmann and Schütz, 2003, p. 456). With recourse to Locke, Briggs (2007) remarks that, “knowledge emerges as individuals contemplate the world and rationally order their thoughts” (Briggs, 2007, p. 553). The form of the interview as a method of eliciting and producing knowledge has been used in socio-cultural contexts relatively recently, but has now become a common research method used in various scientific disciplines, including education, sociology, communication and anthropology (Brinkmann, 2018, p. 577). Based on the above elaboration, the main aspect of data collection in the form of interviews goes beyond the mere application of a methodology (Seidman, 2019, p. 101). The process is based on an interactive engagement between the researcher and the interviewee in a trusting and empathetic relationship (Strübing et al., 2016, p. 247), where the interviewee becomes both subject and object to the researcher (Witzel and Reiter, 2022, p. 84). Moreover Brinkmann (2018) argues that “an interview is not an interaction between disembodied intellects but a joint accomplishment of vulnerable, embodied persons with all sorts of hopes, fears, and interests” (Brinkmann, 2018, p. 577).

Interviews are distinguished by the way of their structure broadly into three main forms (Brinkmann, 2018, p. 579):

- Relatively structured: closely follows the logic of standardised questionnaires, which has the advantage of making data comparable and quantifiable, but does not reveal individual knowledge due to the strict format;
- Relatively unstructured: aimed at extracting narrative content from the biography, the content of the interview is controlled by the interviewee;
- Semi-structured: “sometimes equated with qualitative interviewing as such”, the minimum of interference and direction from the researcher allows the interviewee to share the understanding and meaning of the research area, emanating knowledge to the researcher.

The intention to gather meaning and understanding of real life through the experiences revealed in the interviews refers to phenomenology derived from Husserl (Brinkmann, 2018, p. 580). Each interview develops its distinctiveness in the form of social interaction and inherent character (Meuser and Nagel, 1991, p. 451). This reveals similarities, but also, and more importantly, differentiations between persons and within the field (Meuser and Nagel, 1991, p. 452). Its significance is related to individual understanding and knowledge, which allows for an interpretation of meaning (Meuser and Nagel, 1991, p. 452).

In the social sciences, the semi-structured interview format predominates (Brinkmann, 2018, p. 579). The interview guide is meticulously prepared as a means of accessing the field (Przyborski and Wohlrab-Sahr, 2009, p. 134). The structure consists of a series of questions and sub-questions related to the research task, following a logic of sequence as necessary to stimulate the subjective views and thought processes of the interviewees (Flick, 2017, p. 204). The questions are designed to be open-ended and to allow for a natural flow of conversation (Gläser and Laudel, 2010, p. 111). The interview guide is constructed to start the conversation with a general, open approach and then progress to specific questions (Przyborski and Wohlrab-Sahr, 2009, p. 141). Openness is central to the flow, which aims to facilitate the communication of explicit knowledge, to be complemented by theory-derived questions based on theoretical literature review (Flick, 2017, p. 203), and intended to reveal tacit knowledge (Flick, 2017, p. 204). Finally, the concluding questions are aimed at clarifying contextual topics and to critically analyse the afore communicated contents (Flick, 2017, p. 204).

Typically, semi-structured interviews meet the requirements of an expert interview (Przyborski and Wohlrab-Sahr, 2009, p. 134), where insights on a variety of topics are produced in order to reconstruct social processes (Gläser and Laudel, 2010, p. 111).

This includes a flexible approach that uses the interviewee's experience and knowledge of personal and institutional relevance, and then obtains information on essential phenomena for further abstraction (Przyborski and Wohlrab-Sahr, 2009, p. 141). The distinction of the expert relevant to the interview lies with the researcher, who justifies this status by the relevance of the specialised knowledge to the field, as opposed to the common knowledge available (Meuser, M. and Nagel, U., 2010, pp. 460–461). Here the researcher contextualises the interviewee's relationship with society (Bogner 2014, p. 11) in the role of the expert, often related to a professional role (Przyborski and Wohlrab-Sahr, 2009, p. 132). From a research perspective, an expert is interested in the interrelationships (Meuser and Nagel, 1991, p. 447), experiences, responsibilities and tasks within an organisation or field, and the knowledge that is revealed (Meuser and Nagel, 1991, p. 444). This difference in the knowledge produced is based on the availability of personal experience (Froschauer and Lueger, 2020, p. 31), thus resulting in distinct interviews with the various individuals (Strübing et al., 2016, p. 248).

In the context of expert interviews, a deeper understanding of the meaning towards the research object generates new insights (Froschauer and Lueger, 2020, p. 31). This knowledge is contextual, and heterogeneous due to the specific life-world backgrounds and subjective relevance of the individuals, and therefore specialised knowledge that is essential and particularly relevant for action in their specific areas of social systems (Froschauer and Lueger, 2020, p. 31). In a social context, the assumed responsibilities of the expert and the power to control problem-solving processes represent a privileged level of access to a field, an attribute that can be found at various organisational levels and is not exclusive to management (Meuser and Nagel, 1991, p. 443). The interest in the expert is based on his power of creation and influence in the field, a power which is socially pervasive (Bogner et al., 2014, p. 13).

Crucial to the success of the expert interview is the flexibility to adapt to the expert and the information communicated and to allow the flow to reveal implicit knowledge privy to the interviewee (Meuser, M. and Nagel, U., 2010, p. 465). The continuous identification of the individuals with the desired operational or interpretive knowledge is essential to the overall process (Przyborski and Wohlrab-Sahr, 2009, p. 134). This vigilance and flexibility is also crucial for the interview guide, which can be adapted as the study evolves, including or omitting relevant questions as needed (Strübing et al., 2016, p. 248). However, it should be noted, that the knowledge-producing process is limited to the analysis of the data in transforming the interviews into transcriptions (Strübing et al.,

2016, p. 248). The process verbalises symbols and actions and conveys the analytical context of qualitative-interpretive data analysis; non-verbal components, gestures, voice and tone may have meaning in context, but are omitted from the process (Strübing et al., 2016, p. 248).

9.3.3 MAXQDA

Named in homage to Max Weber and in conjunction with the abbreviation for "qualitative data analysis", the origins of the MAXQDA computer software date back to the 1990s in the field of social science research (Rädiker and Kuckartz, 2018, p. 1). The incorporation of computer software into both qualitative and quantitative evaluation methods aims to analyse multimedia data, such as audio and video, in order to enable comprehensive computer-based analysis (Rädiker and Kuckartz, 2018, p. 1). This approach allows an extensive assessment of both the quantitative and qualitative characteristics of the data (Rädiker and Kuckartz, 2018, p. 1).

Considering the possibilities offered, the advantages of the software are justified and summarised briefly as follows (Rädiker and Kuckartz, 2018, pp. 5–6):

- Assigning code assignement to text and video criteria, using colours and symbols;
- Developing of a hierarchical category system with subcategories and codes;
- Writing memos and comments espoused with associated ideas, or hypotheses;
- Summarizing text with the same code, or case-oriented summaries;
- Searching for coded data segments in the original document;
- Combining quantitative and qualitative data;
- Linking of references, also with external files and websites;
- Keeping a project logbook.

Today, MAXQDA has become one of the most widely used software programmes for qualitative content analysis and the incorporation of quantitative purposes in combination with the possibilities of interdisciplinarity in research fields (Mayring, 2022, p. 111). Given the software's applicability and advantages, it was chosen to be used for analysing this empirical qualitative data.

9.3.4 Analysis and Evaluation Method of the Qualitative Data

The content analysis approach is based on Meuser and Nagel (1991, 2009). The expert interview is one of the most widely used methods in empirical social research and is applied in various perspectives, including industrial and organisational studies, political and educational research (Meuser and Nagel, 2009, p. 465). In expert interviews, the focus is on analysing a person's views in the context of an organisational or institutional framework, and thus distinct from the private life context, their orientations and attitudes (Meuser and Nagel, 1991, p. 442). An expert interview is an appropriate data collection method that follows a semi-structured interview guide and uses an interpretive analysis strategy (Meuser and Nagel, 1991, p. 452), with the benefit of adopting a flexible approach to allow for the inclusion of relevant and interesting content (Marotzki, 2006, p. 114) and the overall evaluation of the data material (Meuser and Nagel, 1991, p. 452). Interpretative methods are governed by the need for methodological proof of circular reasoning, demonstrating the intersubjectivity of the method by providing validation criteria for interpretations (Meuser and Nagel, 1991, p. 453).

The analysis of the expert interviews is based on content passages scattered throughout the transcribed data; the sequence of individual statements is secondary, as the experts' insights into the institutional and organisational context ensure the comparability of the interview texts, facilitated by the use of a guided interview approach focusing on specific topics of interest (Meuser and Nagel, 1991, p. 453). In exploring contextual expert knowledge, the focus is on examining reciprocal patterns within and beyond the organisations to which the interviewees belong (Meuser and Nagel, 1991, p. 453).

The questions in the interview guide represent the thematic dimensions of the preliminary analysis, but the determination of categories is not based solely on the perspectives and statements provided during the interviews (Meuser and Nagel, 1991, p. 454). The process is also motivated by an interest in exploring and defining observed categories, which ensures objectivity in the categorisation process (Meuser and Nagel, 1991, p. 454).

The contents analysis consists of six steps (Meuser and Nagel, 1991, pp. 455–464; 2006, p.58):

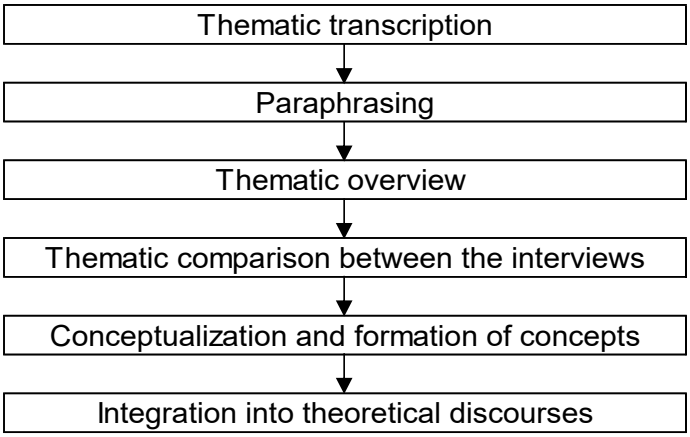

Figure 12 Content analysis in six steps according to Meuser and Nagel (1991, pp. 455–464; 2006, p.58)

The steps in contents analysis are subsequently explained in more detail (Meuser and Nagel, 1991, pp. 455–464, 2006, p. 58, 2009, pp. 465–480):

- Thematic transcription: The analysis of the data requires the transcription of the recorded interviews. The transcription can be focused on the selected, relevant segments, excluding paralinguistic elements from the further analysis process.
- Paraphrasing is characterised by a non-selective approach to the chronological flow of the interview, ensuring that no aspects of the interviewee's opinions, judgements, observations and interpretations are lost and that an accurate account is given.
- The text is structured according to thematic units, with the aim of presenting the content of the conversation in a step-by-step manner and explicitly highlighting the propositional content of the statements in relation to each category, while being careful not to distort or lose meaning through premature categorisation and compression. The paraphrasing steps aim to condense the data and to tentatively identify relevancies and categories. The comparability of the paraphrases is dependent on subsequent review and revision where necessary, and preserving the complexity of the data remains paramount.
- The next step in the data analysis process is to condense the information into thematic classifications or categories, providing a thematic overview that is aligned with the terminology provided by the interviewees. The emphasis is on context and systematic understanding, and the formation of main and sub-

categories to structure the data. Up to this point, the data is analysed at the level of the individual interviewee.

- The next step is to consolidate and compare the interviews, disentangling the individual interviewees from the data, compiling the categories and codes, increasing the complexity of the content, and finally leading to an overall organisation of the collected material. Subsequently, the texts and the interviewees' terminology are conceptualised, which involves subsuming and reconstructing the codes and categories, with the aim of systematically transferring the data into a sociological conceptualisation and applying patterns of interpretation, taking into account the interconnections between the individual concepts. The empirical generalisation transforms the initial statements into structured expert knowledge, thus providing a basis for the sociological validation of concepts, such as organisational sociology, but the generalisation remains limited to the empirical data obtained, even if the terminology used does not originate from the data.
- In the final stage of theoretical generalisation, the findings are integrated into theoretical sociological discourses and the rationale of the empirical research is used to establish meaningful links with existing theories, moving beyond a simple accumulation of concepts and allowing for a reconstructive approach to enhance understanding and contribute to the broader theoretical framework.

9.4 Presentation of the Qualitative Survey Results

The interview extracts from the transcripts are quoted verbatim and represent the perspectives and experiences of the interviewees, who are considered experts in the field. The quotes have been contextualised with descriptive and theoretical references to provide a deeper understanding of the categories made and to reinforce the theoretical discourse provided in the thesis.

Category 1: Human Element and Safety (frequency count total: 106)

Code 1.1: Accidents Investigation – Linear – Complex Thinking – Sharp End

Sub-codes: Workload, Well-being, Error, Blame, Fatigue, Education

The initial examination of the relationship between safety in ship operation and the seafarer's education reveals the tightly connected interdependencies within the broader maritime industry. Accidents and human error have been accepted aspects of the established system reflecting the complex element relations and time dependencies (Luhmann, 2018, p. 160). However, the challenge poses the acknowledgement of the ongoing changes and adaption of power relations between the elements and their context (Elias, 2006, 132f).

> *"What I see is exactly the same, the statistics have not changed within the last twenty years. So, as a company, we have to protect our investment and find how to do this. What can we do? What we try, is to keep and continue educating our seafarers. It is not an easy task because at the same our seafarers are getting, let's just say cheaper, they also have more administrative tasks, so they have less and less time within the same amount of people to do more work. What we can do is that we can automate some of the tasks, some of the administrative burdens that they have on board in order to give them more time to make tests and to prepare and to train, and to develop computer-based training in order to continue the development of our seafarers on board. And now? We think we are at a level where we have too much computer-based training. So now we have also built another administrative burden on that silo you could say. There is no easy fix on this" (E14, Pos. 3-6).*

Given its multifaceted implication within the wider framework, the human is the essential link and enabler of all system components, nevertheless human are limited to the physical and psychological abilities in the given context.

> *"There are many dimensions, and aspects. One aspect we are working now we are working with colleagues is well-being and well-being right, social, occupational, spiritual and many other dimensions, right. But of course, seafaring as a profession is very much. Special from one side, they are key workers, right, they are providing well-being for us. But from the other side, they are very much under pressure from different kind of factors make pressure on them, one of them is a tight schedule like, I don't know. Organization of activities on board, that means work and rest hours. Then, there is the physical conditions, no places to live and rest, not place for making exercises. Some more emotional people sometimes cannot manage themselves, like if they have rest hours they. Just to do something else but not resting, right, maybe some social media or drinking or something, maybe, but not resting. Some people have family issues at home, so when you think about it, it's not only the*

individual, right? Individual as himself and seafarers they are usually very resilient people. The individual can be very strong, but if the system, like the company or family issues or legislation or country like external environment makes pressure on this strong individual, then he or she is not able to be strong anymore. So I think we cannot even discuss all the dimensions here in half an hour" (E19, Pos. 6-13).

In an organization, communication as well as non-communication impact decisions, and not only shape continuous perspectives for the future but also set off a chain reaction, where initial anticipations evolve into an inevitable need to adapt to the feasibility within a given context (Luhmann, 1991, p. 203). The human actions and abilities are deemed both, an asset as well as a complex challenge on the various levels.

"In an accident people would be the greatest problem in maritime industry and because it is the people on board who will be involved in communicating and that is how jobs is done. And then, the people who would be considered to any operation on board, even when ships going to be automatized, there will be some amount of be involved because ultimately in the first place, there is people, so it does play a very critical role" (E1, Pos. 5-10).

The ship and its physical remoteness at sea, but also the physical and mental isolation of seafarers are important considerations in the human element discussion. The direct effect of the physical and mental well-being of the seafarers on the safety aspects of the work environment, has been acknowledged and require an organizational and holistic approach (Justers, 2023, p. 26).

"We don't have the statistics to back it up. But is seems that seafarers are more unhappy and depressed and I don't know a good word to say, mentally not in a good place, compared to where they were before, whatever before, and where ever before is" (E4, Pos. 77-78).

"The ship is a small organization, a small ecosystem because they function independently, because they are separated from the society, they are alone" (E9, Pos. 7-8).

"When you have an incident, we don't see all the environment the information the operator has to process, the environment, and what is going on, or that he or she is having an issue going on, the weather, or tired, or such" (E8, Pos. 7).

The perspective on human error functions as a solution, in a linear cause-and-effect thinking, providing a sense of control over future operations and enabling the application of safety measures to mitigate risk avoidance. Due to the inherent inability to foresee the consequences of acts and decisions, whether through observed action or non-action, carries risk of failure (Luhmann, 1991, p. 203). Initially, safety initiatives aimed at controlling the human behaviour, holding individuals accountable for safety, a view reflected in the criminalization of human error and bureaucratic safety approaches rooted in systematic approach of a mathematical solution to a dynamic system (Dekker, 2015, p. 2). The association with risk extends beyond legal compliance, behaviour and decisions made, but is tied to the role of the actor and to the outcome of an action, and whether deemed a success or failure (Luhmann, 1991, p. 212).

> *"So, I think directly, indirectly, yes, there is the effect of the ship's life, so nowadays, we say it was the human error, and whatever, the wrong maintenance, and all that much of corrosion or something. And then then we stop. But, but why was there corrosion? Where does it come from, where did it start? (E7, Pos. 66-67). So, it is about asking, was it this one person. And then it is easy to blame the captain because it's always the captain. That's easy. But why did steps back and then then I think broader view and saying. There was the chief mate and the chief mate who failed to inform the AB[22], who had a strange winch control. The winch control designer and the AB who is not aware of the winch and then there is a situation on board where the ship has heavy rain and thunderstorm and the touch screen does not work and you have to kick it with your feet or something and. So, I think this way we can get the complex idea" (E7, Pos. 89-93).*

> *"When being in an extreme high-pressure environment, accident, incident, oil spill, gas leakage, how to deal with that? This is very much then tracing back, until we find the human error" (E5, Pos. 14-15).*

The explanation of causes often leans towards a rather simplistic albeit preferred, logical conclusion, chosen over unknown, unfamiliar, or intricate alternatives that might evoke anxiety and fear (Nietzsche, 1997, p. 29).

[22] The denomination of an AB refers to an "able seafarer deck" certified in accordance with STCW 78, Reg. II/5 (International Maritime Organization, 2017a).

“Firstly, I think it's that kind of conclusion is the beginning of an investigation and not the end, because in itself the conclusion doesn't give you much to work with, in solving it. You could say it was the human, you could fire them or punish them, but that wouldn't really solve the problem in the long run. And we also find that anything happens in a context, in a systemic context, that could be sociotechnical or psychological or any kind of even cultural we're finding. That there maybe if you want to solve so to speak this problem, of errors or accidents, you probably have to take a few steps back and how can you design a supportive living and working environment. Because I think part of the problem is that people live at their workplace” (E12, Pos. 4-9).

However linear thinking offers a limited view and avoids the comprehension of the complex implications of the elements in a sociotechnical system, the human actions on the various levels and the technical components involved.

“I think this is a very wide field, so I don’t think that it is very often the case that the seaman is not qualified, I think often it is, that he is alone, on the bridge, and that he is tired. So, much equipment is new on the bridge, and much equipment is electronically based, so, we have performance standards, so for example we have ECDIS, but for every ECDIS you have to do a type specific course to use it” (E10, Pos. 2-4).

“I think that is almost 100% correct, so almost all of the accidents are actually human errors. So of course, even some go into the deeper root cause and it comes out that there was some wrong maintenance whatsoever. So, 80% from my point of view, I can confirm that for all accidents actually, all are somehow related to the human onboard” (E6, Pos. 2).

There has been a long-lasting view assigning failures in the man-machine relationship to “bad seamanship” and hence blaming the seafarers not thoroughly doing their part of the “job” in a system, where tasks are clearly defined and appointed (Sachers, 1995, p. 158).

“So, looking at the seafarer, it’s kind of putting the responsibility of fixing the problem of humans on the actual sharp end operator. I think it's a very difficult question, because i would not put that responsibility on them, but on the other hand, on the understanding a bit more about the system, how they work and live in, we need to

include some general human factors knowledge, about how people work, how people need to sleep" (E4, Pos. 17-22).

Code 1. 2: Organization - Safety Culture - Interdependencies

Sub-codes: Economy, Performance, Procedure, Design, Technology

Most accidents on board are considered to be caused by human error, however related to various factors such as organizational and managerial aspects, legal compliance with safety regulations, commercial pressure as well as technical failures and environmental factors (International Maritime Organization, 2019c), reflecting on the tightly knit interdependencies of the maritime trade permeating the various levels and societal needs and contexts (Elias, 2007, p. 27).

"So, human error, in my opinion it's the wrong wording, I would prefer to use the phrase, called non-technical errors, because when you use the human, you are always relate to the error and to the human itself. But human includes a lot more than just the human itself, as the operator (E18, Pos. 11). In most cases, these accidents refer to organizational error. So, this means either procedures, which are company related or let's also say also communication, which is in one way also a procedure. It's not the person itself who did it wrong up to the last moment. In most cases he is of the opinion, that everything he's doing, is quite well, what is expected by the organization, by the company" (E18, Pos. 18-24).

"You might experience problems with automatism, with machinery and using them in the right way, and I think the most of these problems you can feed back to the human elements, so, even comparing a little bit to the airline industry and what's happening over there, they have the same statistics (E16, Pos. 4). There also might be some misunderstanding or technical manufacturing problem, and there you can't do anything about it, but so there is some human element involved. An accident is not happening by itself, so there is a history which leads to this accident, and the context" (E16, Pos. 9-10).

Human error, extends beyond the individual operator and often involves organizational factors such as procedures and communication. Accidents are often a result of organizational shortcomings rather than solely individual mistakes. When sacrifices are

made for competitiveness and profit, procedures and training are compromised due to commercial aspects, resulting in an 'efficiency-thoroughness trade-off' [original emphasis]" (Hollnagel, 2009).

> *"As per my state point of view it is more than 80%. So, I would like to say one hundred percent. And I can say that without any problem, that drills on board are not carried out not in a professional way, because they [the seafarers] don't care, if it is carried out in a good way or not, because they are more focused on the time schedule, when the pilot comes onboard and the time pressure, maybe for the next port of call (E13, Pos. 5-12). To have an accident is just one little aspect of this all, and how jobs are carried out on board. Drills on board are carried out, I would like to say, in a superficial way, so, it is like this, I would like to do my drill, but I don't perform it in a professional way, sometimes because I am more focused on all the other goals, like the pilot on board, or the time schedule for the next port of call for the ship, and so on. So, for this reason, we forget what is the safety of navigation. And this means the daily attention is put on a lot of things, and then there is no time, for safety, or to perform a drill, and to do it properly, like to wear the face mask and to pressurize the breathing apparatus, to fight a simulated fire, and so, managing the situation as a team. And this is usually the reason (E13, Pos. 19-23). Following the rules, of course, means the crew has to perform a drill. But then, the way they perform it is not done how it should be. And this is not only about a drill, but also the maintenance. There is a lot of tension, about the commercial pressure. So, this is the problem in general, and for that reason, it is almost one hundred percent human error in an accident" (E13, Pos. 45).*

Effective team performance requires a supportive organizational context, and the availability of essential material resources crucial for optimum performance (Hackman, 1987, p. 331). Systematic training and education in an organisation can help support team effectiveness by addressing the needs of specific individuals and teams and providing technical resources (Hackman, 1987, p. 328). The complexity of legal compliance and responsibility in the maritime industry, influence the human error perspective, requires the provision of adequate resources, comprising of materials, tools, organizational support, encompassing communication, information, and knowledge for the specific task execution.

“Yes, education, it is a very important factor. But it's also the quality on board, you can have a very good environment in the office but if you don’t have the right resources to maintain the right level on board, to make sure that everything works as intended and to support, then that can also be a challenge. Language barriers can also be a challenge, we saw under Covid how much rest means, that is also a challenge, so you need to treat your employees fair and to communicate very open. (E14, Pos. 09-13) Seafarers need to be comfortable with the jobs they have and the training that they get and receive” (E14, Pos. 17).

“I think that is a complicated issue because the ship owner always wants to get rid of the responsibility. I think most of the time the shipping companies also they don't want the news to spread about them” (E2, Pos. 3-6).

The organizational communication lines, are associated with the safety culture established, where the enforcement of compliance in a top-down approach limits openness to reflective organizational learning opportunities (International Association of Classification Societies, 2021). The support of communication on all levels is essential, information may be available on a hierarchical lower level, however crucial to the organizational level and to the management in reviewing and adopting procedures and protocol in the promulgation of safety and risk minimization (Manuel, 2017, p. 165).

“Culture on board is a term used for how things are done, so about behaviour, and doing things safely. So, culture, it's more on the lines of rules, of what is right and what is wrong, it’s understood as right behaviour and wrong behaviour” (E17, Pos. 28-30).

“From the point of view from the management side, there are all kind of problems in the organization and in the organizational network, all coming from the human behaviour. This means, that the human factor is the general condition for all different incidents, all different accidents, for different positive elements also, because all organizations are consisting of people” (E6, Pos. 3-5.)

“It is the place where you make sure, that people are safe and comfortable and supported in doing their work they are generally are quite good at” (E4, Pos. 71-72).

The individual actions and behaviour are strongly related to the individual norms and values and to the social interaction within an environment, hence the perceptions of the

collective behaviours in the work place extends to the culture of the organization (Manuel, 2017, p. 52).

> *"If we look at the organizational culture level, I think that is really important that it has to be an increased understanding between ship and shore. And that goes both ways. And this goes back to feeling safe, to give feedback. Most of the issues seems to be on the organizational level, which of course isn't one level" (E10, Pos. 55-57).*

Communication and decision-making are integral parts of risk assessment in organisations, impossible to be based purely on rationality, and taking into account all the factors and possibilities of a situation and its future development; eventually a decision entails the necessity to take subsequent decisions, and determines the inherent progress (Luhmann, 1991, p. 203).

> *"Yes, from the point of sciences, I think that all organizational networks are coming from the human behaviour, so the human is the general condition for different incidents, accidents, because all of the organization they are all consisted of people, and material resources. So, decision making is oriented on the effective usage of material just to be working, and the making depends on human behaviour. So, I think maybe a bigger percentage should be mentioned that for the human factor influence on accidents. Of course, maritime industry is a part of the global, it's international trade, yes, So human mistakes more important role for the International trade for example chain functioning. So, I think this is really true and the person's percentage could be increased a little bit, maybe 85 or 90% could be human factor mistakes" (E9, Pos. 2-5).*

> *"I think it's a very limited view and also a view looking at hindsight. There is an underlying reason where people are involved in people business who make mistakes, and incriminate for human error" (E5, Pos. 7).*

Understanding the various aspects which form a shipboard culture is crucial but often unclear, involving stakeholders from the wider industry, including maritime academies, training institutes, shipowners, and the management of companies.

> *"In respect of shipboard culture, more could be done, in terms of research, understanding and enhancing culture on board, it is a very important topic, but not well understood, and how it can be assessed. In fact, what this concept actually means. So, studies on how this culture can be actually understood and measured,*

and how it can be reinforced from time to time onboard. So, that would bring a better understanding among the stakeholders. So that again starts at the academy and training institutes, but also involve people like shipowners, and at the top management of companies, they could play a more active role when it comes to shipboard culture. So maybe some more could be done, more in depth, not just quantitative" (E17, Pos. 51-59).

It has been recognized, that incident investigation models have limitations in terms of the time taken for the overall investigation and the consideration given to the complexity of the wider system components, where conclusions point to human error as the ultimate cause of system failure rather than at a holistic system improvement.

"I think maybe that our incident investigation models are not good enough and we stop too early. When we have found something like an error, we stop and say, 'ok, it's a lack of safety culture, this is the problem'. I think. So, we haven't really got the knowledge behind this statement." (E8, Pos. 5-6)

"In Germany we still tend to have the blame-the-single-person mentality if there was an accident, as a tendency: In Scandinavian countries, there is a different tendency, the main goal is not to find one guilty person, but to find the system failure and to improve the system" (E4, Pos. 85).

"It is about asking why things happen, and so I think that the incident investigation models maybe obsolete" (E3, Pos. 8). "There I think is a very different approach, because in a nutshell nothing different happens, somebody did something wrong, one person pressed the wrong button, but the investigation is different. This is interesting, why did he press the wrong button, was it a wrong training? Or, I don't know, was he unconcentrated or was he tired, was the wrong button placed wrongly, so was it simply a design problem? So where is the systematic challenge that you avoid that same mistake happening a second time? So I think that is this the main question when we talk about human error, where is the systematic behind it, was it this one person? And then also, it is easy to blame the captain, because it's always the captain" (E3, Pos. 86-88).

The maintenance and compliance with performance standards and procedures or regulations is a task of the crew on board. When challenges arise, the risk is with the sharp end operators (Hollnagel, 2009, p. 127). A communication system providing support enables the enhancement of knowledge, motivation and togetherness, making

the overall processes better understood and safer, while appointing the responsibility solely on the crew has a detrimental effect on an organizational culture, and lacks of a holistic learning process (Manuel, 2017, p. 67).

> *"One of the biggest challenges we have on board today is, the testing of life saving equipment. The crew onboard has to do the risk assessment by themselves, before the first training. And that could easily be done by teams via video before the exercise. So, before the exercise is done, the office, or the manager is comfortable with the performance, and for the test to be done by the crew themselves. And having such video call with the team before, that could that could maybe limit the accident ratio, and it could be seen as a strong tool" (E14, Pos. 56-58). "Blaming and blaming is not the way forward, caring and sharing is the only way to build a good relationship. And that is needed because you cannot have small units sailing around in the world without having an open communication, that is the only way to build trust" (E14, Pos. 68).*

The design and availability of technological equipment on board are the result of financial calculations that impact the final performance. Considerations such as equipment setup and design are important components of a comprehensive system, closely related to the abilities and behaviours of the final user.

> *"I think I I've read an interesting approach, so, it says if you only go for the first step, it is 80% human error. But if you would then investigate further, you could find out why this human did an error, and then very often it turns out, that it was, I don't know, the setup of the screen or something, the design, so I think it's questionable if this is always the real root, and it might be the only the first step of what really happened, so it is not the real cause" (E11, Pos. 3-5).*

> *"Involving this wider view, including the hardware, the technical and the human, as the operator, and really having the whole picture of the system looked at" (E7, Pos. 81-82).*

> *"Either the system itself made by the programmer who did not understanding what the system needs to deliver or it had been the users not using the system as intended" (E10, Pos. 6-7).*

> *"You need to make sure that they have the adequate and well working resources on board, so that they are able to do their job. So, a small example, if there is an engine*

problem and you cannot get the resources to fix it, that's a problem, because it's their safety, say, it could be small problems for seafarers on board to feel protected" (E13, Pos. 14-16).

"What I think is, that we have not enough statistics saying and proving how often was the human element the rescuer of the situation. So, accident investigation usually stop investigation after having found one man or one woman being guilty for something. It might be an easy thing to say, ok, we have 100% of accidents. But we have to look into these accidents. We will always find someone to blame. And that's why, ok, it might be, and there is always a human involved in an accident. So, I even would like to express a hypothesis. I have no statistics available, anyway, in each and every accident which is blamed or caused by human error, or which mentioned human error as the reason, I will find a technical piece of equipment which has not functioned according to IMO standards. In a number of cases the human has taken the good action and is the one that failed, for whatever reason" (E12, Pos. 12-16).

"Maybe we say it's more than the single seafarer standing on the bridge and doing his job. I think that is what makes the human element interesting that it's not only one behavioural thing, to improve that, and then everything is very easy" (E14, Pos. 78-79).

"If you are researching the manning levels, how do the companies deal with this kind of legislation, because companies are under pressure, they want to compete with others, if one more efficiently, than the other, of course, but who thinks about the people, so it's a very complex issue" (E19, Pos. 15-18).

The integration of technology and automation in nautical work has not necessarily improved safety aspects in the industry (Window, 2023, p. 5). It is important to acknowledge the valuable contribution of individuals at various levels in enhancing safety aspects. This should be seen as a responsibility to enable and improve the system, rather than a mere legal obligation to comply with regulations (Dekker, 2015, p. 2). Despite technological advancements, the human element remains crucial in the maritime industry. Shipboard operations, safety, and communication rely on people, highlighting their essential role even in the context of autonomous shipping.

"The human element plays a very important role in a majority of the maritime accidents and accident investigations. In my opinion the people would be the greatest asset when it comes to the maritime industry because ultimately it is the

people on board who will be involved in automation, it is the people who communicate and that is how jobs get done (E17, Pos. 5-7). People are to be considered to greatest asset in any operation on board, even in talks about ships going completely autonomous, there will be some amount of intervention involved because ultimately who created the automation in the first place, so there were human beings involved, so it does play a very critical role" (E17, Pos. 9-10).

Category 2: Competences of Seafarers (frequency count total: 154)

Code 2.1: Complex System Management

Sub-codes: Digitalization, Automation, Awareness, Problem-solving, Stress

Expert interviews were examined to identify the core competencies considered critical and the knowledge required to achieve them. The questions facilitated the inclusion of "specialized knowledge justifying the status of the expert, as opposed to the common knowledge" (Meuser Nagel 2010, p. 460), relating to the expert status assigned to the professional role, thus understanding essential knowledge and skills, drawn from the interviewees and their personal experience in the maritime field. „Von Kompetenzen kann nur dann gesprochen werden, wenn man grundlegende Zieldimensionen innerhalb eines Faches benennt, in denen systematisch, über Jahre hinweg Fähigkeiten aufgebaut werden" (Klieme, 2004 quoted in Rohlfs et al., 2014, p. 45). The term competence is used to depict the degree to which individuals fulfil requirements and possess the abilities to successfully perform tasks and address challenges specific to their work (Klieme et al., 2007, p. 5). In the dynamic and complex maritime work environment, core competencies include an individual's motivation to learn, where problem solving, setting and achieving goals and conflict resolution are all linked to the ability to apply interpersonal skills in a sociotechnical context.

"First of all, it is awareness and that for all aspects of the jobs, including the ship, safety, navigation, cargo safety, and of course also the environment, and efficiency" (E1, Pos. 11-12).

"The core competencies would be understanding systems, thorough understanding of processes, how to work with technology. So, it would be and amalgamation of processes, so, the more soft skills along with digitalization, some background and upscaling yourself would be very important for a seafarer" (E17, Pos. 12-13).

“There is a plethora of soft skills involved, but at the very edgy level, the soft skills would be communication, I think that would be the key. Along with the communication you would have accountability, and that again would be a core skill. Learning orientation, would be a core skill if you are taking a cadet at the entry level, it would be a high level of learning orientation where he's able to identify objectives, able to solve problems, and also looking at achieving goals. So, is he able to set targets, and is he able to achieve target that are assigned? Is he able to overcome the challenges and how is he trying to overcome those challenges? I guess this would be the core skills because it's a very complex environment” (E17, Pos. 15-19).

Seafarers' roles have evolved, requiring skills beyond traditional sailing, including management and organization. While sailing remains crucial, increased complexities, automation, and additional responsibilities demand a broader skill set, making seafaring a multifaceted profession.

“Overall it's a dynamic environment, which includes problem solving, reasoning, communication, learning orientation and achieving goals. And then you have the higher order skills, so again, communication plays a key role, and conflict resolution, interpersonal skills, also taking responsibility, so leadership would play a very core competency there” (E17, Pos. 20-22).

Maritime professionals, both at sea and ashore, require a comprehensive understanding of the sophisticated onboard systems, including digital and soft skills, to effectively meet the demands of the dynamic maritime market (International Maritime Organization, 2024c; Maritime Technologies Forum, 2023).

“The competencies of a seafarer, I think it's changing, for the future. In former times, *there were less complex elements, less workload, less things; there was just sailing the of a ship from A to B. And meanwhile, a seafarer has become a manager onboard. They have to do more than just sailing, so they need more competency than just to sail a ship, competencies besides sailing, you have to do the management, the organization, bureaucracy. So, that does not mean they have less competency in sailing, no, it should be the same skills, you have to sail a ship, have to bring it safe into harbour. But the other parts are getting more complex, and getting more and more overall workload, and even more with the automatism. That sometimes overloads the crew. So, sailing is just one skill a seafarer has to have,*

one part of his competencies, the sailing of the ship, but there are much more competencies for the future besides this" (E16, Pos. 12-17).

Effective soft skills involve both education and practical support, based on knowledge and the ability to access necessary resources and receive the support required.

"Soft skills can be education and it can also be support. Let's say something very, very simple: you have some equipment on board and it's not functioning. If you cannot help and identify the resources in repairing the product, and then you leave it sometimes up to the vessel to do what is needed to do to fix the issue, that's not good support. When we are talking about soft resources, then yes, it is also about the education. But they need also another support onboard, because they can't source and fix the problems by themselves, something as simple as user manuals or technical descriptions, and a lot it is about this, when the vessel is too technically built, and you cannot source the support. Then all the equipment is just left unused, so there is a gap somehow in whole operation when it is not working as it should be. This is also part of the soft skills needed" (E14, Pos. 28-33).

Seafarers need technical navigation skills as well as essential soft skills such as communication and teamwork to effectively manage the various challenges in non-routine work environments.

"They should know how to navigate the ship, how to control, how to manoeuvre the ship, all the conditions that might occur. So including all the weather, all the environmental conditions including the ships status, so all about the loading conditions, trim, and of course they need the skills to know how to manage shortcomings, technical failures, how to compensate non-technical skills, soft communication, culture. Essential also for a seafarer in the future, we remain human individuals that compensate our shortcomings by working in a team, yes, so communication skills, team working, team leading, these are the main things we still need in the future. If on board, if in a control centre, wherever, this remains" (E12, Pos. 19-27).

"There are very clear human factors that range from awareness, to team work, or the lack of working together, all connected to communication and learning from each other, knowing about assumptions, creating a backup from the incident reports that are connected to human error. Especially this is connected to all the parts of work, of routine work and being in an accident or incident, like an oil spill, or extreme high

pressure and work load. It is about communication and learning from each other and avoiding assumptions, creating a backup behaviour" (E5, Pos. 9-15).

While the ship and the maritime industry have become highly automated, with prospects for greater levels of automatism and minimal need for human intervention in routine operations, the necessity for human involvement still remains crucial in addressing unforeseen or undefined situations (Rasmussen, 1979, p. 7). The advancement of technology, automation, and remote-control operations is reshaping the role of seafarers and requires a reconsideration of educational procedures for the overall ship operation.

*"Automation systems and the safety characteristics in this field coming on board in the future, of course this will be important to understand" (E11, Pos. 17). "Also**, in** the future, even when the shipping environment will change, of course, we will come to the autonomous shipping but especially when we are working with autonomous ships, it is more important, to have this situation awareness and also, the ones who will take care of these autonomous ships. They must have every important detail, they must keep in mind all the technical parts and details of everything in mind. How is the condition about everything onboard and how is the situation around the ship? Is everything in good condition. So, that is the most important, and it will be in the future" (E11, Pos. 52-60).*

The job of a nautical officer and the associated tasks and competencies has been evolving over time, from the initial stages of education to the advancement and assignments in responsibilities in the ship's hierarchy and moreover in a role within the bridge team (Window, 2023, p. 5).

"One aspect might be, that they [the seafarers] know the sensors and that they know how to read them, how to understand, something that can really change the job in the future, the work or the communication with a remote-control operator and how it looks like" (E7, Pos. 15-18).

The idea of seamlessly substituting human work with automation, and consequently achieving greater safety and efficiency, is rooted in the Taylorist principle of linear division of tasks, and is referred to as the "substitution myth" (Dekker, 2015, p. 207). However, it fails to recognise that automation changes tasks and leads to new system complexity, which in turn prescribes the transformation and adaptation of human practices within complex system management (Dekker, 2015, p. 207). The development

of a sustainable training structure that integrates advances in automation and autonomous shipping requires the active involvement of all industry stakeholders. Strengthening seafarers' analytical and digital systems skills, communication and decision-making are areas found currently deficient in education.

“We also need to look at the technical system, the design of technology, the design of alarm systems, so that we can prevent incidents and accidents from happening, and that's what's costly in the end. Basically anything else you like, that comes in your mind, which would add to it. It is a way for a business and a maritime company to work more sustainably and to look more into its policies: do we need procedures, training, competency development, recruitment” (E3, Pos. 43-44).

“In the future, it is the Human Computer Interaction. This is like a new architecture model. And if the seafarers have strong hardware competencies, they know what they have to do, with the equipment onboard. If they have strong soft competencies they know how to keep communication and other soft competencies effectively” (E15, Pos. 43-44).

“Automation is a prerequisite in the future. And a higher demand on digitalisation onboard, and certainly reporting, safety procedures, performance, to be able to work with digital solutions and also the flexibility to work with new technologies. We will see new technologies, which will have a hazard, methanol, ammonia, or it might be hydrogen, which is super explosive. So, awareness and knowledge to operate the system is certainly required” (E2, Pos. 16-22).

“The understanding of what is happening, how systems work together, will be even more complex in the future. Automating some layers of artificial intelligence will be very challenging for the human in this loop, and to expect them to be both an engineer and a mechanic and a navigator. I think you have to make some choices there about the competencies, to give them a broad education. A lot is stemming from technology and mathematics, this is required, as the ships get more advanced (E6, Pos. 15-17).

“We always have to be aware of the limit of the system and how to use the system and why. Only then it's useful. We have a tool with some buttons, something, but nobody knows what this means really. To me at this point, it is something we have to include more, and those who make decisions about remote controlled vessels. Also, they need strong analytical and digital competencies in the future and from

my point of view this is the weakest part of the seafarer education at the moment. There are plenty of methodological tools for hardware and software competencies development, but they don't have enough competencies in methodological data analysis, in decision making and working together with digital systems" (E9, Pos. 12-17).

Code 2.2: Cognitive and Interpersonal Skills

Sub-codes: Communication, Team, Leadership, Culture

Effective communication, intercultural and workload management are considered to be at the core of seafarers' skills. Training needs to be relevant to the specific duties, context and position on board, particularly in developing leadership skills and effective resource management. Drawing on Pestalozzi, Reichenbach (2014) reiterates that competences are a combination of 'knowledge, skills and dispositions', where task-specific knowledge and skills are applied together with individual and cognitive abilities (Reichenbach, 2014, p. 45).

"I think what we have learned over of the last decades is definitely, that at the end of the day, it is about communication. And when we talk about soft skills this means, in a nut shell always various aspects of communications: communication about special situations, communication about standard situations, communication about conflict situations and communication with other cultures. But in the end it is always about how we exchange information and how we perceive and understand the information, and how we do our own interpretation about the information that we have exchanged. And that is maybe something that is really visible in this industry and in other industries: the way, how the communication is done. That is really the core of it" (E7, Pos. 25-29).

The understanding and adoption of interpersonal skills involves a gradual process of skill acquisition, application, and continuous improvement over time.

"For the training of this non-technical skills, it should be done before vocational school is finished, but in most cases, this is not really the case. So, it should be started, at least when the cadets start the classes at the university, there they can reflect what they had experienced, on their seagoing service, and based on this to build up" (E18, Pos. 106).

“The development of the skills at the interpersonal level, it is very important, to develop right at the entry level at the maritime academy” (E17, Pos. 48).

“The ongoing process of communication, the team skills, the cultural understanding, all of these should be trained. We can see that transformation, especially in a lot of the twenty-first century skills. These are all elements which cannot be trained once at a specific moment and being mastered at once. In terms of learning and development, if the basics are not set at the university, then we face the situation, where one says later, why do I need that now, in the maritime world? I would say, that it needs to be a part of daily, normal skills training, if you do this profession” (E5, Pos. 65-66).

The ability to succeed in emergency and high-pressure situations depends on continuous training in communication, teamwork and cultural understanding, and the gradual application of these skills in practical contexts.

“It is about being much more confident when a situation develops from routine to high pressure. That is the time now to be a high performing team, being able to manage that situation and not to freeze. I think the difficulty or the huge challenge from a seafarer perspective is, that these challenges never go away” (E5, Pos. 28).

“Very important, the soft skills. And I think I would name from my experience the ability to think and to behave under stress, and the stress from the overall ships operation” (E2, Pos. 27-29).

Shipboard work and life is traditionally organised in a hierarchical structure defined by assigned ranks and associated qualifications. Therefore, the application of leadership and team skills must be understood as the ability to flexibly adapt resource management skills to the context. The integration of diversity and the consideration of individual contribution is part of the information process to enhance safe operations. Teamwork is a core competence in the circular, adaptive and flexible learning process involving intercultural communication and cooperation, in the vertical and horizontal integration of human and technical resources.

“It is always about the awareness or lack of focus, or a lack of motivation or the ability to work together” (E18, Pos. 13). “Seafarers have this every day, this integrating, forming teams, that kind of intercultural team composition. You need to create focus already on the academic level. Then, a few people work together for a

few days, they need to change, and then there is again a crew change. New people come in, and the need to integrate them. This whole process needs to start again and again and again" (E18, Pos. 29-31).

"The skills required, of course, communication, and cooperation are an issue, especially when it comes to team work at the manoeuvring station. But I would say, 80 to 90 percent are the technical skills for the support level. Then, on the operational level for junior officers let's say, is still technical skills and navigation, engineering, whatsoever, and 40% social skills, but on the management level, for the captain, chief engineer, there the communication, cooperation and leadership becomes even more important" (E6, Pos. 8-10).

"The problem is, with leadership, how everybody defines it, and in the literature, how it is expressed there, in several ways, there is not one decision and there is not one way of leadership. So, every master, let's say I reflect on the master, must develop his own way of leadership, there is not one way, because the kind of leadership is related to your personality. You cannot say this is good leadership and this is bad, so everybody must try to develop, based on general ideas and on his own individual idea about leadership" (E18, Pos. 92-98).

"Always, people need to reflect and act on what is my personal leadership. How do I interact with others? What are the team dynamics, do we have a team? How to integrate and communicate best with this person, best for all of us, and in a language, which is a second language for all of us" (E3, Pos. 62).

Traditional shipboard organisation follows a pyramidal hierarchy of communication and decision making based on rank and responsibility. The active promotion and training of team skills encompassed in the application of "Bridge Resource Management" (International Chamber of Shipping, 2022, p. 27), have been critizized for being ineffective (Griffioen et al., 2021, p. 4). In assessing the effectiveness of a team, Hackman (1987) proposes three criteria, "output, social process and group experience", with an emphasis on the team members' self-assessment of achieving an acceptable outcome, as a challenge to develop strategies to enhance team effectiveness (Hackman, 1987, p. 323).

"We have this maritime resource management courses, but, I think we need some more time until this is coming in the mind of the people" (E11, Pos. 18).

“The most important is the situation awareness, that is the most important skill humans must have on board. Mostly they don't pay attention to what is going on around them. That's it. So, there must be more situation awareness, that is the important skill they must have” (E11, Pos. 37-45).

“Everything is working fine on a vessel when all crew members have the idea of belonging together, having some kind of a family on the vessel” (E15, Pos. 25-26). “If you have a mixture of many different nationalities on board, language might be a problem. This will be English, and it is important, to have a common base to have a good and clear understanding for all crew members. This is part of communication. Otherwise, you have some guy standing outside the box, so to say” (E15, Pos. 29-31).

“It is so important for the crew to work together. So, there is a leader, the captain, and the officers and the crew, but there is no single person who can sail a ship, so it's a teamwork thing. So, there is one leader, who has to lead the team and to take the final decision, but there's all the team, it is necessary that the crew acts together and has one target together. Mainly, to streamline this, the leader might form this team a little bit, but always makes sure, that everyone in the team sees the responsibility by himself. For acting as a team member and informing your team, and the knowledge, best behaviour, best possibilities, best resource management. This crew management is vital to the operation on any machinery, on any outcome, in any management of company, or ship. So, there is the master, and he used to do everything by himself, and yes, he needs to take the decision. But to come to the best solution, he needs his team, and maybe to convince him from another point of view or to take another decision mentioned, the importance to see all the possibilities, this is the knowledge he needs” (E16, Pos. 23-28).

“Having the communication skills, that's an absolute must. Having the skills to work together is also an absolute must. Having the systems and the understanding of systems that support you in that process is also a must and can also be a big barrier. So, communication skills for students is absolute essential. Because the students one day will end up becoming either a vessel manager or someone in the office, so they will be the ones who have to educate and understand how to communicate and they should know how to deal with issues” (E14, Pos. 43-46).

“I consider non-technical skills essential, but it's hard to say, exactly, this, this and this. So, communication, leadership and also culture. This means, you must be aware of all these differences, but it's really hard to say, because it depends again, on what you define with leadership” (E18, Pos. 45-49).

“The most important thing is, and I cannot stress this enough, it is anything to do with the soft skills. Sure, you have to train how to sail a ship, and you must know the technical things, but it is not the objective to perfectly know this. You have to sail safely, sure, but this is just a little part of the job now. You have to know the soft skills, the work with the crew, how to bring them together. Without a functioning crew, you are not able to sail a ship safely. You might reach the harbour, yes, but this is not enough, and it is not possible without a functioning crew” (E16, Pos. 69-71).

The approach to cultural understanding is based on subjective interpretation of other cultures’ behaviour (Hampden-Turner et al., 2012, p. 275). The habit of stereotyping and cultural “dichotomising” is a view that derives from the linear thinking based on the “hard science of Newtonian physics” (Hampden-Turner et al., 2012, p. 273), that is still prevalent in the 'Western' world, a mathematical and methodical approach to measuring and solving problems (Hampden-Turner et al., 2012, p. 274). Working and living on board, however involves a shared understanding of a work culture and a resultant application of a safety culture, where the concept of stereotyping has been recognized as an existing issue in maritime industry (Manuel, 2017, p. 169). Awareness of cultural differences, and skills in intercultural interaction and communication techniques are essential to safe working practices and to avoid harmful effects on social and mental well-being. However, the existing provisions on cultural awareness within the STCW framework are considered inadequate and inappropriate to meet the needs of seafarers (Manuel, 2017, p. 169).

“Well, of course you must know that different cultures have different things in mind. They behave maybe in another way and they work maybe in another way. But I think this is not so important because we all have same aim when we are on board, primarily, that is most important” (E11, Pos. 68-69).

“To work as a team, you have to share one kind of culture. So, this means you don't have to care about your religions, or, you know, anything special that is private and belongs to the seaman himself. And this may also cause problems when you are getting into conflict with your private thoughts, private ideas, when you bring it into

the team, so it needs a separation. When working on board, as a team, you have to find one way of living, one way of acting. Maybe you can describe this as culture. And so, for this privacy things, there is little time, or no space, and you have to keep it for yourself. It is like a separation in the mind. And this may also cause problems or conflict with your private life" (E15, Pos. 46-50).

"Culture means, it's part of the communication, because you have to know how to you have to deal with people and you have to be aware of their cultural habits. So, for a seafarer, the working place is the world. From their thinking, they're sometimes national minded. And not open for other cultures and so on" (E18, Pos. 57-65).

"If you deal with people from other cultures, you have to use maybe other techniques, as a leader for communication to reaching the expected goal (E18, Pos. 69-72). One example is, if communicate, not to individuals, but just as a culture you know, with people from Eastern Europe, you really have to be tough, you know, when you communicate with them, really tough, so if you communicate in that way with Asian cultures, you might fail. This means, you must always be able to adapt your techniques to the cultures, to communicate with what you expect from them" (E18, Pos. 75-80).

Category 3: Knowledge Transfer in Education (frequency count total: 130)

Code 3.1: Human-Machine Interface

Sub-codes: Simulation, Role-play, Behaviour, Resource Management

The educational discourse has acknowledged the difficulty of transferring and measuring knowledge of soft skills such as communication, conflict resolution and leadership, applied in multicultural work environments (Reichenbach, 2014, p. 47). While the importance is recognised, the challenge is to measure the effective transfer of this knowledge and moreover, the acquisition of these skills (Reichenbach, 2014, p. 47). Individuals and organisations must possess the necessary competence to apply both "cognitive and affective aspects", and utilise information, knowledge, and resulting skills in context (Kieback et al., 2017, p. 10). Competence is recognized as observable behaviour and action, only "if it is defined beforehand with regards to what this competence is supposed to constitute" (Kieback et al., 2017, p. 10). Higher education must equip students with the necessary skills to meet the demands of developing

knowledge societies, including not only subject knowledge but also critical thinking, creativity and social skills, and ensure that students adopt a lifelong learning attitude (Hoidn and Kärkkäinen, 2014, p. 47). A sustainable approach embraces the strengths rather than the weaknesses or failures of humans, and supports them with integrated automation technology tailored to complement human work at different levels.

> *"The skills that the industry is asking for are on a high level and difficult to teach and difficult to assess. Skills, like being prepared to learn and knowing what to do in certain situations, being a critical thinker and being at the very high level in the education system, where they would probably have learned all that, is closer to a PhD level, that kind of a topic description. Which makes it difficult because you can't really imagine everyone being captain, having a PhD, being McGuyver, problem solver, all at the same time" (E10, Pos. 24-27).*

> *"The thinking is, if we teach people more about themselves, all would be better. But I think, it needs to be a systemic approach and I can't tell you how to do it. When you list a lot of things they need to know, then it is getting too technical, so, by the end, you should just teach them not to make mistakes. But how? It is the human condition and there can be one way to react to the same situation and it can lead to a total different outcome depending on factors we don't have complete control over. So, probably the best thing is, to know what people are good at, and support them in that part of the work and try and automate if you like and some of the other bits if they can be broken off from the holistic work system without creating a gaping hole" (E4, Pos. 121-134).*

> *"It is the continuous personal development in let's say people skills, and then also a way of developing the agility to acquire new technical competencies, the whole system of technological systems and intercultural aspects of the environment" (E5, Pos. 44-46).*

Role-play, as an activity, brings the participants beyond their established and familiar comfort zone and has a profound effect on the learning process. This promotes the possibility of double loop learning (Manuel 2017, p. 63) and the openness to reverse mentoring.

> *"When you are put into a scenario, and then you are evaluated by your peers and the trainer, it is not very comfortable, but you learn a lot. You get out of your comfort zone" (E11, Pos. 48).*

"Make it some good role play where the theory is put in place and in a controlled setting where they feel safe, and that they will remember. Some kind of scenario would be very great. You just give them the theory and some writing stuff, it will not stick in the mind, so they need interaction with other people and discussing and evaluating what happened. I think that this is the best" (E8, Pos. 45-46). "The educational part is very much about assessment, hard facts, books and achieving some kind of marks with doing something like exams, but without something like role play. So, it's technical or it's other skills. So, combined in a way. You still have more or something better, in a way" (E8, Pos. 50-52).

Various forms of exercises can be used and combined, including regular feedback and evaluation as an essential means for the development of skills and competences.

"If you have something like a team of experts within the academy who could be looking at these behaviours, you could look at personal behaviour and the sense of responsibility applied, let's say on a quarterly basis, through role-play, through exercises, through informal forms, these skill could be assessed and further developed" (E17, Pos. 44-46).

"Early training in digitalization and in communication helps in a lot of issues. To give feedback and also to keep an open communication is important. Video is a very good example, like having this meeting now. Most office people are accustomed to working like this, remote, and having meetings online. For a seafarer, this might not be normal and they might not have been educated in this. If they were, it would be so much easier just to make a team call and to communicate like this. And I think that would combine so many topics, the technical let's say, and this shared idea about the understanding, and communication" (E14, Pos. 51-53).

The use of simulators provides a contextual and complex application of technical and interpersonal skills in an environment where the workload is high. Emergency situations training can be effectively done in a bridge simulation exercise, while assessing the adoption of human behaviour in specific situations (Window, 2023, p. 5).

"During education, I think there are many ways of studying. For example, using the simulator is a way for training the situation awareness, of course. That is one of the best possibilities you can have, because they can simulate the different situations, and also stressful situations. And then they can train to see, how was the situation before, and then, understanding all the details and how to handle these situations,

and to handle the stress and to use all you have, and this is a good training for the situation awareness" (E11, Pos. 103-105).

"Simulator training is a good choice, the bridge simulator, table top exercises, this kind of things, where they really have to interact and communicate with each other. I think that this is the only way, because they get direct feedback, they get real feedback. That is what you need in order to change you own behaviour" (E7, Pos. 64).

Bridge Resource Management involves all the internal and external resources and the application of non-technical and technical skills required in a situation (International Chamber of Shipping, 2022, p. 28). The development of skills occurs progressively during the training phase and throughout one's professional life as experience is gained and espoused with repetitive training (Griffioen et al., 2021, p. 4).

"Basic knowledge, basic understanding before you take your first step onto a ship. I mean, the basic things you have to learn, it is the hardware, about the ship and how to sail the ship. And from my opinion, it is a good idea to get the basic understanding about the training before working on the job. This means, the basic of the resource management, what they expect from you as a part of the team, and what your life is on board. I think that the things which belong to sailing and the resource management, there is always time to learn more and to be further trained, the longer you are sailing, maybe on board or maybe off the ship, during training days in harbour, but the basic training must be done before" (E16, Pos. 35-37).

"Acting out" in given or chosen roles, integrated into simulation exercises, provides a safe learning environment for experimenting and reinforcing skills (Carson-Jackson, 2010, p. 15)**.** This approach facilitates individual and team learning, particularly in interpersonal activities involving leadership, communication and cultural awareness, where the emphasis is on the desired real-world outcome (Carson-Jackson, 2010, p. 15). Individual competencies should be aligned with the knowledge and skills associated with the skills and tasks. While critical thinking and problem solving skills and a willingness to learn in a technical and interpersonal context are essential, the expectations of an individual to excel in a role or skill should reflect a realistic approach to the nautical profession and the competencies required.

"It can be done integrated in parts, teaching some parts like simulation, feedback, team, depending the object But it can also be teaching in a separate subject, some

extra-teaching, let's call it. I do believe that we carry our experience with us. What we do today is, we put students in low fidelity simulators and the paying customers in the high fidelity simulators, when in some way it should be the other way around, because you could put a very experienced team of navigators and the pilot into a quite low fidelity situation. But if the situation is really sticky enough, you know they come out with sweaty palms. You know this because, they know, that they just fixed this. They have the experience and they have this image and they carry this image with them. The students, the younger ones need more help in building this mental model of situations. They need more realism I suppose. That not only goes for the teaching the technology, but I think that that goes for the content and the teamwork and whatever we put them through. Try and anchor it how it is going to be like out there is as much as we can do" (E4, Pos. 100-107).

"For the development in the technical and the social skills we have a huge training centre in the Philippines. Even with our senior officers, and the officers on the operational level, before every employment we train them to become even more confident compared with what requires their job description" (E6, Pos. 18-20). "We actually train in a real-life scenarios, based on poor examples from the praxis from the past. And we try to solve this" (E6, Pos. 29-30).

"We are saying that there will be people there, we talk too little about what that actually means, so, they must not feel alienated towards the technology and still need to make it a good workplace because there are still people with hearts and minds and feelings. I don't think they change that much because we get more advanced. So yeah, we need to be even more mindful about how we can make a good work environment for the people" (E13, Pos. 30-32).

Code 3.2: Informal and Work-related Learning

Sub-codes: Cooperation with the Industry, Social Interaction, Sports

"Learning a skill implies a process that includes acquiring and processing information (mental activity), translating the information into coordinated action (mental and physical activity), and using repetition to increase efficiency" (Carson-Jackson, 2010, p. 13). Hence, "practice is connection, meaning making, sociocultural entrenched, and life-giving" (Spry, 2018, p. 643). Repetitive action is essential for transforming knowledge

into meaningful skills and, especially when learning from mistakes, as a tool for reflective exploration and development of knowledge (Spry, 2018, p. 643). This has been reiterated by the International Maritime Organization (2020a), which emphasises the integration of case studies and lessons learned from shipping companies as an effective training method to improve overall safety awareness and to reduce risks associated with the human element (International Maritime Organization, 2020a). Additionally, problem-based learning, involves scenarios or tasks related to job-specific details or accident scenarios, promoting analytical and critical thinking, as well collaboration and trust in team interaction (Carson-Jackson, 2010, p. 12).

> *"I think the competences should be a mixture between theoretical knowledge and practical skills" (E15, Pos. 10). "I guess training should be a mixture of some theoretical knowledge and some practical experience. And then back again to theoretical, to start again with some own experience, this is how it should be" (E15, Pos. 14-15). "In terms of safety, for example as theoretical knowledge let's say, safety is very important, so you need to get the information, about the safety appliances, about how it works, what is your equipment and where is it located on the vessels. This could be done in a theoretical way. But then later on you need to you know how it works, to try it out how it works and as an officer you must be also able to show the other crew, how to operate this equipment. So, it is a combination of a theoretical part and practical skills as well" (E15, Pos. 18-19). "Training of the soft skills, like communication, should be trained right from the beginning of your education, from the first day of seafaring, and to develop some effect it should be trained until you are finished with your education, so it will be a long process. You need to get familiar with it and it will grow up during the process of education. This will take years in education" (E15, Pos. 52-54). "At the beginning of the career, as a nautical cadet or trainee, who steps on board for the first time, and gets some first experience, and impressions, it's about getting in touch with the way of life, on board and to pick up the system of a ship and of the work later on. For example, when they are back for schooling or studying, they can be fed with some more information, with some techniques to control a team, to build up a team, these things" (E15, Pos. 58-59).*

> *"When you study some years and then you go to the ships, basically, it is a long time and you don't have contact to the shipping companies unless something is organized, like some visits, but otherwise you don't have input from these*

companies. So it makes sense in my opinion, that they come together with the maritime schools to give seminars, and say a little bit about their safety culture or some other necessary things. Because when you are at school you are learning a lot of rules and you have to do lot of reading and writing exams, but afterwards, when you go to a company, you basically don't understand the way they work, you don't know anything still" (E2, Pos. 59-62).

"Safety culture is how to behave and how to manage certain challenges in the crew. We are in the situation where we know quite a lot about human communication and about how to make a good team. So, I use a comparison to sports, to teams, not football, but handball, team sports. So, usually the coach is looking for good players, who play for the team. So, the coach is looking for the individual characteristics of the players and not for a name. This is the most important thing, having the full spectrum of characteristics that will be needed to successfully fulfil a task" (E12, Pos. 34-41).

"During sports at the university, when they are working in a team, there it is always needful, the situation awareness. And also, you can train during other courses, when you have to work with a team and fulfil some examination with a team. You must look around, to your team members, where are they, what do I have to do? What are they doing, how can we do this together? So, you can train this during the whole studies" (E11, Pos. 113-121). "I think this understanding of soft skills, it should start already, at the childhood, when they are small. But of course, the best point, of course to teach it during the nautical studies, is when they grow up with this, then it is easier to bring it into the studies, because they know situational awareness. You need this all day when you are let's say in a traffic situation with your bicycle. You must also have situation awareness. But of course, when you are already used to this, it's easier and then you have already a view on that. But most of the children are not learning this when they are kids. So, it must start at the latest point during their education, when they are starting studying they must learn the situation, but it's too late when they finished studying, when they are working already" (E11, Pos. 82-94).

Theory knowledge is adamant in the learning process, however not sufficient to allow a comprehensive understanding or application to develop skills (Bolmsten et al., 2021, p. 325). Education and training in safety should be tailored to the individual's experience and practical skill level of the students, emphasizing on safety culture and promoting

cooperation among institutions and stakeholders (International Maritime Organization, 2020a). Organized events provide an opportunity for informal learning and networking, and for the exchange of experiences and knowledge among peers and stakeholders.

"If you want to train any kind of human behaviour, you need to know the theory behind things and how things are connected. But the thing is, if we talk about behaviour, and behavioural change, in my view, humans only change their behaviour when they are confronted to other humans. Therefore, what we definitely need is an exercise or training with a social group. You can learn the theory alone, maybe remotely, distant learning, whatever, that could be ok. We have to think about each target group separately each time again, but if we say it is the behavioural challenge as the objective, then I think sitting alone in your room at the computer that would not change your behaviour" (E7, Pos. 57-60).

"To learn to find strategies how to deal with contents you want to know and you want to learn, this is for me also a part of leadership" (E18, Pos. 141). "Working in groups and solving problems in communication, all this is very important because you need this, later, I mean, as a part of leadership. And this has to be supervised because it makes sense. Only to say, create leadership, this means nothing, so there must be reflection and some group work. Based on this, you can develop" (E18, Pos. 145-149).

"There are, possibilities, like doing some training once a year, for example a day, where you can talk to each other and receive feedback, and share experience. This you can do anytime, during the education time. It is important to really share this experience and see, what was the outcome and what effect does it have on the job and what is the experience of different colleagues. Then, I think it is very important to cover these aspects in the training" (E16, Pos. 53-59).

"The focus is on a real situations environment, which gives you more of an effect, which is stronger than just books and class rooms. Real people and real situations, more than just to read, like some years ago. It's about this, to make people think and learn from that real situation environment, that is very good" (E10, Pos. 43-45).

"In any initial training, it's about communication" (E1, Pos. 29). "When planning for cargo operation, the communication should be taken for granted, to talk to each other. And it had been seen a little bit like vessels versus shore, but it should be a togetherness, in all aspects. Be it safety, be it efficiency. So, universities could

maybe bring together a broader spectrum of industry vendors presenting their systems, making seafarers aware, that there are so many systems out there, so that they get used to being flexible that there are so many systems, and that the technology changes fast, and will change in the future. Also maybe helping in learning how to communicate efficiently, how to organize a work day on board. This is maybe not in the focus of the nautical and technical studies" (E1, Pos. 46-54).

"What can be integrated, that is so broad. Offering students to run projects with companies, like on new fuels or different ways of safety, and culture development, or different IT systems, and so many areas where there is a transition in the industry, and with elements that are already there. Let's say the cognitive competence. What do I need to know at the moment, how can I gain more knowledge" (E5, Pos. 97-100).

"Understanding both sides is important. The shore side and the ship side, both need the understanding of what is happening. I have very good experience with face-to-face talks, in regards to performance. So, visiting is always good, and that helps to understand, how shore side works, and how the nautical or technical officers on the ship work" (E2, Pos. 50-52).

"It could be a good idea that companies cooperate with academies, with educational institutions, and invite experts, or do a gathering with the crew. It's good for people to be together and to do something together" (E19, Pos. 53-54). "I think maybe it has to come more from the company side, and in cooperation with educational institution, we cannot put more pressure on academies" (E19, Pos. 57). "If you are adding one more requirement into the study programme, maybe this is too much. Then you have to put in more resources, so, I think you need more resources from the stakeholders. They need to think together how to deal with additional aspects of the human element, in the whole system, not only the regulations, more of a holistic view, this is important" (E19, Pos. 58).

Continuous improvement depends on the openness and willingness to innovative and informal learning opportunities, recognising the need to involve experts in specialised training and adopting ideas from other industries.

"What can be covered in training, it's important to keep knowledge up to date. Change is influenced by so many factors around us and it is very easy for us to get influenced by a disappointment here and there, things that make us short sighted,

because of the way we communicate and the way we work. It is important to keep some safety professionals in the process, continuously working on that safety culture and on that safety mindset. And to show that, incident investigation is part of the organizational learning and we have a culture of speaking up and respecting people who challenge the status quo" (E11, Pos. 28-34).

"At first, these training was done through input from our facilitators from the aviation industry, but now we have our own specialized trainings, at three different levels, as well as resilience facilitators" (E15, Pos. 30).

"We need to be able to connect people, to set up as a team. We need to be able to form and develop teams out of individuals to become a team. there we need to be able to develop people, to make them learn about their responsibilities, and to make them learn about the most appropriate behaviour in that context, and how to be successful as a team to bring it on the next level, actually it is down to a capability. It's all a part of developing a high performing team and this sounds simple, if we only look at the science part, how a team is developing. But it's also very much an art, learning from each other, backing each other up" (E6, Pos. 21-27).

"Outside of the normal lesson hours, the learning with the social contacts would be a possibility, where you could have a lunch and combine different things. Maybe you can go to the seaman's mission and play a football or soccer play and then you can have BBQ party with them or something like this" (E10, Pos. 36-39).

"Influencing the human behaviour is more than the actual seafarer. Talking about design, we have to also train those who design technology, software or any such material, software for the user. They should get a training, they should get an understanding of how does the design of my engine manufacturer or bridge manufacturer, or something else, how does that influence the daily work of the seafarer later on? Maybe that's another aspect. Why do we limit ourselves to the training of the seafarers? Yes, we have to do training with them, that's obvious, that's the clear target group. But maybe we can spread the message a little bit further" (E7, Pos. 77-79).

"Let's say this message is to almost every stakeholder in the maritime system and we find that it works best if it is very practical and very integrated and of course close to the work that the person we are trying to teach is going to do. We we've put a lot of effort into teaching naval architects about maritime work and maritime workers.

And we're still doing that because it turns out they don't know what it's like to be on a ship. That's like an architect building a house when he has never been in one. So, where we have to put the most effort, is teaching people to stop making mistakes" (E4, Pos. 42-49).

"When it comes to shipboard culture, that understanding starts at the academy and training institutes and not only with the people that are at the top management of companies, who make the rules. So maybe something could be done more in depth, not just quantitative" (E1, Pos. 91-95).

In conclusion, it was found that there is no such thing as "theoretical" knowledge, only applied, practical and contextual knowledge (Willke, 2011, p. 42). Knowledge is generated when information is contextualised by experience (Wenger, 1998, p. 225). The ongoing process of social life is guided by the continuity of practices based on reflexivity and direct purposeful actions in a spatial and temporal manner (Giddens, 1997, p. 53). Thus, the establishment of a comprehensive organizational safety culture involves circular and effective lines of communication in between all levels involved (Manuel, 2017, p. 165).

Code 3.3: Psychology

Sub-codes: Emotions, Well-being

The safety aspects of the working environment require not only the recognition of a structural organisational approach, but also the care of seafarers' mental well-being, which goes beyond rules and regulations and is considered an essential aspect of leadership and the facilitation of the necessary communication in this regard (Justers, 2023, p. 26). The active cultivation of safety aspects is strongly related to a "growth mindset", which means to empower individuals and provide reliance on core values, however may challenge established rules and structures (Dweck, 2016).

"In this study program for four years, training the minimum standards, and in addition for the degree of a bachelor, and including sea-training and a higher education standard for bachelors in addition to STCW Convention, so in my view it is a very important aspect to more deeply develop an understanding of ourselves and our well-being and how to take care of ourselves" (E19, Pos. 25). "Because they need to understand, and they need to take care and understand these dimensions, how

to take care of seafarers. So, in general, I think if the education is provided well, not just for getting the certificate, but as a means of achieving competencies and learning outcomes which usually are stated properly in the study programs. And if every person involved in this process does his best, not skipping some activities, I think the competences are OK. But in addition, some kind of understanding of those mental health well-being issues how to take care of ourselves is important, in addition to all of that" (E19, Pos. 27-31). "I think this kind of changing mindset that we have, the responsibility for each other, from the lowest level, the ratings, cadets, seafarers, till the highest level, the owner and manager. And taking care of this developing culture of care, it can be called, not culture of adjustment according to the legislation, just adjusting records to the requirements, but it has to be done involving more parties, and speaking about this issue and raising the importance of that" (E19, Pos. 38-39). "It has to be more holistically on all levels, this is the importance, because usually we speak about fatigue or rest hours, but probably it's not enough. This is about changing mindset, that we have to be responsible for each other and for our job" (E19, Pos. 43- 44). "Conventions and competences, is that about well-being and mental health? Yes, there is some management and leadership, and this simulator course, the crew and team resource management, something is involved in these courses. It's good, but it's not enough" (E19, Pos. 50-51).

"It's just a matter of offering a vocabulary. I suppose, when the human element becomes psychology, then people shy away from it. But really this is what drives the business, and we need to look at it, because we don't invest in this understanding. Then solutions we put in place to prevent things from happening again or by firing people or dismissing them. Then you are not looking at the systemic issues of what is happening" (E3, Pos. 41-42).

"When it's about emotions, this is the challenging part, because the emotion, which could be positively or negatively, they affect us, and we hope that it's always positively. What we need, well, I'm thinking, it is talking about emotions. Humans tend to avoid any situation where they might risk negative emotions, that is kind of a human behaviour. They tend to avoid such a training, because they think, well, I might be challenged with something that I am doing wrong, or where I could be better. Therefore, I think it's good if we include such a training as early as possible, just to make people aware of the fact that we need it. How deep we go, this can be

decided per level or per studies. But I think when it is more of a permanent topic in your education and in your job career, than you think it is normal to talk about ways of communication and emotions that you experience, so, that's an ongoing process, throughout the career" (E7, Pos. 34-40).

"I think that in the future maybe there should also be organizational psychology and HR principles, so students learn from science, what we know of people to feel belonging, to be motivated, to give them some theoretical background on psychology, and some HR principles and also to make some skilful, practical exercises." (E8, Pos. 35-38).

"Speaking about those issues in training, and to bring the industry in with some initiatives from different companies, like Shell, they are doing a lot of these trainings, for well-being. There could be some seminars for dealing with stress. I think there is a lot of stress involved when working on board, and teamwork also and you have to be very resilient to deal with these things otherwise you can get sick" (E2, Pos. 72-73). "And about the situations on board that could happen, and how to deal with them, group dynamics, because you have to deal with a team, with a group onboard. But this should not be totally abstract, as a social subject. I think you also have group dynamics in the classroom, and with the colleagues. There are people you like, or maybe even hate, and some you would never go out with. All in the same group. And then you see, what is happening. Maybe you work on group dynamics, and this kind of subjects with the students. And also, an idea would be to have a psychologist, who is a specialist, not a social worker, but I don't know if any school would do it" (E2, Pos. 77-84).

Code 3.4: Curriculum

Sub-codes: Flexibility, Train-the-trainer, Generation Gap

The knowledge educators and trainers impart depends both on their expertise gained during their professional maritime career and moreover on their specialization therein, but also on didactive and educational knowledge and skills. This embraces relevant advanced training, continuous education, and a network supporting a life-long learning process in the various disciplines. MET universities are tasked to develop both didactical and competency related approaches integrating innovative and digital solutions in

strengthening the necessary skills of students in their future professions and to espouse both advanced technological and digital solutions with the promotion of cognitive and interpersonal skills (Bolmsten et al., 2021, p. 309)**.** The structure of the curriculum and the required courses contained allow only limited time for additional contents, courses and training of interpersonal and cognitive skills.

> *"There are things that we could teach if there was time in the curriculum. Things like how do we make sense of situations, how do make decisions and how do we perceive and process the information that is around us. Of course, there are at least several different theories about that, but at least having some kind of insight into how we and our colleagues work could make it a bit easier to work together" (E4, Pos. 65-69).*

> *"To learn and to use the systems on the ship and the human element issues altogether, you have to simulate this in the school and this is only for a limited time. You don't have time but this also belongs to this life on board. It's not easy to do this at the university, there is only limited time at the academic side, for this sort of interactive training" (E10, Pos. 29-31).*

The integration of theoretical knowledge with active skills development is crucial, although limited integration and application is feasible in the university environment.

> *"When it comes to the development of personality skills, I think it should start right there at the academy. When the person is recruited and he enters the maritime academy, these interpersonal skills should be part of the curriculum. So, you are looking at, for instance communication. This could be done on campus, it could be done outdoors, or, at least not just classroom training but practical based training. I think the refinement of these skills also plays a very important role" (E17, Pos. 37-41).*

> *"It is better to get some training and experience during the studying than to make some hard experiences, with an accident on board. For example, with communication in challenge and response. To challenge one who has a higher position, this is really hard work. That must be done during studying, the training in challenge and response. Also, workload management, this is something that must be trained more, during studying" (E11, Pos. 134-138).*

The integration of information and communication technologies in higher education enhances learning processes and requires educators not only to adopt new teaching methods and skills, but also to understand the learning styles of the next generation of students (Valionienė, 2016, p. 68).

> *"My idea is to change some structure of the education from a training experience. From what we see, what we learn of ourselves, the trainer as well as the professionals, and the experts, we should never stop learning, which is a tricky thing. The older we become, the more focused we are, so to say. We the need to be open for the whole thing and, we all know the saying of the Greek Socrates, that the young people are getting worse and worse. But we shall be open, we shall listen to them, which is not always easy, and it's a challenge. But there is no other choice" (E12, Pos. 69-70).*

> *"You know the biggest problem, the first problem with new competencies is related to the age of the lecturers because a big part of the professionals which are working as lecturers are people from old times. They don't have some data analysis and decision-making competencies by themselves, so they cannot renew the study program for the students. So, how to solve this problem? I think the first stage is to educate the educator, to give them some knowledge of the students, the new generation of students, to give them some knowledge first and later to enhance the courses for the students, and add some new subjects. For example, to create teams and practice decision making, and to learn new competencies in decision making and digitalization. I don't think that new subjects will improve anything. So, it should start from the lecturer. I know this is a big problem and a big challenge" (E9, Pos. 23-31). "When you want to teach them, first you need to have this knowledge and then to prepare the students for this knowledge transfer, and also discuss this. Like this, you will help your students to identify where they need improving. So, first you need to prepare and share this knowledge, and the communication of the sharing is the most effective transfer of knowledge" (E9, Pos. 41-44). "Knowledge transfer is very important, but first you have to have this knowledge in yourself and then to prepare for the students for the effective transferring. It is a main aspect of functioning, this channel between lecturer and student. And also involving the students in the production of the material. When they have the mind to improve their knowledge and to collect new knowledge and they will want to share their knowledge. If I don't have knowledge, I cannot share anything with anyone else. I*

need to have knowledge by myself, and then to share and that way the communication will be more effective. This is mostly what it is about how to transfer knowledge between lecturer and students" (E9, 55-59).

The learning process requires the teacher to use team leadership skills to set clear objectives, deliver relevant knowledge tailored to the target group and empower students to apply problem solving strategies (Yukl, 2013, p. 247). The distribution of roles and assignment of tasks are crucial measures in the individual and team learning process, and more significant than the difficulty of the task itself (Yukl, 2013, p. 247). Essentially, challenging and going beyond one's comfort zone is critical to developing skills and competencies (Herold and Herold, 2011, p. 82).

"Every training is specific to the target group and what they already know and what the learning objective is for the session. Only then, you can really say, OK, this is the best way or the best method to do it for these people in this situation. Of course, there are some generic ideas like where people tend to avoid situations where they feel uncomfortable. But the question is, why do you feel uncomfortable? Because you don't know, have no idea what will happen in this upcoming session. So, we need to explain what is going on, what is the purpose of doing this training. Then they have an understanding what will happen. This is the necessary first step for people to develop more, like the communication skills, soft skills and understanding" (E7, Pos. 44-54).

The active promotion of reverse mentoring and circular learning processes falls under the lecturer's responsibility in managing a long-term approach in knowledge transfer (Valionienė, 2016, p. 76). The advancement and strengthening of skills and competences has to be set in a structured learning environment, where double-loop learning and feedback is exercised (Manuel, 2017, p. 164).

"The understanding of the lecturer is a big problem, when he likes to be on a separate level. But when looking at the total system, all must be connected, and to give and to get feedback. If they want to get feedback from the students, they need to be on the same level, and not to be afraid of the lecturer (E9, Pos. 61-63). A big problem is, that professors and lecturers want to have some privileges. I don't know why, but it is not correct, not to get feedback. They need to be on the same level as the students, and they need to work together. They are not managers, but just a little bit, to control the process. But lecturers are the leaders and, let's say the students

are the followers. It is a new condition, leaders and followers (E9, Pos. 75-76). It must be a learning environment where feedback is wanted. Because students are afraid of mistakes" (E9, Pos. 79).

"Where it is relevant, discovering more. People need challenges, understanding this is my responsibility, my leadership, and everything that the leadership challenges. Then a critical learning intervention needs to be done. This means stages that actually lead to what I have already acquired, the competencies at every level at the university. This could also mean a talent program development as a whole system" (E12, Pos. 77-80).

Code 3.5: Lifelong Learning and Openness to Change

Skills requirements are constantly changing. They are linked to different roles, different career stages and the demands of the wider industry. Adapting to these demands goes beyond formal education, thus the pursuit of lifelong learning should be actively promoted within the university context (Kieback et al., 2017, p. 20). Individual skill development and improvement is directly related to the individual's drive and motivation for higher performance in the job, in turn, to continuous learning (Csikszentmihalyi, 2004, p. 71).

"In this job, it is necessary to be training lifelong" (E16, Pos. 32).

"I very much appreciate a forward-looking view to see what can we do to deliver on high performance in the competencies, and in the learning process. But actually, this is not only a maritime element for the ship, but we can look across all industries and all business tasks to find this view" (E5, Pos. 4). "From the ship managers side you set up candidates for success in certain situations, being a team, being under pressure. And then it stops. All of a sudden, the managers say, what can we do with our captains and chief engineers? Because they are not nautical guys anymore, but they are the top responsible leaders, they are business managers, but they never learnt about that. They really need a structured learning development and encounter that they really need continuous development, a kind of a road map. During the studies foundations need to be made, for a personal leadership skills program, connecting people skills and technology. Then, with the experiences, and new responsibilities with people, and new learning experiences on the job and connected to the career of the officer, and learning on the job, developing skills, then is the next

step when learning really becomes relevant. This kind of teaching differs, for when you are a student, and how to support and then when you are 35 years old. In the studies, how can you have a difficult intercultural conversation about on board the ship? It is difficult to understand and to relate that to a performance, to an experience. So, the negative performance, was never felt, and they are afraid, to have a difficult conversation, like after someone jumping off the ship. Then, after a very bad experience, this conversation needs to be done. So, the drive to learn about that when you are 18 is very limited, then later when someone is closer to the position in the career, or after some experience" (E5, Pos. 70-80).

"There are two strains of knowledge, let's say. You must have the knowledge, without knowledge, nothing really can go in a good way and knowledge, it's not like a specific thing. Knowledge means, you have to expand. You have to know the regulations and all the items in shipping. The second strain is, if you have the knowledge, you need human competence. This means, then you must be able either by yourself, as individual lifelong learning, you must be able to be a communicator, to be a facilitator" (E18, Pos. 34-39).

"There are elements that are possible to integrate in a university studies, for this human element development. Unlikely in a five days course, but to give them a simulation of lifelong learning, having this provided to them. With a development over teaching eight semesters, this is what studies also need, developing your own goal, because this is never technical innovations and transformation and it's never going to stop, that we will work in teams, on board the ships" (E11, Pos. 96-102).

The competences applied must lead to deliberate action and concrete and observable results, rooted in an educational programme that emphasises an open-mindedness and flexibility in approaching challenges (Dweck, 2016), aligned with a conceptually and methodologically guided structure (Kieback et al., 2017, p. 23). This base of knowledge and skills is embedded in an attitude of flexibility and learning for work and life.

"As a part of the study program at the university, there is no such course like leadership. It is in the objectives, as a key competence. This is about having a group, and to communicate and to discuss and agree, and to develop. From the theory side, it is part of the educational program, but from practice it's not part of the educational program. This everybody knows, but nobody cares" (E18, Pos. 110-117). "It's about the content. It needs to be more structured and deeper content.

First of all, this is what it is about" (E18, Pos. 122-129). "And after the educational career, when you are on board, depending on the company, you have a very low budget for annual training, then it is too late" (E18, Pos. 152-158). "What is also important, in human related issues and how these are working, when we see how the things are today onboard, and we see that these issues still the same as how they have been five years ago, then we just say, ok, it's just like this. But then, we don't have a mindset for change. And this should be always part of the educational career" (E18, Pos. 163-167).

"There are different ways of how to train someone and even the captain onboard is still a teacher, a kind of driving teacher, showing and supervising, giving alternatives, and tips, how he's doing it in a perfect way, without overruling someone, but only showing possibilities. This is the best way. Not taking over the control but offer some alternatives and I think that is the best way also during studies, during education, showing possibilities how to learn more. Also, during the job, there is always more to learn and more to know. The way of learning is very important" (E16, Pos. 43-49).

In order to meet the current and future needs of maritime education and training, as well as the professional needs of seafarers, it is essential to integrate and actively seek the contribution of the younger generation (Le Goubin, 2023, p. 3).

"Education is a very complex and difficult field. You need to have knowledge and ideas about a lot of subjects, not just the general idea. Starting from psychology, going to the preparation of learning materials, e-learning systems, books, interactive tools, it is very difficult. Also, the knowledge about the different young people, the generations, to learn about their ideas and to adopt. You know, everything, and it is very difficult, but also interesting. I think sharing this between educators could benefit for better ideas in education. Getting added values, that is needed, to see what is my routine and see what are the experiences from others, that could be useful" (E9, Pos. 108-112).

10 Discussion of the Qualitative Data Assessment

The analysis of the interviews provides a reflection of the opinions and views of the interviewees, who are considered experts within the global maritime industry and the higher education system. Emphasis was placed on personal experiences and perspectives shared by the interviewees, rather than on statements derived from studies or secondary sources, which were used for contextual abstraction and data analysis.

The interviewed experts represent a heterogenous range of genders, nationalities, years of professional experience, and range of expertise. This approach encompasses a broad range of perspectives from micro to macro levels within the maritime industry. The study aimed to scrutinise the human element as a sharp-end operator, identified as a the dominant causal factor in maritime accidents and as a challenge to enhance the complex safety system in ship operation. The objective of the interviews was to assess the necessary competencies of a nautical officer in carrying out their professional responsibilities and to reveal effective methods for transferring knowledge to students in a higher academic curriculum. The considerations outlined in Chapter 9 have been thoroughly evaluated and subsequently analysed, providing valuable insights into the complex dynamics of the maritime industry.

The results of the empirical study revealed three main categories in the research. The first category presented the human element as the sharp-end operator on ships and its impact on safety. The approach of framing human error in the context of accident investigation served as an open-ended introductory question, allowing the course of the interviews to adapt primarily to the perspectives and arguments of the experts. At first, respondents acknowledged the causal link between human error and accidents, hence confirming the vital impact of human actions on the safe navigation and operation of ships and the potential for harm to human life, the marine environment and economic assets. While the importance of automation, advanced technology and the comprehensive regulatory framework was recognized as essential safeguards, the ultimate responsibility was confirmed to be related to human behaviour and 'non-technical' factors. Hence, the aspects of a seafarer's life world on board a ship were emphasised. Considerations of workload, psychological and physical well-being and fatigue were recognised as influential factors contributing to the ’human error concept’, attributed to the nautical officer or master, who is ultimately held accountable for all actions and outcomes. Although the legal status of the master as the responsible

individual on the ship was confirmed and accepted, the overall implications on the concept of safety and the public perception of this issue were critically commented. The complexity of safety in the maritime industry was highlighted, where the potential simplifications portray the decisions and actions of seafarers in a linear approach, providing an answer of "who" rather than the "what" caused detrimental effects to safety concept and suggesting an "easy fix" as a solution; an approach shaping public opinion. The management and organisation of a safety culture, and its subsequent consideration of economic and legal constraints, compliance and technology design, were identified as factors that either promote or hinder individual motivation and abilities to act in a situational context, as a result to the long-term processes of established lines of communication. The interviewees emphasised the safety system view and the implications of the wider maritime industry. Thus, the ship management establishing a corporate safety culture, the economic and competitive factors entailing considerations of technology and ship design, and compliance with the regulatory framework, all emerged as human-related elements in the overall safety system. Human related actions at the various levels were considered as influencing factors on the sharp-end operator. This was reiterated as an essential consideration to be recognised in addressed the maritime human error perspective, which was found to be "the beginning of an investigation and not the end, because the conclusion in itself doesn't give you much to work with in solving it" (E12, Pos. 4). Another perspective emphasised that accident investigations often portray the seafarer under investigation as a superhuman figure, unaffected by the physical and psychological challenges of working and living on board. In hindsight, a seafarer is conveniently depicted as an all-knowing, ever-vigilant individual alike “MacGyver" (E12, Pos. 31), who is expected to either succeed regardless of the circumstances, or justifiably face legal consequences. The search for identifying and solving 'problems to be fixed' and drawing 'lessons learnt' often reaffirms the impact of human actions, and reinforces the established concept of human error with no tolerance for mistakes, an approach opposed to a just culture (Dekker, 2012), which promotes a double-loop learning cycle (Argyris, 1977), and sees mistakes as valuable opportunities in the process. It has been recognised that any accident model can illustrate the circumstances of an accident to some extent, but fails to reproduce all the details involved in the course of an accident. The attribution of accidents primarily to human error oversimplifies a complex reality and conveniently places the shortcomings and blame at the sharp- end, as often proclaimed in statistical accident publications.

The second category in the empirical analysis examines the competencies the skills and knowledge required of a seafarer now and in the future. The role of the nautical officer responsible to respond to routine and high workload situations, as well as the challenges of the daily social and working environment on board were scrutinized. The role of the individual as an integral part of the sociotechnical system and the importance of managing ad hoc challenges in this context were examined. A wide range of competencies was considered essential for a seafarer. A significant consensus among the respondents highlighted the overall ability to manage the complexity and dynamics of the ship and its environment, which requires a high degree of situational awareness, critical thinking and problem solving, the effective use of all resources, both technical and human and communicating effectively within culturally diverse teams, while working under high workload, and despite physically challenging conditions in a harsh environment. The importance of the evolution of digitalisation and technological advances was recognised as driving significant change in the industry and requiring strong analytical skills. In addition, cognitive and interpersonal skills, with an emphasis on teamwork, leadership, communication and cultural awareness, have been identified as essential in the dynamic maritime environment and, indeed, in the wider working and social environment of the future.

The nautical officer's knowledge is grounded in the context of STEM studies, with skills in digitalisation, automation and regulatory compliance identified as essential for successful performance in the profession, nonetheless the ability to interpret, manage and process relevant information in complex systems was reiterated. It was pointed out that the existing education system mainly emphasises technical skills and the advancement of automation. Automation literacy was recognised as an essential future requirement for the profession, along with a general increased demand for digitalisation in all life contexts. However, the means of technology were not seen as a substitute for human skills, but rather translated into a necessary ability to be adaptable and flexible to new technologies. Particularly in the context of future ship automation, the interviewees highlighted the importance of human communication and teamwork skills as the greatest asset in promoting a holistic approach to safety in a remote working environment. The demands of integrating diverse sociotechnical systems require a flexible and holistic approach to the existing hierarchical structures of the traditionally organized system ship. Awareness and development of individual competencies challenge the assignment of knowledge and skills to formal roles and the appointment of competencies to ranks. The role of the nautical officer was reflected in the ability to understand complex situations

and to make contextualized, well-informed and goal-oriented decisions using both technical and human resources. The key competencies highlighted, were referring in particular to communication and language skills, decision making and problem solving. The dynamic changes in the context of technological progress and the resulting competence requirements for students in terms of long-term career prospects require the involvement and expertise of industry stakeholders. While the conservative lines of communication in the industry have been well established for centuries, it was recognised as a lack in flexibility to incorporate and promote individual skills. The application and reinforcement of effective circular processes of communication, reflection and feedback, especially in a multinational working environment, were identified by the interviewees as challenges to be transferred to the university environment.

Within the third category scrutinized in the analysis, the transfer of knowledge in education was elaborated on. The focus was on exploring approaches to incorporating learning methods to enhance the human element competencies in the higher academic nautical curriculum. Understanding the implications of the current academic education system has been considered crucial, particularly in the context of promoting the individual professional as an entity of the complex system ship. Mathematical and technical principles as well as language skills form the basis of a nautical officer's knowledge. The effective application of this knowledge has been identified as a fundamental and essential competency in the profession. However, the traditional method of classroom teaching, which focuses primarily on the transfer of knowledge from books, has been criticised for its limited value in transferring knowledge or motivating the strengthening of individual skills. The design of an active learning process was identified as the most important aspect of competence acquisition. Several examples of applications were provided, with simulation being identified as the most effective tool with the potential to integrate and train both technical and interpersonal skills. This includes simplified forms of simulation, such as role-playing, which can take place in classrooms and in other informal settings. Through active experience, individuals can acquire and develop the necessary skills. While the technical-social component was mentioned, the majority of interviewees emphasized on the emotional and interpersonal experiences that make simulation particularly valuable. The emotional experience of a situation, of feeling the physical sensation of having "sweaty palms" and to step out of one's comfort zone to enhance a learning experience were particularly highlighted. The creation of a well-structured learning atmosphere, which sets specific learning objectives and allows for

the measurable achievement of personal goals, was commented as being at the core of the process. Allowing for mistakes and developing skills through feedback was added as a significant contributor to individual motivation to learn. In addition, informal interaction outside of the curriculum structure, including sporting events and social gatherings, was discussed as a way of providing an enjoyable environment and a motivating learning atmosphere that encourages the exploration of personal strengths and perspectives. Effective knowledge transfer, facilitated by active experience and application, using simulations and exercises, with an emphasis on practical skills, requires transfer to the specialised, high workload ship environment and, in addition, the management of emergency situations. In this context, aspects such as stress, emotions and well-being have emerged as critical considerations to be integrated into training. While the essential knowledge of theory needs to be provided, the active learning process through feedback and reflection are facilitated through activities that appeal to mental and physical aspects.

Raising awareness of the mental and psychological aspects of life on board and providing an understanding of basic psychological principles was also seen as an aspect to be included in training and education. This understanding supports an analysis of the systemic view as opposed to the ‘human error thinking’ and the apportionment of blame, which leaves the seafarers alone and "mentally in the wrong place". Basic knowledge of psychology needs to be integrated in the context of higher education, both to provide the theoretical knowledge and to contextualise it with practical exercises, role-plays, simulations and stress management where deemed appropriate. The importance of a professional and well-structured approach to psychological lectures and topics was emphasised.

The interviewees stated that the true competence of a nautical officer is revealed in the context of emergency situations, emphasising the need for active experience. The transfer and reinforcement of knowledge and skills is perceived as a combination of theoretical training and active application. Training limited to the prescribed structure and content of the STCW 78 Convention and the STCW Code was considered insufficient to provide this knowledge effectively, a dilemma caught between the constraints of time, resources and regulatory compliance. The active learning process and the incorporation of the progress and requirements of the industry and the application of these skills need to be contextualised and promoted in cooperation with the maritime industry through projects, seminars and partnerships. This approach was seen as particularly necessary and fruitful in the adaption to evolving technology, where flexibility in problem solving and

cognitive skills promotes openness to active knowledge acquisition. With the input of industry partners and potential future employers, as well as educational institutions, the curriculum can be reciprocally aligned to the demands of the professional environment.

The generation gap between educators and students in the university context was addressed, as well as the promotion of lifelong learning and openness to change in order to meet the evolving needs of the maritime industry. This recognition has been translated into the concept of 'reverse mentoring' between educators, students and peers, bridging knowledge gaps between generations and extending beyond formal learning concepts. Individual learning motivation is strongly linked to the openness to establish a shared understanding and a “growth mindset” based on individual experience and trust, a crucial aspect identified by respondents.

The qualitative research shows that the historical development of the existing competency system, aimed at a globally harmonised structure, lacks the necessary effectiveness and flexibility for effective knowledge transfer. Initiatives that critically incorporate both educational and maritime safety aspects are subject to dynamic changes that permeate from micro to macro levels, challenging educational processes and the industry as a whole. The findings from the expert interviews reveal that the human contribution to safety in ship operation and in all underlying processes requires the integration of a broader perspective and the involvement of all actors, including students, teachers, industry professionals and administrators, as well as the incorporation of adaptable educational methods to support lifelong learning and hence the promotion of a holistic maritime safety system.

10.1 Future Prospect

Seafarers are considered essential workers in the maritime transportation chain, driving the global economy and having a significant impact on social wealth. Historically, accidents resulting in extensive loss of human life and environmental damage have led to significant changes in the training and education requirements of nautical officers.

Maritime operations are subject to strict legal and socio-economic constraints within the dynamics of global and local interdependencies. The human element operates at all levels, driven by contextualised motivations and limited by the varying degrees of knowledge, skills and resources available.

The globally harmonised education system forms the basis for the acquisition of knowledge at both individual and collective levels and involves a process of repetitive and long-term experience and the development of practical skills. Reflection and assessment of the learning process of the sharp-end operator and the student requires a critical evaluation of the underlying human aspects, including psychological and emotional dimensions, the enhancement of individual strengths and the empowerment to pursue personal life goals. These approaches form the basis for lifelong learning and enable knowledge and skills to be acquired and enhanced. The individuality and diversity of the actors is a distinctive asset of the learning and working concept and should be understood as an essential contribution to the improvement of safety in maritime operations and to the future development and impact on employability.

The recommendations made for knowledge transfer in the Learning Journey depend crucially on the coordinated initiatives and active support of the wider maritime community. Industry stakeholders need to promote a dynamic and continuous development of the necessary skills in both formal and informal education processes. The application of a sustainable and resilient maritime education and training system must embrace the evolving needs of the maritime industry and the safe operation of ships with the diverse life motivations of the individuals who are the drivers of social wealth and change.

10.2 Recommendations for a Learning Journey

Based on the qualitative interviews conducted within this study, the opportunities and needs for practical knowledge transfer at university level have been highlighted. The recommendations are based on the insights of the maritime experts and can be incorporated into the university curriculum in the form of additional modules, optional electives, interdisciplinary exercises or integrated into the lectures of the faculty's established maritime programmes. The provided recommendations are partly suitable for theoretical or practical exercises and tasks and can be adapted to the level of knowledge and competence. Some exercises suggest the involvement of external parties, such as non-academic individuals or organisations that are not part of the university complement. These exercises relate to specialised skills which go beyond the common curriculum outline and the expertise of the lecturer normally required in higher nautical education, or relate to practical training during the semesters at sea, supervised

by officers and masters on board, which is a compulsory part of the study programme and essential for the practical experience of nautical officers.

The lifelong learning aspects, which include the possibility of mentoring, are considered an essential aspect of knowledge transfer and the learning process, however outside the scope of this study.

The design of a learning journey should comprise of theoretical knowledge and the application of practical skills (E15, Pos. 10, 14-15), and allow for the adaptation to individual levels of knowledge and the setting and achievement of goals. This essential personal foundation is embedded in the principle of “enjoying” a guided learning journey, reflecting on and establishing individual and shared values, thus translating knowledge into personal and collective growth, and 'feeling skilled' as a motivator to face challenges and to advance (Csikszentmihalyi, 2004, p. 71).

Awareness and understanding of human behaviour are based on active experience and interaction (E7, Pos. 57) and understanding and changing behaviour can only develop through social interaction (E7, Pos. 58-60). Teaching material should be tailored to the student's level of knowledge and the context of the working and living environment at sea. Theoretical lectures may include online and computer-based course content delivered during practical semesters at sea. Therefore, it is recommended to include group exercises together with basic theory explaining models and theories of behaviour. The overall understanding of the profession, the application of safety procedures and the complexity of human behaviour depends firstly on a theoretical structural approach and then on the integration and improvement of the experience gained (E2, Pos. 59-62; E15, Pos. 14-15, 18-19;).

Module 1: Introduction to Maritime Safety (E2, Pos. 50-52; E7, Pos. 89-93; E10, Pos. 3-7; E12, Pos. 4-11; E15, Pos. 58-59; E16, Pos. 35-37;).

- Overview of the learning journey and its objectives.
- Individual goal setting espoused with personal mentoring.
- Introduction to the concept of safety, culture and human behaviour.
- Legal framework of safe ship operation – concept of safety and education.
- Basics of communication, teamwork, and leadership on ships.

- Digital and technical knowledge.

Learning Activities:

- Awareness and understanding of personal and professional motivation.
- Group discussions on shipboard safety perspectives.
- Role-play and team exercises to apply basic models, standards, and regulations.

The introduction to the learning journey is based on stimulating the necessary awareness and motivation to strive, based on individual interests, goal setting and supported by personal mentoring. Technical and digital literacy is seen as a core competence in the maritime profession, which is promoted by using various software tools, video and audio applications, combined with active participation in project assignments and presentations (E2, Pos. 16-22). This also promotes effective communication skills and an understanding of processes in the ship-shore work environment (E14, Pos. 51-53).

Module 2: Communication, Team, and Leadership (E2, Pos. 59-62; E7, Pos. 25-29; E11, Pos. 82-94; E15, Pos. 14-15, 52-54; E18, Pos. 145-149;).

- Understanding the information process in human interaction.
- Effective communication strategies in critical situations, and in various contexts.

Learning Activities:

- Exercises focusing on assertiveness and critical communication scenarios.
- Analysis of real-life communication and impact on behaviour and situations.

Communication skills, along with teamwork, situational awareness, problem-solving and leadership, are developed over time (E11, Pos. 82-94). The acquisition of these skills relies on a continuous practice throughout higher education and beyond (E15, Pos. 52-54), which is based on social experience and reflective learning opportunities (E18, Pos. 145-149).

Module 3: Intercultural Communication and Intercultural Management (E1, Pos. 5-10; E2, Pos. 59-62; E5, Pos. 65-66;).

- Cultural interaction, communication, and problem-solving in a maritime context.
- Theory on cultural dimension models.
- Hybrid, online and computer-based course content.

Learning Activities:

- Role-play and team exercises.
- Interdisciplinary seminar with stakeholder, shipping company and ship's crew.
- Application and self-study project during the practical semester at sea.

The module on intercultural communication and management is based on an understanding of cultural theory models and should be adapted to the maritime context, including relevant case studies. The practical semester at sea provides an opportunity for students to pursue self-study projects and to gain experience in an intercultural work and life environment. This espouses individual awareness and motivation to deepen the understanding of the subject through real-life experience. At sea, a hybrid approach may be feasible by integrating online and computer-based content with the possibility of mentoring and guidance. University learning activities may include interdisciplinary seminars with stakeholders, shipping companies, and ship's crew, which may integrate role-play, team exercises, and games.

Module 4: Human Behaviour and Human Error (E5, Pos. 7, 14-15; E7, Pos. 66-77; E8, Pos. 7; E12, Pos. 4-11; E13, Pos. 45; E18, Pos. 11, 18-24;).

- Theory of skill-based, rule-based and knowledge-based human error.
- Identification of mistakes and errors in sociotechnical systems.
- Risk and Safety Culture, Just Culture.
- Organizational framework of performance, procedures and compliance.

Learning Activities:

- Case study analysis of safety incidents in the maritime industry.
- Group discussions on human error, risk and safety.
- Table-top exercises simulating shipboard scenarios.

- Workshop in accident investigation with a maritime stakeholder.
- Scenario training and error recognition.

Human error is considered a core element in the concept of safety and risk assessment. The theory of human error needs to provide, elaborate and identify linear cause-and-effect thinking and sociotechnical systems management. The views on safety culture and just culture can be provided both in theory and then applied in exercises and scenario evaluation. The reflective, individual and team learning activities promote opportunities for reflection and behavioural change and provide a foundation for understanding of the overall complexity of the safety concept in the industry.

Module 5: Psychology, Mental Well-being and Stress (E2, Pos. 77-84; E3, Pos. 41-42; E4, Pos. 78; E8, Pos. 35-38; E9, Pos. 108-112;).

- Human psychology, mental well-being and stress management.
- Models and application in the work environement and in accident investigation.

Learning Activities:

- Theory lectures of psychology by a professional expert.
- Role-play and team exercises.
- Study project during the practical semester at sea in regards to physical and psychological deprivation, high workload, fatigue and mental well-being.
- Mentoring by university staff and/or an expert during practical semester at sea.

Life on board ship involves prolonged periods of physical isolation, adjustment to the work hierarchy, high workload and fatigue management, with the need for self-care and mental wellbeing (E4, Pos. 78). These elements have been recognised as important issues on the training agenda and are covered to some extent in the curriculum as required by STCW 78 and the STCW Code, however the content depth and effectiveness is considered unsatisfactory (E8, Pos. 35-36). A structured integration into the learning journey aims to raise awareness and acceptance of the physical and mental challenges faced by seafarers and to provide a “vocabulary” in the curriculum and work environment to avoid 'shying away' from the subject (E3, Pos. 41-42). Learning about human psychology in a structured way requires a professional to teach the theory and to provide

the expertise in the subject (E2, Pos. 77-84). This provides a seafarer with an essential understanding of human behaviour in various forms of interaction and in emergency situations (E8, Pos. 37-38). In addition, and because this learning content goes beyond the nautical curriculum required by the STCW framework, this module aims to enhance the attractiveness and satisfaction of a career in seafaring by providing a holistic learning experience that permeates all levels of the maritime industry.

Module 6: Problem-based Learning, System Interdependencies and Teamwork (E4, Pos. 17-22; E7, Pos. 89-93; E9, Pos. 7-8;).

- Comprehension of the wider industry system application of a safety-conscious mindset.
- Social competence for effective teamwork and critical communication.

Learning Activities:

- Group projects analysing safety procedures and proposing improvements.
- Problem-based learning to address safety challenges and develop action plans.
- Specialized, individual or team project during practical semester at sea.
- Mentoring by university staff during practical semester at sea.

The development of both “Fachkompetenz” and “Sozialkompetenz” and their application to a safety-conscious mindset is linked to and requires social skills and the ability to communicate critically. This can be achieved through problem-based learning activities that address safety challenges and develop self-designed solutions and can be choosen as a specialised project during the practical semester at sea. The project assignment at sea necessitates the use of technical and digital skills, as well as the application of soft skills, involving a learning community with peer participation and guided mentoring.

Module 7: Safety and Risk Management (E14, Pos. 68; E15, Pos. 10, 14-15; E17, Pos. 5-7, 9-10;).

- Examination of safety and risk methodologies.
- Application of safety procedures in emergency response.

- Group and team working principles.

Learning Activities:

- Theoretical or active presentation of specific safety equipment.
- Identification of risk mitigation methods and communication.
- Application of leadership and management techniques.
- Team exercise in emergency response.

The use of safety equipment and risk mitigation methods is designed to enhance safety system management skills, leadership and team management techniques in emergency response. The theoretical analysis of the principles of group and team work in a classroom exercise promotes awareness of a safety-conscious culture as a key element of the learning activities. In a guided simulated environment, safety, risk and communication are identified as reflective learning opportunities.

Module 8: Simulation Exercise with Peers (E4, Pos. 100-107; E6, Pos. 18-21; E11, Pos. 96-102; E14, Pos. 10; E15, Pos. 30;).

- Creation of a sociotechnical work environment.
- System management, stress, workload and critical communication.
- Case studies of safety incidents and lessons learned.
- Circular learning through feedback and mentoring.

Learning Activities:

- Simulation of bridge resource management.
- Peer interaction from different study levels.
- Challenge-and-response communication.
- Individual reflection and goal-setting for personal development.

The inclusion of students from different academic levels facilitates the simulation of a shipboard hierarchical structure, integrating various levels of knowledge. In addition, peer review serves as a tool for reflective learning, enabling participants to assess and

simulate levels of competence within a crew context, contributing to a comprehensive understanding of team dynamics, critical communication and decision making, and practising “challenge and response” in a team structure. The learning activities are designed to be practical, with simulation exercises based on real-life scenarios and the management of technical and non-technical resources with high workloads experienced. In addition, the module includes individual reflection and goal setting for personal development and skill enhancement.

Module 9: Complex System Management (E2, Pos. 27-29; E4, Pos. 100-107; E5, Pos. 9-15, 65-66; E6, Pos. 6-10; E7, Pos. 25-29; E8, Pos. 45-46; E9, Pos. 55-63, 79, 111-112; E11, Pos. 96-105; E12, Pos. 4-11, 19-27, 69-70; E14, Pos. 28-33; E16, Pos. 12-17; E17, Pos. 12-13, 15-22; E18, Pos. 29-31, 92-98; E19, Pos. 6-13;).

- Complex, sociotechnical system management including high workload, and a high degree of automatism.
- Simulation exercise, a student self-designed complex scenario in emergency contexts engaging peer mentoring.
- Strengthening core competences in human behaviour and the application of a safety-conscious mindset.
- Social competence for effective teamwork and communication.

Learning Activities:

- Analysing team processes and proposing improvements.
- Application of resource management and development of action plans.
- Interactive sociotechnical resource management.
- Creation of a simulation team exercises in emergency response.
- Addressing technical issues and identifying the required resources including system manuals and effective analytical, problem-solving skills.
- Training in safety protocols, procedures, and emergency response.
- Interpersonal skills, leadership and decision-making.
- Critical analysis of stress, workload management and resilience.

- Recognition of reverse mentoring with peers and lecturers.
- Setting and achieving goals as a core competency.

The scenario's complexity should gradually increase to incorporate the various modules of the learning journey and support a personal, progressive learning experience. The students' task is to create an exercise that covers various ship-related aspects and contexts, including safe navigation and technical equipment management in different environmental and cargo loading conditions. Furthermore, the exercise should concentrate on enhancing interpersonal skills, conflict resolution, and stress management, combining shipside and shoreside human and technical resources management, as an integral element of an organizational safety culture (E6, Pos. 6-10). The scenario exercises can involve students of different courses and knowledge levels. Thereafter, peer review and mentoring encourage an active approach to working in changing teams and developing flexibility in leadership skills (E18, Pos. 29-31, 92-98) as well as stress management within a dynamic work environment, considered as a core competence of the nautical officer (E2, Pos. 27-29). The overall process of the simulation exercises is guided by a university's lecturer, who acts as a mentor, providing the structure but also the flexibility to challenge the individual's "comfort zone" in order to advance the learning process (E8, Pos. 45-46) and to create an environment in which feedback and peer mentoring is encouraged.

Module 10: Practical Semesters at Sea and Computer-Based Learning (E7, Pos. 57-60; E10, Pos. 29-31; E12, Pos. 4-11; E14, Pos. 3-6; E15, Pos. 18-19, 43-44, 58-59;).

- Choice of specialized project related to maritime safety and the human element.
- Cultural interaction, communication, and teamwork exercises.
- Sociotechnical system operation.
- Human element regulations including fatigue, working hours, physical health.

Learning Activities:

- Online and computer-based training on safety and human behaviour.
- Preparation of multimedia presentations by means of various software technologies.

- Mentoring by ship's officers and crew, and online mentoring by university staff.

The curriculum includes two compulsory seagoing semesters in the second and seventh semesters, which are an integral part of the STCW qualification. Although the integration of theory, technical systems, and human behaviour is crucial in education, practical aspects can only be applied to a limited extent in the university context. Interactive training, including simulations and role-plays, can only replicate experience within a limited time frame and with limited options (E10, Pos. 29-31). During the time on board, theoretical knowledge of the operation of safety systems is translated into practical skills through hands-on experience (E15, Pos. 18-19).

Theoretical knowledge of cultural theories is fundamental to intercultural awareness and management. Students can apply this basic knowledge during the two practical semesters through project studies and individual or comparative assignments, which will develop and deepen over time. In order to enhance the individual and team motivation, skills, and competencies based on the practical experiences and social interactions at sea, it is essential to provide individual feedback as part of a reflective learning process (E15, Pos. 58-59). This affects the understanding and the necessary appreciation of the sociotechnical and psychological implications of the shipboard working and living environment, as a core challenge of the profession (E12, Pos. 4-11).

Module 11: Informal Learning Activities (E 10, Pos. 40-41; E11, Pos. 82-94, 113-121; E12, Pos. 34-41;).

- Organization and participation in sports and cultural events, including barbeque or games, involving crew from a ship or at the seaman's mission.
- University sports and collaborative courses focusing on effective teamwork, situational awareness, communication and the comprehension of the individual strengths in the team.
- Specialized intercultural project during the practical semester at sea or with an industry partner/stakeholder.

Informal learning activities involving different maritime organisations, universities and stakeholders within the wider industry provide opportunities for 'networking', sharing of experiences and integration of innovative ideas, fostering the development of individual goals, motivations and strengths as fundamental assets in lifelong learning.

All modules can be adapted and extended in terms of content and level to suit the target group, course or activity, and can be offered as a stand-alone concept or in an interdisciplinary form. The documentation of the achievements over a longer period of time is essential for the gradual progress of a comprehensive learning experience in the nautical education and training. The adoption of a lifelong learning perspective has significant implications for both students and lecturers. Although this issue is outside the scope of this study, it was identified in the interviews as a valuable aspect that contributes to the holistic approach required in education.

11 Appendices

11.1 MAXQDA Main Categories, Codes and Sub-codes

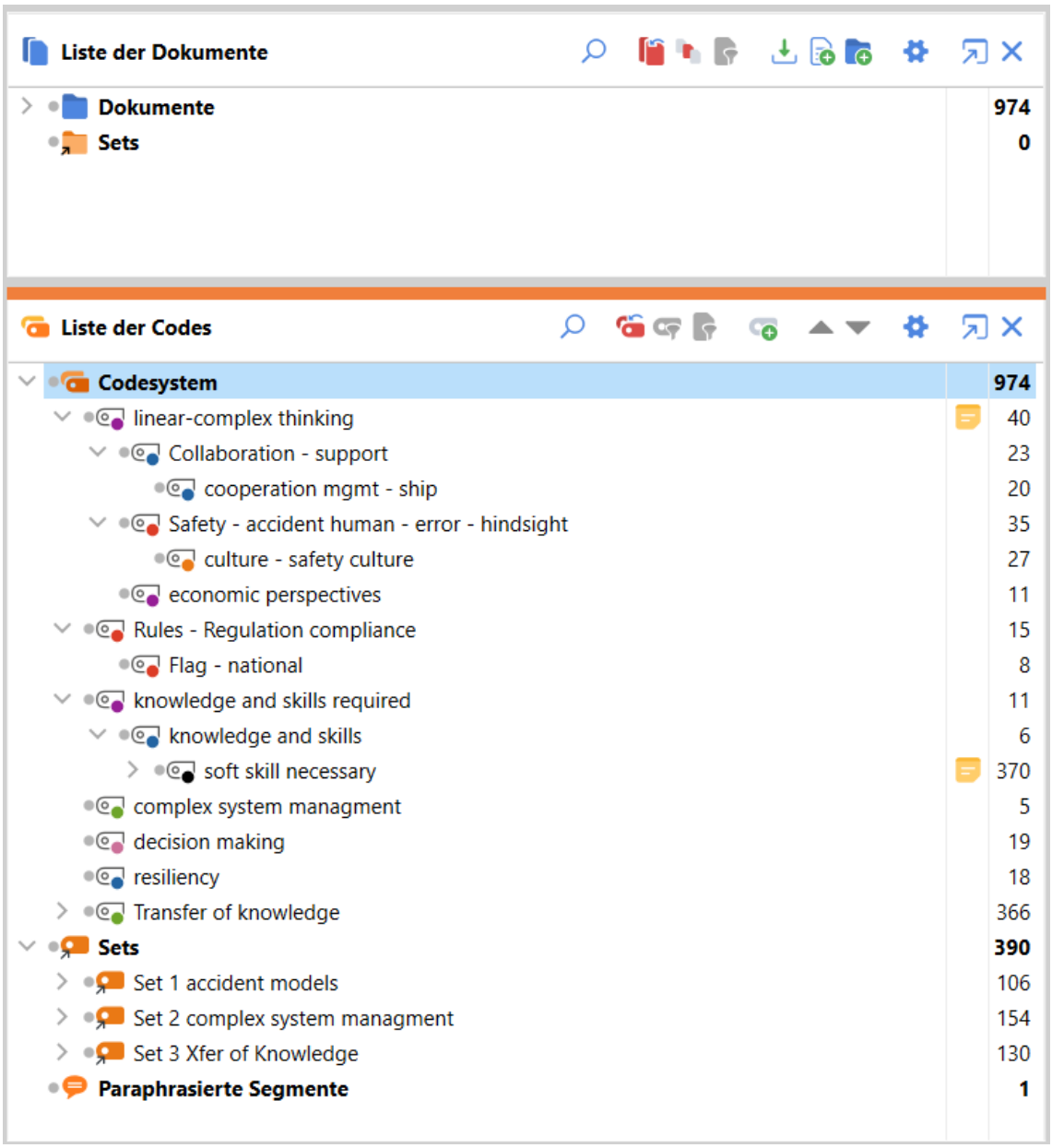

Figure 13: MAXQDA main categories, codes and sub-codes, screenshot

11.2 Questionnaire

The semi structured interview guide used with the subsequently questions, and optional ad-hoc sub-questions, served as an aide to the expert interviews. Each interview was commenced with the first question and then followed a course adopted to the individual input and views expressed by the interviewees.

1

Maritime Accident statistics say that around 80% of the overall cases are caused by the "human element" or "human error".

> How is your view – how do you see that? (allows to a free narrative, "to paint a picture")
>
> How can humans be the possible cause in 80% of the cases investigated?
>
> How is the "human element" part of the problem or solution in safe shipping?

2

What are the competencies, skills, and knowledge most required by a present and future seafarer?

> What would be the essential skills, competences, knowledge, understanding for
>
> a captain or nautical officer in your view?

3

Do you consider soft skills, or "non-technical skills", for example teamwork, communication, culture and leadership, essential for a seafarer now and in the future?

> Are non-technical skills relevant in seaman's profession and life?

4

What does culture mean in context with the daily life on board ships?

5

Should the awareness and development of "non-technical" skills be trained in the maritime education, when and how can this be trained, during the education at the university, or after during the professional career?

> Do you have suggestions, examples, experience, on training of skill training?
>
> How can skills best be trained in education in order to have a long-term effect?

6

Overall, how can maritime universities enhance their contribution to the education of the seafarers for the future?

7

Would you like to share some more thoughts, a personal experience, or add a topic you find crucial to the subject?

11.3 Interview Consent Form

I would like to thank you for your support and agreement in participating in my PhD research thesis as an interview partner.

Please note, that the interview will be part of the qualitative empirical data evaluation, as part of a PhD thesis in social science with the working title:

" WHAT DRIVES THE SHIP: THE HUMAN ELEMENT"

Ethical procedures for academic research undertaken require that interviewees explicitly agree to being interviewed and how the information extracted from the interview will be used. This consent form is necessary to ensure that you understand the purpose of your involvement and that you agree to the conditions of your participation.

I would like to ask you to please approve the following:

- the interview will be recorded and a transcript will be produced
- you will be sent the transcript and given the opportunity to correct any factual errors
- the transcript of the interview will be analyzed by Barbara Woltron as the research investigator
- access to the interview transcript will be limited to Barbara Woltron and the examiners of the thesis, as and if required for reasons for proof of veracity, prevention of plagiarism or misconception of analytical consent
- any interview content, or direct quotations from the interview, used and made available in the academic publication will be anonymized
- no personal information about the interviewee will be revealed in the thesis or made public
- all interviewees will remain anonymous, and the contents of the interview transcriptions will be deleted after the completion and publication of the thesis
- any other terms will be communicated and require explicit approval from both

Please sign further below, if you agree that;

1. I am voluntarily taking part in this interview, as part of a PhD thesis.
2. I will not receive any benefit or payment for my participation.
3. I may request a copy of the interview transcript and edit or delete parts where/if I feel necessary within one month after the interview.
4. I will remain anonymous, unless I do expressly wish to be named in the thesis.
5. I am at liberty to contact the researcher with any questions in regards to the thesis any time after the interview.
6. I may request an electronic copy of the complete PhD thesis, after publication.

For analytical purpose, please indicate the following (if you prefer not to say, please disregard):

Gender:	F ☐	M ☐	other ☐	prefer not to say ☐
Age:	20-30 ☐	30-40 ☐	40-50 ☐	50-70 ☐

Years of professional experience: <10 ☐ 10-20 ☐ 20-30 ☐ >30☐

Participants Signature and date _____

I wish to be expressly named (please indicate form, e.g. title, name, company) in the PhD thesis,

date and signature_____

Researchers Name, Date and Signature:

Contact Information

This interview research is carried out as part of the PhD thesis under the supervision of the University of Vechta and the University of Applied Science Emden/Leer, Faculty of Maritime Science. For further questions or concerns, please find the contact details provided below.

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