

# **Safety of ship to ship transfers and investigation of marine accidents: an evaluation of the UK MAIB reports**

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## **Abstract**

Given the growing commercial practice of ship to ship transfers, the safety of these operations is becoming increasingly important. This article will highlight ways of preventing ship to ship transfer casualties and accidents. By looking at accident investigations, states can be better informed of lessons learned and be more ready safely to accommodate ship to ship transfers or respond to casualties/serious incidents. A regulatory and evaluative assessment of the UK Marine Accident Investigation Branch (MAIB) investigation of ship to ship transfer-related accidents is carried out, together with a further examination of how independent investigations ought to evolve.

## Introduction

Ship to ship operations are now a global commercial reality,<sup>1</sup> especially for the transfer of crude and refined oil products, as well as liquefied natural gas (LNG), liquefied petroleum gas (LPG), chemicals and dry bulk cargoes.

Ship to ship transfers have important commercial and operational benefits<sup>2</sup> but also carry risks of incidents. Indeed, ship to ship transfer-related incidents and casualties continue to happen. Several states are exposed to and/or affected by the phenomenon of ship to ship transfers and their associated risks, in their capacity as coastal states, flag states or port states.

Little detail of ship to ship transfer-related incidents is known, so we cannot have a clear idea of what safety lessons were learned from these accidents<sup>3</sup> in terms of management and prevention. The UK MAIB reports were considered to be a reliable methodological toolkit and have been used as a case study for marine accident investigations assessed against two criteria, namely disaster management theories and models, and the IMO framework. The aim is to learn

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<sup>1</sup> Nikolaos Ventikos and Dimitrios Stavrou ‘Ship to ship transfer of cargo: latest developments and operational risk assessment’ (2013) 63(3–4) *SPOUDAI Journal of Economics and Business* 172, 173.

<sup>2</sup> Alexandros Glykas and Stelios Perissakis ‘A risk assessment methodology as a tool for screening of ship to ship transfer operations’  
<https://site.onlinests.net/images/articles/riskassessment.pdf>.

<sup>3</sup> The sources vary from very few ship to ship transfer-related accident investigation reports to brief and often anonymous industry reports or third-party statistics.

lessons from these accidents so that they can be prevented in the future and also to establish the ‘gold standard’ of practice, in line with international marine safety principles and policy objectives.

### **The UK MAIB reports**

Marine safety investigation reports<sup>4</sup> identify safety deficiencies so that the transport system can be improved and lessons can be learned. A marine safety investigation aims to enhance safety and prevent future accidents.<sup>5</sup> The UK MAIB reports have been selected because of the world-leading reputation of the MAIB,<sup>6</sup> and its important reports on ship to ship transfer-related accidents. The UK is a major coastal, port and flag state, so assessment of investigation practices followed in the UK is particularly pertinent to states with similar geographical characteristics and involvement in shipping. States with congested ports, but also smaller coastal or flag states can potentially be affected by ship to ship transfers and may also benefit from the lessons learned.<sup>7</sup>

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<sup>4</sup> J A Stoop ‘Maritime accident investigation methodologies’ (2003) 10(4) *Injury Control and Safety Promotion* 237, 238.

<sup>5</sup> SI 2012/1743 reg 5(1).

<sup>6</sup> <https://www.gov.uk/government/organisations/marine-accident-investigation-branch/about#our-priorities>.

<sup>7</sup> See para 2.9 of the report on the investigation of the collision between the *Saetta* and the MT *Conger* on completion of a ship to ship transfer 9.5 miles south-east of Southwold, UK on 10 August 2009.

The findings of the MAIB reports do not have the force of law. The aim of these investigation reports is not to apportion blame but to suggest principles for better safety,<sup>8</sup> to offer knowledge and deepen the understanding of why marine accidents occur, as well as to develop national and international cooperation in marine accident investigations.<sup>9</sup>

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<sup>8</sup> See SI 2012/1743 (n 5) reg 5. Generally, investigations seek to identify the causes and circumstances of accidents at sea with the aim of preventing them from reoccurring.

Investigation reports are written in order to make recommendations on increasing safety at sea and to demonstrate the actions taken by the MAIB.

<sup>9</sup> <https://www.gov.uk/government/organisations/marine-accident-investigation-branch/about#our-priorities>. See also Stoop (n 4) 238.

## **The phenomenon of ship to ship transfers**

A ship to ship transfer operation<sup>10</sup> can be undertaken at sea or in port, and refers to the transfer of liquid (eg oil<sup>11</sup>) or gaseous cargo between ships moored side by side; it may take place when one ship is at anchor or alongside or when both vessels are underway.<sup>12</sup>

Ship to ship transfers constitute common practice for crude oil and, more recently, for LPG and LNG,<sup>13</sup> while the first barge to ship bunkering of methanol fuel occurred in May 2021.<sup>14</sup> Ship to ship lightering operations began in the late 1960s, in response to port draught

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<sup>10</sup> For the definition see *Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases* (2013) xi; Dimitrios Stavrou and Nikolaos Ventikos ‘A novel approach in risk evaluation for ship to ship transfer of cargo using process failure mode and effects analysis’ (2016) 19(7) *Journal of Risk Research* 913; Ventikos and Stavrou (n 1).

<sup>11</sup> For ship to ship transfers of oil see eg the explanatory note of the Merchant Shipping (Ship-to-Ship Transfers) Regulations 2020 (SI 2020/94).

<sup>12</sup> For this definition see *Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases* (n 10) xi.

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<https://www.onlinests.net/app/images/articles/successful%20STS%20operations%20require%20joint%20planning.pdf>.

<sup>14</sup> [https://www.portofrotterdam.com/en/news-and-press-releases/waterfront-shipping-takes-leadership-role-in-demonstrating-simplicity-of- ;](https://www.portofrotterdam.com/en/news-and-press-releases/waterfront-shipping-takes-leadership-role-in-demonstrating-simplicity-of-) <https://www.fleetmon.com/maritime-news/2021/33785/worlds-first-barge-ship-methanol-bunkering-carried/>. See also ‘First ship-to-ship LNG bunkering for boxship takes place in Singapore’ *Lloyd’s List* (24 March 2021).

limitations, and were devised to cater for the inability of very large crude carriers (VLCCs) safely to navigate the shallow rivers leading to oil terminals in ports in the Gulf of Mexico.<sup>15</sup>

Ship to ship transfers are ways to avoid port congestion,<sup>16</sup> when traffic density can compromise safety, or when there is lack of shore infrastructure. Such transfers are cheaper than berthing at a jetty.<sup>17</sup> However, the inherent risks<sup>18</sup> of any ship to ship transfer include contact (damage), collision, environmental pollution or fire, as the chances of leakage occurring are significant in the open sea when a vessel is in transit or not moored, not forgetting the risk to human life.<sup>19</sup>

Ship to ship transfers are extremely common the world over ( and notably eg in the east coast of the USA, the Caribbean, the Mediterranean Sea and off Singapore and Malaysia). Ship to

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<sup>15</sup> UK MAIB Report No 3/2010, 4 <https://www.gov.uk/maib-reports/collision-between-oil-tankers-saetta-and-conger-on-completion-of-a-ship-to-ship-transfer-off-southwold-england>.

<sup>16</sup> This was relevant in the context of the ship to ship transfer and relevant casualty of the *Jo Eik*. See UK MAIB Report No 24/2009 (26 November 2009). See also Tony Fishwick ‘Escaping vapours during tanker ship offloading cause two men to collapse’ (2011) 220 *Loss Prevention Bulletin* 9.

<sup>17</sup> <https://www.marineinsight.com/maritime-law/what-is-ship-to-ship-transfer-sts-and-requirements-to-carry-out-the-same/>.

<sup>18</sup> Dimitrios Stavrou and Nikolaos Ventikos ‘Ship to ship transfer of cargo operations: risk assessment applying a fuzzy inference system’ (2014) 4(4) *Journal of Risk Analysis and Crisis Response* 214, 218.

<sup>19</sup> *ibid*.

ship operations offer solutions in cases of sharp market demand and can also be deployed for the prevention of pollution.

The focus of the remainder of this article will be on ship to ship operations within the scope of IMO Resolution MEPC.186(59). Achieving a balance between the commercial advantages of ship to ship transfers and uncompromised marine safety has led to relevant regulatory frameworks.<sup>20</sup> The evolution of theories and models on marine accident investigations, which should underpin regulation and inspire its reform is discussed forthwith.

### **The evolution of accident and safety theories**

Accident investigations are key in promoting both transport safety and more effective regulation, so both theories and practice are relevant.<sup>21</sup> Remarkable research into tanker accidents has been conducted by George Psarros and his team.<sup>22</sup> Scientists<sup>23</sup> have commented

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<sup>20</sup> For example, in the UK, the first statutory move was the Merchant Shipping (Ship-to-Ship Transfers) Regulations 2010. See also ‘UK ship to ship transfers gets industry thumbs up’ *Lloyd’s List* (7 December 2010).

<sup>21</sup> Romanas Puisa and others ‘Unravelling causal factors of maritime incidents and accidents’ (2018) 110 *Safety Science* 124.

<sup>22</sup> George Psarros, Rolf Skjong and Magnus Strandmyr Eide ‘Under-reporting of maritime accidents’ (2010) 42 *Accident Analysis and Prevention* 619.

<sup>23</sup> Harilaos Psaraftis ‘Maritime safety: to be or not to be proactive’ (2002) 1 *WMU Journal of Maritime Affairs* 3.

on the post-accident<sup>24</sup> creation of regulations prior to 2010, which had the nature of ‘quick fixes’.<sup>25</sup> This is at odds with the principle of proactive enhancement of marine safety that drives the regulatory intervention of the IMO. Regulating towards safety objectives has been suggested, so that the regulatory system is credited with more flexibility.<sup>26</sup> As accident models evolve faster than international regulation, study of the former comes first.

Accident models are a description of a system or process to assist presentation of accidents occurrence on the basis of an accident theory.<sup>27</sup> They are vital for accident understanding, analysis, prediction and prevention.<sup>28</sup> They also offer a taxonomy for the categorisation of

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<sup>24</sup> *ibid* (n 23) and Jens-Uwe Schröder-Hinrichs and others ‘Introducing the concept of resilience into maritime safety’ 6th REA Symposium, Lisbon, Portugal (2015).

<sup>25</sup> *ibid*.

<sup>26</sup> See Psarros, Skjong and Strandmyr Eide (n 22), citing R Skjong ‘Experience with the use of risk assessment in IMO’ in T Bedford and P van Gelder (eds) ‘Proceedings of the 13th European Safety and Reliability Conference’ ESREL, The Netherlands (2003) and C Breinholt and others ‘Risk-based ship design and ship system design and their approval’ Proceedings of the RINA Conference on Developments in Classification and International Regulations, London (23–24 January 2007).

<sup>27</sup> Zobair Ibn Awal and Kazuhiko Hasegawa ‘A study on accident theories and application to maritime accidents’ (2017) 194 *Procedia Engineering* 298, 300.

<sup>28</sup> Arben Mullai and Ulf Paulsson ‘A grounded theory model for analysis of marine accidents’ (2011) 43(4) *Accident Analysis and Prevention* 1590, 1591.

factors within a certain investigation and for holistic research (eg trends).<sup>29</sup> They can be divided into accident development (or causation)<sup>30</sup> and accident analysis models.

The first models were linear (or sequential), defining accidents as ‘the culmination of a series of events or circumstances, which interact sequentially with each other in a linear fashion’.<sup>31</sup>

They suggest that accidents can be avoided by removing one of the causes. The first model in

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<sup>29</sup> ATSB Transport Safety Report, Aviation Research and Analysis Report AR-2007-053, ‘Analysis, causality and proof in safety investigations’ (2008) 32. In the same report, it is stated that accident analysis frameworks are also important in order to provide terminology, rules for critical reasoning and a structured method for the identification, ascertainment and testing of safety factors.

<sup>30</sup> Alex Garcia de Almeida and Jan Erik Vinnem ‘Major accident prevention illustrated by hydrocarbon leak case studies: a comparison between Brazilian and Norwegian offshore functional petroleum safety regulatory approaches’ (2020) 121 *Safety Science* 652. Accident causation reveals that these undesirable outcomes are the result of multifactorial synergies. About accident causation we read: ‘Accident causation models sustain that different roles in different levels, including regulators, companies, and the work environment, create the necessary conditions to a loss event, and therefore should be part of the accident analysis.’

<sup>31</sup> Safety Institute of Australia Ltd ‘OHS body of knowledge-models of causation: safety’ in *The Core Body of Knowledge for Generalist OHS Professionals* (2012) 3

<https://www.ohsbok.org.au/wp-content/uploads/2013/12/32-Models-of-causation-Safety.pdf>.

this category was Heinrich's domino theory:<sup>32</sup> accidents are a chain of causal factors and can be thought of as dominos placed one after another.<sup>33</sup>

Complex linear models were developed progressively considering accidents as the 'result of a combination of unsafe acts and latent hazard conditions within the system which follow a linear path'.<sup>34</sup> The origin of any unsafe acts is usually in the management system, not within the individuals who performed the unsafe acts.<sup>35</sup> This model takes a 'system' approach: in order to avoid accidents, barriers and defences must be enhanced.

In response to the increasingly complex socio-technical environment, equally complex non-linear models were developed, theorising that accidents happen because of combinations of mutually interacting variables. These models highlight the need to study the combination and interaction of these various factors.<sup>36</sup>

According to Benner,<sup>37</sup> the analysis of an accident and the response to it are highly dependent on an accident model. Models that associate individual, systemic and organisational failures

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<sup>32</sup> H W Heinrich *Industrial Accident Prevention: A Scientific Approach* (McGraw-Hill 1931).

<sup>33</sup> The accident happens when an accident factor/domino falls and has this knock-on effect.

<sup>34</sup> Safety Institute of Australia Ltd (n 31).

<sup>35</sup> MAIIF Manual 123 <https://maiif.org/wp-content/uploads/2020/10/MAIIF-Investigation-Manual-2014.compressed.new-logo.pdf>.

<sup>36</sup> E Hollnagel (ed) *Safer Complex Industrial Environments* (CRC Press 2010).

<sup>37</sup> Ludwig Benner 'Rating accident models and investigation methodologies'(1985) 16 *Journal of Safety Research* 105.

increased in light of more complicated accidents:<sup>38</sup> the Swiss Cheese<sup>39</sup> and SHELL<sup>40</sup> (named after the initial letters of its components: software (S), hardware (H), environment (E) and liveware (L)) models are among the best known.<sup>41</sup>

According to the Swiss Cheese Model (SCM) of Reason,<sup>42</sup> accidents are the result of interrelations between unsafe acts and latent conditions in a system, such as weakened barriers and defences, similar to the holes in a slice of cheese. In a complex system, hazards are prevented from causing human losses by a series of barriers. However, each barrier may have unintended weaknesses, or holes – hence the analogy with Swiss cheese. The sequence of an

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<sup>38</sup> Shih-Tzung Chen and others ‘A human and organisational factors (HOFs) analysis method for marine casualties using HFACS-Maritime Accidents (HFACS-MA)’ (2013) 60 *Safety Science* 105.

<sup>39</sup> James Reason *Managing the Risks of Organisational Accidents* (Ashgate 1997).

<sup>40</sup> F Hawkins *Human Factors in Flight* (2nd edn Ashgate 1987). The model started as SHEL, but Hawkins developed it to SHELL, looking at the interactions among people (liveware–liveware).

<sup>41</sup> These developments looked for underlying factors that could cause an accident to occur and were in response to further high-profile accidents.

<sup>42</sup> James Reason ‘Human error: models and management’ (2000) 320 *British Medical Journal* 768. On this model see also Justin Larouzee and Jean Christophe le Coze ‘Good and bad reasons: the Swiss cheese model and its critics’ (2020) 126 *Safety Science* 1, 5: ‘The accident is presented as a “loss of control over the risks causing damage”, “loss of control” resulting from interactions between organisational processes, local work areas, defences, risky acts and latent conditions.’

accident begins from negative results of organisational processes/conditions, which then lead to local conditions, eg at the operational level of the workspace; these have a negative impact on an individual's performance and set the conditions for unsafe human acts.

The SCM underlines organisational and management system deficiencies. However, it has certain limitations, such as that it may not be great at covering technical issues.<sup>43</sup> Furthermore, although the SCM is widely used by a variety of industries, it is sometimes interpreted contrary to its creators' expectations, resulting in disagreement among investigators and, in 'overly dogmatic interpretations'.<sup>44</sup> Models have evolved,<sup>45</sup> and it has been acknowledged<sup>46</sup> that they need to be updated,<sup>47</sup> as accidents happen in a socio-technical environment that is constantly becoming more complex.<sup>48</sup>

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<sup>43</sup> 'Revisiting the "Swiss Cheese" model of accidents' EEC Note No 13/06.

<sup>44</sup> *ibid* 2.

<sup>45</sup> See Awal and Hasegawa (n 27) 303. First came statistical accidental analysis (eg Vernon in the UK studied industrial accidents), then risk analysis (identification of threats and determination of consequences), followed by Gordon's epidemiologic theory on the premise that causative factors reside in agents, the host and the environment. Finally, James Reason came up with the SCM and the Organisational Accident model.

<sup>46</sup> Mullai and Paulsson (n 28) 1590.

<sup>47</sup> J R Harrald and others 'Using system simulation to model the impact of human error in a maritime system' (1998) 30 *Safety Science* 235.

<sup>48</sup> M Grabowski and others 'Sailing on Friday: developing the link between safety culture and performance in safety-critical systems' (2010) 40(2) *IEEE Transactions on Systems Man and Cybernetics* 263.

The Human Factors Analysis and Classification System (HFACS) is a model of analysis of accidents which has received support in the maritime sector in the previous ten years.<sup>49</sup> HFACS was developed in order to evaluate the role of human performance issues in aviation accidents in the United States Navy. It assists with the identification of human and organisational factors and their relationships in an accident<sup>50</sup> and it builds on the SCM. HFACS helps investigators identify the holes in the safety barriers.<sup>51</sup> It can be used proactively by analysing historical events to locate human and system-related accident factors and trends.<sup>52</sup>

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<sup>49</sup> Mehmet Kaptan and others ‘The evolution of the HFACS method used in analysis of marine accidents: a review’ (2021) 86 *International Journal of Industrial Ergonomics* 103225; Helen Omole and Guy Walker ‘Offshore transport accident analysis using HFACS’ (2015) 3 *Procedia Manufacturing* 1264.

<sup>50</sup> Y F Wang and others ‘Accident analysis model based on Bayesian network and evidential reasoning approach’ (2013) 26 *Journal of Loss Prevention in the Process Industries* 10.

<sup>51</sup> D Wiegmann and S Shappell *A Human Error Approach to Aviation Accident Analysis: the Human Factors Analysis and Classification System* (Ashgate 2003).

<sup>52</sup> In accident investigations, human factors are examined to ‘understand in detail how and why people make errors (including slips and lapses) or commit violations that lead to accidents’. See also ATSB safety information paper B2006/0094 ‘A layman’s introduction to human factors in aircraft accident and incident investigation’ (June 2006).

Shipping,<sup>53</sup> and arguably also ship to ship transfers within it, are no exception to the trend that the general regulatory approach to safety has been reactive.<sup>54</sup> The IMO looked at human factors much later than aviation or the railways.<sup>55</sup> Since the above-mentioned research of Psarros of 2010, there has been abundance of research assessing and proposing accident theories and models for marine disaster management. None of this is specifically about or designed for ship to ship operations. It was the *Herald of Free Enterprise* accident, which resulted in the loss of 193 lives that motivated the study of human and organisational factors in maritime safety.<sup>56</sup> The most important positive actions<sup>57</sup> after this accident were the introduction of the International Safety Management (ISM) Code<sup>58</sup> and the establishment of the UK MAIB in 1989.

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<sup>53</sup> Psarros, Skjong and Strandmyr Eide (n 22) 619.

<sup>54</sup> This is also the observation of industry stakeholders: see DNV Industry insights ‘A hot approach to incident investigation’ (20 March 2019).

<sup>55</sup> Shiqi Fan and others ‘Maritime accident prevention strategy formulation from a human factor perspective using Bayesian networks and TOPSIS’ (2020) 210 *Ocean Engineering* 107544; J U Schroder-Hinrichs, M Baldauf and K T Ghirxi ‘Accident investigation reporting deficiencies related to organizational factors in machinery space fires and explosions’ (2011) *Accident Analysis & Prevention* 1187.

<sup>56</sup> Fan and others (n 55) 2.

<sup>57</sup> Wieslaw Tarelko ‘Origins of ship safety requirements formulated by the IMO’ (2012) 45 *Procedia Engineering* 847, 849.

<sup>58</sup> In 1994, SOLAS was amended to add chapter IX entitled ‘Management for the safe operation of ships’.

Root Cause Analysis (RCA) is yet another accident model proposed.<sup>59</sup> For example, the American Bureau of Shipping has adopted the Marine Root Cause Analysis Technique (MaRCAT) to investigate accidents and near misses.<sup>60</sup> The investigative approach starts with human errors, problems (of structure, machinery, equipment or outfitting items) and/or external factors. There follows a consideration of fundamental causes and aspects of organisations, such as controls for the task and the process. Finally, the management systems and the organisation's culture are scrutinised. Similarly, the SHELL model is useful for triggering the questions of 'where', 'what' and 'who' about an accident, but has been criticised as insufficient in terms of the 'how' and the 'why'.<sup>61</sup>

According to the industry and research, loss prevention depends on good risk assessment and avoidance through risk management.<sup>62</sup> Risk assessment aims to determine the probability of causes and contributory factors of accidents. Risk analysis, according to Mullai, is wider than

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<sup>59</sup> Serdar Kum and Bekir Sahin 'A root cause analysis for Arctic marine accidents from 1993 to 2011' (2015) 74 *Safety Science* 206.

<sup>60</sup> A root cause analysis examines causal factors, intermediate causes and root causes of an incident and develops recommendations to address each level of the analysis:

[https://ww2.eagle.org/content/dam/eagle/rules-and-guides/current/other/142\\_investigationofmarineincidents/ii\\_rca\\_guidance\\_e-feb14.pdf](https://ww2.eagle.org/content/dam/eagle/rules-and-guides/current/other/142_investigationofmarineincidents/ii_rca_guidance_e-feb14.pdf).

<sup>61</sup> Young-Chan Lee 'A study on maritime casualty investigation combining the SHEL and hybrid model methods' (2016) 40(8) *Journal of the Korean Society of Marine Engineering* 721.

<sup>62</sup> For the P&I perspective see <https://maritime-mutual.com/blog/2020/12/11/ship-to-ship-bulk-liquid-transfer-operations-compliance-best-practice/>.

accident analysis, as it contains the additional elements of exposure analysis and risk estimation and presentation.<sup>63</sup> In ship to ship transfers, risk analysis forms the background behind the STS operations Plan, so that the operation can unfold avoiding identified risks.<sup>64</sup> The latter helps visualise how various events can result in accidents.

Hybrids of the HFACS model have also been proposed.<sup>65</sup> Examples involve the Human Factors Analysis and Classification System for Maritime Accidents (HFACS-MA) devised by Chen.<sup>66</sup> The framework embraces aspects of HFACS, Reason's SCM and Hawkins' SHELL models. The Bowtie Model is now also in use, depicting how a critical central event may have various precursors and several consequences.<sup>67</sup> Another hybrid marine accident approach was devised by Akyuz, combining the analytical network process (ANP) and HFACS methods.<sup>68</sup>

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<sup>63</sup> Mullai and Paulsson (n 28) 1592.

<sup>64</sup> Awal and Hasegawa (n 27) 303.

<sup>65</sup> Emre Akyuz 'A marine accident analysing model to evaluate potential operational causes in cargo ships' (2017) 92 *Safety Science* 17; C Chauvin and others 'Human and organisational factors in maritime accidents: analysis of collisions at sea using the HFACS' (2013) 59 *Accident Analysis and Prevention* 26.

<sup>66</sup> Chen (n 38) 105.

<sup>67</sup> C Devolsalle and others 'Identification of reference accident scenarios in SEVESO establishments' (2005) (2–3) *Reliability Engineering and System Safety* 238, 239–40; Erik Hollnagel 'Risk + barriers = safety?' (2008) 46 *Safety Science* 221, 223.

<sup>68</sup> Emre Akyuz 'A marine accident analysing model to evaluate potential operational causes in cargo ships' (2017) 92 *Safety Science* 17.

## **The modern theory: from Safety-I to Safety-II**

Approaching accidents with a ‘find and fix’ approach stands at the core of the concept of Safety-I.<sup>69</sup> As discussed above, according to Schroder-Hinrichs,<sup>70</sup> marine safety investigations reflect the Safety-I philosophy, as conceptualised by Hollnagel and others. This includes looking for failures and malfunctions, trying to identify their causes and then eradicating them. A more modern safety concept is that of resilience engineering:<sup>71</sup> this emphasises that the complexity of the modern environment necessitates a change of approach beyond the root cause analysis of linear models.<sup>72</sup>

The authors of *Resilience Engineering* believe that it is now time to examine safety not just from the Safety-I approach (ie looking for what goes wrong), but with a more proactive mindset. It is therefore necessary to look at operations (arguably also maritime ones) to see what ‘goes right’ and with what adjustments, and understand how people flexibly avoid near misses, errors and mistakes that could lead to major accidents. It has been suggested that safety

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<sup>69</sup> Erik Hollnagel and others *From Safety-I to Safety-II: A White Paper* (2015) at <https://www.england.nhs.uk/signuptosafety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-white-papr.pdf>.

<sup>70</sup> Schroder-Hinrichs and others (n 55).

<sup>71</sup> Erik Hollnagel, David Woods and Nancy Leveson *Resilience Engineering: Concepts and Precepts* (Ashgate 2006), as cited in Hollnagel and others, ‘From Safety-I to Safety-II: A White Paper’.

<sup>72</sup> Hollnagel, Woods and Leveson (n 71).

management should shift from ensuring that ‘as few things as possible go wrong’ (Safety-I) to ensuring that ‘as many things as possible go right’ (Safety-II).<sup>73</sup> This also extends to how investigations are conducted. Their aim must also be to comprehend how things usually ‘go right’, since that is the basis for explaining how things occasionally go wrong.

Under Safety-II, the priorities of safety management are changing. Instead of conducting investigations after the event or trying to limit adverse outcomes, safety management should also study the events that go right. People should try to learn from events based on their frequency and not on their severity, thus paying attention to incidents of a smaller scale.<sup>74</sup> Again, instead of analysing single severe events in depth, investigators should explore accidents more broadly to identify the trends in system performance: ‘A good way to start would be to reduce the dependency on “human error” as a near-universal cause of incidents and instead understand the necessity of performance variability.’<sup>75</sup>

Applying the Safety-II approach to a marine investigation context suggests that there is much to be learned by observing the elements of the safe practice itself, the near misses and the circumstances where people adapt or react in a certain way to avoid undesired outcomes.

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<sup>73</sup> Hollnagel and others (n 69).

<sup>74</sup> As explained by Hollnagel: ‘Many small improvements of everyday performance may count more than a large improvement of exceptional performance’

<https://www.england.nhs.uk/signuptosafety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-white-papr.pdf>.

<sup>75</sup> *ibid.*

This can arguably also mean that there are reasons to open investigations directed more towards safety issues and not just occurrences. Investigation bodies can also write reports that they then share with organisations, stakeholders and the public, with details of incidents for which reports are not usually or compulsorily written. In the context of ship to ship transfers, a helpful but also critical role can be played by the International Chamber of Shipping (ICS) and the Oil Companies International Marine Forum (OCIMF), that publish good practice guidelines.

## **Published guidelines on accident investigation**

### *The IMO regulatory framework*

The IMO is a major driver of international maritime safety regulation and produces common guidelines on the technical investigations to be carried out following maritime casualties and incidents.<sup>76</sup>

The Maritime Safety Committee adopted the Casualty Investigation Code by Resolution MSC.255(84).<sup>77</sup> A new regulation 6 in chapter XI-1 of the SOLAS Convention by Resolution MSC.257(84) makes the Code mandatory.

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<sup>76</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52005PC0590&from=EN>.

<sup>77</sup> Resolution MSC.255(84) (adopted on 16 May 2008) ‘Adoption of the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code)’.

This Code clarifies the scope of an investigation<sup>78</sup> and its guiding principles. As its title suggests, it is a list of standards and practices. These evolve, which may denote that at some point the Code will need to be updated. This can take time, and therefore this justifies the need for an additional evaluative framework of marine safety investigations. More specifically, the contemporary principles of accident investigation can serve as a framework for the assessment of the MAIB safety investigation reports on incidents or casualties associated with ship to ship operations. The IMO Code and MAIIF guidelines are therefore texts that represent the standards of their time, whereas the contemporary or evolutionary principles of safety investigation can be a more accurate reflection of the best way forward.

According to the Casualty Investigation Code: ‘Marine safety investigating state(s) shall submit the final version of a marine safety investigation report to the Organization for every marine safety investigation conducted into a very serious casualty.’<sup>79</sup> The Code has the

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<sup>78</sup> *ibid* para 16.5.

<sup>79</sup> *ibid* Pt II ch 14 para 14.1.

objective to prevent marine incidents or casualties in the future.<sup>80</sup> This can materialise through states:<sup>81</sup>

‘1.1.1 applying consistent methodology and approach, to enable and encourage a broad ranging investigation, where necessary, in the interests of uncovering the causal factors and other safety risks and

1.1.2 providing reports to the Organization to enable a wide dissemination of information to assist the international marine industry to address safety issues.’

The IMO<sup>82</sup> suggests the development of an investigation plan and the delegation of investigation tasks (international coordination), which is followed by the UK MAIB. The IMO<sup>83</sup> invites the investigatory body to consider the marine incident or casualty not only in

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<sup>80</sup> References to this aim can be found in Casualty Investigation Code paras 1.1, 2.11, 2.12.7, 14.2, 16.5, 17.1. The Maritime Safety Committee, at its seventy-fourth session (30 May–8 June 2001), and the Marine Environment Protection Committee, at its forty-seventh session (4–8 March 2002), approved the Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process (MSC/Circ.1023-MEPC/Circ.392, as amended by MSC/Circ.1180-MEPC/Circ.474 and MSC-MEPC.2/Circ.5).

<sup>81</sup> Casualty Investigation Code para 1.1.

<sup>82</sup> Resolution A.1075(28) ‘Guidelines to Assist Investigators in the Implementation of the Casualty Investigation Code (Resolution MSC.255(84))’ (adopted on 4 December 2013) para 5.4.

<sup>83</sup> *ibid.* Para 5.1.1 states: ‘Marine casualty or incident safety investigations should therefore be seen as a means of identifying not only the accident events, but also safety deficiencies in the overall management of the operation from policy through to its implementation, as well as in regulation, survey and inspection.’

terms of accident events, but also by looking at safety deficiencies, operational and management handling of factors making observations in terms of policy, compliance, implementation and regulation.

The IMO encourages an accident analysis from a systemic perspective, which looks at conditions that influence an incident, and also places the human factors and their interplay with the machine and the organization into focus.<sup>84</sup> This is reminiscent of the SCM, SHELL, and HFACS models and Safety-I overall. The IMO encourages an investigation that looks at causal factors and safety risks.

Evidently, the most recent IMO guidance shows openness and not exclusive approval of accident investigation models.<sup>85</sup> That said, on the IMO website, under the heading ‘Lessons Learned’, there is a diagram of the SCM,<sup>86</sup> which suggests that it is a framework of reference. The IMO establishes benchmarks for models:<sup>87</sup>

‘...Some methods focus on human factors; some support the understanding of the sequence of events; others are more supportive in a complex safety analysis or in understanding technical failures. Analysis methods (be they human-factor centric, or

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<sup>84</sup> *ibid* para 5.11.1.

<sup>85</sup> *ibid* para 5.11.2.

<sup>86</sup> <https://www.imo.org/en/OurWork/IIS/Pages/Lessons-Learned.aspx>.

<sup>87</sup> Resolution A.1075(28) (n 82) para 5.11.2.

sequential<sup>88</sup>) should therefore rather be seen as tools in a toolbox. A good investigation will choose the optimal set of analysis tools to meet the characteristics of that casualty or incident. However, the method or the combination of methods used in each investigation should as a minimum requirement support:

1. reconstruction of the casualty or incident as a sequence of events;
2. identification of linked accident events and contributing factors at all appropriate levels; and
3. safety analysis and development of recommendations.’

It is clear from the above that the IMO is not prescriptive. However, an important detail is that the Casualty Investigation Code requires the choice of a methodology or a combination of analysis tools to be adopted by the investigators. This arguably means that investigators should include the justification and explanation of this method in the report, especially if reference to specific methods or theories is not made in other publications of the investigatory authority. It is noteworthy that a specific accident analysis model has been designed and documented by the Australian Transport Safety Bureau (ATSB), although nothing similar has yet been published by the MAIB. A comprehensive accident framework is important, so that the scientific structure and appropriateness of the investigation report can be seen.

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<sup>88</sup> Note on this that according to Mullai and Paulsson (n 28) 1593, accident models are in their majority sequential, as they consider accidents as a sequential chain of events that occur in a specific order. Three typical sequential models are the Bowtie Model, the Swiss Cheese Model and a framework for maritime risk assessment.

According to the IMO Resolution A.1075/28,<sup>89</sup> the prerequisites for an efficient safety analysis tool are that it should:

- ‘1. encourage different perspectives of casualty or incident causation
2. support communication and deeper questioning
3. enable the identification of safety issues and safety deficiencies, including those remote from the casualty site and
4. enhance the development of effective remedial actions at all appropriate levels.’

In IMO Resolution A.884(21), which has now been revoked, it was explained that as the investigator begins the data collection step, it would be only natural that an attempt be made to place the information, albeit often fragmentary in the preliminary stages of an investigation, into the context of an occurrence sequence where the SHEL and Reason models can be combined. The MAIIF manual<sup>90</sup> echoes the standards that several safety investigation authorities have developed within the international framework.

### ***The Marine Accident Investigators’ International Forum (MAIIF)***

The MAIIF includes within its membership the chief investigators of many of the marine safety investigation organisations from around the world. One of its principal roles is to champion and promote best practice in marine safety investigation. As the IMO does not prescribe or name approved accident models, the MAIIF manual<sup>91</sup> has been issued in line and in support of

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<sup>89</sup> Resolution A.1075(28) (n 82) para 5.13.

<sup>90</sup> The Marine Accident Investigators’ International Forum.

<sup>91</sup> MAIIF Manual (n 35).

the IMO Casualty Investigation Code. As such, it is a more specific source for discovering what models and methods investigation authorities recognise in their practice.

Investigators deal with information collection in a spirit of cooperation, rather than one of confrontation.<sup>92</sup> This is also reflected in the approach of the UK MAIB in its investigation reports. In MAIIF's Job Aid, there is a recommendation for compliance with the SHELL model.<sup>93</sup> The MAIIF manual mentions the wide acceptance of Reason's model, but also warns that there may be limitations.<sup>94</sup> For this reason, it also promotes more refined variants of the Reason model for the maritime sector, such as HFACS, Sequential Timed Events Plotting, HuMan – Technology – Organisation, Cognitive Reliability and Error Analysis Method, and Casualty Analysis Methodology for Maritime Operations (CASMET).<sup>95</sup> Importantly, the MAIIF advocates the model of the ATSB, which is a variation of Reason's model, as a structured example of an investigation analysis framework.<sup>96</sup>

The ATSB has produced a modified and thorough SCM, with justifications, and has explained that, at certain points, the terminology it uses is slightly broader: this is so that the investigation process does not adopt language that could be considered as apportioning blame, in line with principles of independent accident investigations. The ATSB has numerous publications about

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<sup>92</sup> *ibid* 23.

<sup>93</sup> Marine Casualty Investigation 'Investigators' In-the-field Job Aid' MAIIF/IMO, <https://maiif.org/wp-content/uploads/2020/12/JOB-AID-V.7-IMO.pdf>.

<sup>94</sup> *ibid* 24.

<sup>95</sup> MAIIF Manual (n 35) 120.

<sup>96</sup> ATSB Transport Safety Report (n 29) vii, 95.

its role and scientific methodology, which may help it to review its approach and to analyse accident trends. It also may serve as an example for other investigation authorities, especially so that more transparency is offered as to the usefulness of accident models.

### ***Ship to ship transfer obligations stemming from the IMO***

In accordance with Resolution MEPC.186(59),<sup>97</sup> a new Chapter 8 has been added to MARPOL Annex I, entitled ‘Prevention of Pollution During Transfer of Oil Cargo between Oil Tankers at Sea’. Regulation 40(1) provides:

‘The regulations contained in this chapter apply to oil tankers of 150 gross tonnage and above engaged in the transfer of oil cargo between oil tankers at sea (STS operations) and their STS operations conducted on or after 1 April 2012. However, STS operations conducted before that date but after the approval of the Administration of STS operations Plan required under regulation 41.1 shall be in accordance with the STS operations Plan as far as possible.’

According to Regulation 42, the relevant authorities must be notified not less than 48 hours in advance of all scheduled ship to ship operations within the territorial or the exclusive economic zone. Guidance on what the approved STS operations Plan should include is offered through publications/guidelines of the ICS and the OCIMF.

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[https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.186\(59\).pdf](https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.186(59).pdf).

## UK MAIB ship to ship transfer-related reports<sup>98</sup>

### *The Jo Eik incident*<sup>99</sup>

The officer and crew of a chemical tanker were instructed to load a cargo of 2,000 tonnes of crude sulphate turpentine (CST), which is a category X MARPOL substance for a ship to ship transfer at a cargo terminal. The crew had no experience of handling it or knowledge of its hazards. The safety briefing prior to the loading of the cargo was conducted by the chief officer and took place without him having the cargo Material Safety Data Sheet (MSDS). This meant that the safety briefing did not cover the cargo hazards.<sup>100</sup>

The pre-arrival conference did not warn of the specific CST hazards, and the location of the ship to ship operation subsequently changed without a new pre-arrival conference taking place. Cargo and safety checks took place without cross-checking the MSDS data, as all involved were complacent that they already had the right information.<sup>101</sup> The cargo surveyor undertook his checks while wearing his respirator. The accompanying Able Bodied seaman (AB) did not reflect on the need to also adopt a similar safety precaution and had no respiratory protection.

From the outset of the ship to ship transfer there was a strong smell which became even stronger as the atmosphere of the receiving ship's tanks was displaced. This smell (although pungent)

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<sup>98</sup> Marine Accident Investigation Branch.

<sup>99</sup> UK MAIB *Jo Eik* Report No 24/2009 (n 16); Fishwick (n 16).

<sup>100</sup> The pre-arrival conference did not mention the specific hazards associated with the CST cargo.

<sup>101</sup> *Jo Eik* Report No 24/2009 (n 16) 1.

was not investigated, and again no reference to the MSDS was sought for cargo hazards. The harbourmaster's staff made several enquiries to try to identify the source, but without success.

Because of the transfer of a MARPOL X category substance, the pre-wash was mandatory.<sup>102</sup> According to the Procedures and Arrangements (P&A) Manual,<sup>103</sup> washing would normally take place through fixed systems, which in this case were defective. Portable washers were used instead, which passed through the open Butterworth hatches. The washers unbalanced the tank's atmosphere. As a result, the heavy air vapours travelled through the open hatch and gathered in the surrounding area.

On completion of the pre-wash, an AB went towards the hatch to remove the portable washer. As he descended the ladder that led to the hatch, he lost his sense of smell, struggled to breathe, fell unconscious and slumped across the open hatch. The Ordinary Seaman (OS) went to see if the AB needed help, saw him unconscious and alerted the chief officer, who then informed the master. The master went to the bridge and sounded the general alarm: he did not use the terminal's emergency procedures, but instead informed the ship's agent of the problem.<sup>104</sup>

Meanwhile, the chief officer cautiously attempted to rescue the AB, as he also noticed the strong smell, but without testing the atmosphere and without wearing breathing apparatus

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<sup>102</sup> In accordance with MARPOL 73/78 (Annex II, Appendix 4), every ship certified to carry category X, Y or Z substances is required to have a procedures and arrangements (P&A) Manual on board.

<sup>103</sup> This was stipulated in the note accompanying Table B1/B2 in the P&A Manual.

<sup>104</sup> *Jo Eik* Report (n 16) para 1.3.4.

(BA). In the event, the chief officer was also overcome by the toxic gas and lost consciousness several times before he was rescued.<sup>105</sup> Despite the pungent smell, the AB did not consider the need for respiratory protection because he did not recognise the risks and had not been warned of the cargo hazards. The report made the following finding:<sup>106</sup>

‘The physiological effects on both the AB and chief officer strongly support the hypothesis that inhalation of the accumulated cargo vapours, coupled with possible oxygen deficiency in the vicinity of P10 inboard Butterworth hatch, was the cause of their disablement.’

The MSDS is an essential component in the effective and safe management of cargo handling procedures. The cargo-specific MSDS that was passed to the chief officer of the *Jo Eik* and which identified the hazards was not then transferred. None of the parties dealing with the ship to ship transfer was aware of the true dangers of the cargo, and so did not have the proper information needed to make a complete risk assessment or to take effective safety control measures. Furthermore, they did not have specific instructions on how H<sub>2</sub>S cargoes should be handled.<sup>107</sup>

It is also clear that the cargo surveyor was not properly protected, as his mask was not fitted with the correct filter: he would have known this, had he consulted the cargo-specific MSDS.<sup>108</sup>

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<sup>105</sup> *ibid* 43.

<sup>106</sup> *ibid* 42.

<sup>107</sup> *ibid* 43.

<sup>108</sup> *ibid* 44.

The MAIB found as follows:

When the MSDS for the CST cargo was received on board *Jo Eik*, there was no attempt made to review the document carefully, nor to brief the crew about the likely risks and necessary precautions that would be required due to the nature of the product. Instead, the MSDS was merely posted in a position where it was assumed the crew would see it, read it and be guided accordingly.<sup>109</sup>

The practice of not repeating pre-arrival conferences and of being complacent towards safety management can easily result in crews forgetting the safety issues during the prolonged period of ship to ship transfer activities. The MAIB also found that the risk assessments and safety control measures did not rely on accurate information. The report criticised the fact that the process of correctly completing the checklists was neglected.<sup>110</sup> This complacent attitude led to lapses in well-documented procedures, which put the crew at risk.<sup>111</sup>

Due to the prevalence of fatal accidents and the risks relating to access to enclosed spaces, the Chief Inspector of Marine Accidents published a MAIB Safety Bulletin in July 2008, in which he emphasised the major causes of these accidents: ‘These accidents were due to complacency leading to lapses in procedure, lack of knowledge; potentially dangerous spaces not being identified and would-be rescuers acting on instinct and emotion rather than knowledge and training.’<sup>112</sup>

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<sup>109</sup> *ibid* para 2.4.1.

<sup>110</sup> *ibid* 45.

<sup>111</sup> *ibid* para 1.22.2.

<sup>112</sup> Safety Bulletin No 2/2008 (July 2008).

### *Evaluation of the Jo Eik report*

It is useful in fostering awareness that, before analysing the particular accident, the report makes reference to similar accidents. In the Synopsis of the report, the MAIB stated that inadequate risk control measures had been put in place, although no reference was made to either the SCM or the ATSB models.<sup>113</sup> The report identified the lack of safety precautions taken by the crew, as well as the omission to enforce safety requirements about respiratory protection, which also increased the risk.

The MAIB report provided a detailed analysis that focused on a chronological investigation of all aspects of the voyage, so there was a determination of non-compliance with rules and regulations, as well as a qualitative investigation of all the underlying causes. Subsequently, recommendations were made about the importance of safety issues and lessons learned. The MAIB made recommendations for issues that directly caused the accident, as well as for other issues that did not contribute directly. The report also addressed elements considered important, which could in other cases create casualties. The follow-up actions after the sending of the draft report show proper monitoring of the feedback process that is important in accident investigations, for the purpose of promoting lessons learned.

It is noteworthy that within this investigation, the MAIB issued bulletins and flyers further to enhance the visibility of lessons that could be learned from the specific accident. This is how prevention awareness is cultivated. The MAIB made recommendations not only to the companies directly involved but also to the ICS and to the IMO.

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<sup>113</sup> *Jo Eik* Report No 24/2009 (n 16) 1.

An assessment of this MAIB report, with reference to the IMO and MAIIF guidelines, shows that the report did not include a visual representation of the occurrences and contributing factors (eg through Accimap or Fault Tree).<sup>114</sup> According to the Casualty Investigation Code,<sup>115</sup> the aim of any investigation is to unveil immediate causal factors and failures: the investigation report used non-judgmental language, listing in the conclusions a classification of safety issues directly contributing to the accident, and other safety issues.<sup>116</sup> At the same time, the term ‘contributing factor’ was used once in a specific context, to clarify that fatigue was not such a factor. Therefore, an overall assessment of this MAIB report shows that it was largely within the MAIIF manual specifications, and presumably a model was followed (SCM or ATSB), with the exceptions noted in this paragraph. That said, acknowledgement of a specific accident model used would have been an advantage, crediting the report with additional scientific reliability. Gradually, and in the long-run, compliance with a certain accident model would enable the MAIB to reflect on the safety culture stemming from the investigation reports, establishing an investigation system inspired by the Safety-II theory.

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<sup>114</sup> A Hopkins ‘Fault trees, ICAM and Accimaps: a methodological analysis’ (2003) 25(2) *Safety in Australia* 13.

<sup>115</sup> See para 16.5.

<sup>116</sup> This is in the spirit of ‘no-blame’ investigations (para 16.2 of the Code).

### *The Saetta/Conger incident*

Another well-reported ship to ship transfer incident is the collision between the Greek registered oil tanker *Saetta* and the Marshall Islands' registered oil/chemical tanker *Conger*.<sup>117</sup> The vessels collided at a very slow speed on completion of a ship to ship transfer 9.5 miles south-east of Southwold, UK on 10 August 2009. The first cause of the accident was the failure of the *Conger*'s main engine to start as the vessels separated. The MAIB also noted: 'Both [tankers] manoeuvred to try and avoid a collision, but they were very close when the engine failed and the action taken was not effective. The response to the engine failure, and poor communications, were also contributory factors.'<sup>118</sup>

The lack of a plan for the mooring and unmooring operations, and the consequent omission to have a relevant risk assessment in place were emphasised. Another missed opportunity, according to the MAIB, was that a brief requiring the steps to be followed in the event of an engine or steering failure had not been provided by either tanker.<sup>119</sup> The superintendent on board the *Conger* had 47 years' experience of oil and chemical tanker operations.<sup>120</sup> The STS service provider had issued its STS operations manual which was revised in March 2009. The aim of the manual was to ensure that all ship to ship transfers were compliant with the ICS/OCIMF Ship to Ship Transfer Guide (Petroleum). The *Saetta* suffered structural damage

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<sup>117</sup> Report No 3/2010 (n 15).

<sup>118</sup> *ibid* 1.

<sup>119</sup> *ibid* 28.

<sup>120</sup> *ibid* para 1.7.1.

to her starboard lifeboat and her lifeboat davit arm.<sup>121</sup> The *Conger*, however, received nothing more than scratches to her paintwork.<sup>122</sup>

In the *Saetta/Conger* report, the MAIB noted four other collisions that had occurred off the UK coastline between 3 July and 1 December 2009.<sup>123</sup> This confirms the premise of this article: although ship to ship operations are generally carried out safely, the frequency of minor accidents demands that the industry should become more familiar with their causes, in order to prevent them from reoccurring.

The MAIB also recognised the then-anticipated contribution of the OCIMF to the raising of the operational standards for STS service providers and of the occupational standards for STS superintendents: this has been done by updating the industry best practice through the publication of the *Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases*. The revised *Ship to Ship Transfer Guide* also covers operations between gas and chemical tankers, and designates risk assessment obligations and manpower requirements. Reflecting on the frequency and circumstances of incidents associated with ship to ship operations, the MAIB underlined the importance of regular reviews and amendments of the *Ship to Ship Transfer Guide*.<sup>124</sup>

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<sup>121</sup> *ibid* 1.3.5.

<sup>122</sup> Fortunately, there were no injuries or pollution caused by the collision.

<sup>123</sup> Report No 3/2010 (n 15) para 1.14.1.

<sup>124</sup> *ibid* 30 and 31.

At the same time, the MAIB took a consolidated approach and included similar ship to ship transfer accidents in the *Saetta/Conger* report. These were collisions presented briefly, but they were mentioned in order to highlight common underlying weaknesses or causative factors. The *Saetta* report used the term ‘contributory factors’ more prominently, before the Analysis section, compared to the *Jo Eik* report. In this sense, it was much more compliant with the IMO framework and prominent accident models.

The first similar ship to ship transfer-related accident mentioned by the MAIB occurred on 3 July 2009:

'a bunkering vessel had completed its operation with a tanker and was unmooring when her starboard quarter struck the port wing ballast tank of the tanker, causing an indentation.'<sup>125</sup> In the second accident, on 25 July 2009, two tankers were getting ready to take positions for a ship to ship transfer within UK territorial waters. The manoeuvring vessel had difficulties in maintaining the desired heading as the tankers approached each other. The superintendent was not made aware of the steering difficulties, but took action to try and prevent a collision. The collision occurred.

The MAIB stated the following as causative factors in these ship to ship transfer accidents:

the master’s lack of ship to ship experience, the probable effects of interaction, poor communications on the bridge of the manoeuvring vessel, the lack of a risk assessment, the lack of a pilot card, poor line of sight between the bridge wing gyro repeater and

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<sup>125</sup> *ibid.*

bridge instrumentation, and an inability to secure a forward secondary fender at deck level.<sup>126</sup>

On 27 August 2009, a ship to ship transfer resulted in a collision just outside UK territorial waters during the final stages of the approach. The cause was clearly identified as poor communications. The superintendent in charge of that operation was also in control of the operation conducted on 25 July (the second accident discussed above). A recommendation was provided that he should undertake refresher training.

The contributory factors of the fourth collision included in the *Saetta/Conger* report referred to the long duration of the ship to ship transfer operation and the fact that it occurred in the darkness, with poor visibility and thus ineffective monitoring by the superintendent;<sup>127</sup> the officer on watch was not checking the helmsman's activity and the superintendent failed to identify that his orders had not been followed.

Coming back to the *Saetta/Conger* incident, as far as service providers are concerned, the MAIB made the following observation:

It is almost certain that the provision of operational standards for service providers within the STS guide would not only help to simplify the vetting process for the majors, but it would also provide service providers with a benchmark standard to reach and maintain.<sup>128</sup>

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<sup>126</sup> *ibid* 24.

<sup>127</sup> *ibid* para 1.14.1.

<sup>128</sup> *ibid* para 2.6.

On the whole, another reason why this investigation report is significant is because the area off Southwold is a ship to ship transfer location, where tankers frequently remain if they need to stay at anchor for a prolonged time.<sup>129</sup>

### ***Evaluation of the Saetta/Conger Report***

The alignment of the *Saetta* report with the IMO guidelines and accident literature is again confirmed. In this report, the elements of the investigative methodologies were clearly followed.<sup>130</sup> First, the typical stages of the investigation were carried out: these included the initiating phase, the fact-finding phase, the safety-deficiency identification phase, the recommendation stage and the feedback stage. Moreover, the question frameworks that should drive the investigation operation (what, when, why, who, how) also seem to have been observed.

The MAIB noted that had a breakdown procedure been prescribed and complied with, the main engine would have been started sooner. The report's findings also identified ineffective communications. It was pointed out that crews who are not experienced in ship to ship transfers may jeopardise such operations. In turn, this has led to the reliance on superintendents to assist inexperienced masters. The MAIB report also contains a remark on the ramifications of there being few available accident statistics: 'Through its membership of Intertanko, FCM, along

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<sup>129</sup> Michelle Wiese Bockmann 'Jet fuel stored on tankers amid moribund European demand' *Lloyd's List* (24 July 2020).

<sup>130</sup> Stoop (n 4) 239.

with the oil majors, attempted to establish a global database of accidents during ship to ship transfers. However, the database was not populated by other service providers, and was discontinued.<sup>131</sup>

The MAIB also showed concern about the frequency of ship to ship transfer-related incidents and emphasised the critical role of frequent revisions and amendments of the ICS/OCIMF *STS Transfer Guide* for future safety. This was done twice, in the Industry Best Practice section of the report and in the Conclusions.

It may also be assumed that the SHELL model must have been followed, as the main areas of human factors were considered and accounted for.<sup>132</sup> Accident investigation bodies identify safety issues and communicate them to relevant organisations, which has also been done by the MAIB.

## **Conclusions**

This article has analysed the phenomenon of ship to ship transfers, with emphasis on relevant incidents and casualties and the UK MAIB investigative response to them.

The UK MAIB reports have been tested against regulation by the IMO and the MAIIF guidelines, and also against principles on which the international standards are based.

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<sup>131</sup> Report No 3/2010 (n 15) para 1.14.2.

<sup>132</sup> In accordance with para 4.3.3 of the MAIIF Manual (n 35).

The MAIB ship to ship transfer-related investigation reports that were evaluated are a representative example of great practice. The underreporting of accidents established by renowned academics is further corroborated by the views of the UK MAIB and the findings of this article. There is a need for ship to ship transfer accident databases with agreed harmonised reporting and recording standards internationally.

Also, in the most recent resolution of the IMO, concerning guidelines for the Casualty Investigation Code, there are no more specific evaluations or suggestions of named investigation theories discussed. This allows space for the evolution of accident theory research, but perhaps there will be a time when guidelines or recommendations in this regard will be produced. Because of the evolution of technology and the socio-economic complexity of shipping, conducting investigations while combining Safety-I with Safety-II is the way forward.<sup>133</sup>

The UK MAIB emphasised the need for regular updates and reviews of the *STS Transfer Guide*. This shows the awareness and collaborative spirit in which the UK marine investigatory body assumes its role towards ship to ship operations and safety investigations in general. In evaluating the UK MAIB approach, it appears to be sound according to the IMO and MAIIF standards. However, there was no specific evaluation or discussion of a preferred accident model or methodology or a comprehensive framework expressly adopted by the MAIB.

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<sup>133</sup> *ibid* 624.

A suggestion for empowering the effectiveness of investigations under the Safety-I approach is the commitment of the MAIB to one or more accident frameworks, as the ATSB has done. This will make the MAIB more accountable to its own 'code of conduct' and it will enable it to test its accident methodologies over time. Focusing on a scientific framework will offer even greater rigour and reliability to the reports.

Also, for the sake of international harmony, it makes sense for frameworks of independent investigation bodies to be defined and publicised, so that a better assessment of accident analysis can be enabled. A holistic analysis and response to safety issues and not just occurrences can thus be facilitated. This will also help the MAIB and other accident investigation bodies to identify safety factors and good practice in marine and ship to ship transfer-related accidents offering insights into the safety culture in line with Safety-II.

Perhaps what can enable an even more robust monitoring of incidents and recommendations is a record tracking by the MAIB, and one also by the ICS and the OCIMF that feeds into the IMO and an international database. This would make for greater visibility of marine safety investigation reports. Moreover, important statistics can be kept and perhaps lead to the design of an accident model tailored to ship to ship transfers.

A look at these, as well as greater emphasis on what goes well in a ship to ship transfer operation, will safeguard the practice and help states to be better prepared for it. Notably, in this direction, ship to ship transfers can be understood, their safety idiosyncrasies can be better identified and a harmonious safety culture that celebrates human successes in their context can be promoted.

It is clear that empirical research by the OCIMF and the ICS can contribute to the common aim of demystifying operational trends of ship to ship transfers, leading to open discussions with marine safety investigation authorities, so that safety can be proactively fostered.