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TMSA and KPI Systems - Challenges in Business Performance Measurement

by

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Acknowledgments

> God must have been a shipowner. He placed the raw materials far from where they were needed and covered two thirds of the earth with water.
>
> Erling Naess

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Abstract

This thesis investigates whether it is feasible to merge the Shipping Key Performance Indicator [hereinafter referred to as: KPI] Standard and the Tanker Management and Self Assessment [hereinafter referred to as: TMSA] and, thus, to use the former standard for the performance measurements required by the latter. As both schemes are the outcome of quality awareness developments, the thesis begins with the description of applicable Quality Management Systems and then discusses the role of Performance Measurement and Management in achieving operational quality objectives. Following this introduction the thesis will focus on the tanker vetting and its requirements. The actual merging of the TMSA, which is part of the tanker vetting scheme, and the Shipping KPI Standard is done in a separate chapter. In this chapter the stages of the TMSA are identified for which the Shipping KPI Standard can be used, either directly or additionally in order to provide a framework to establish intra-company KPIs. This merged structure is examined in order to create an intra-company's TMSA compliance verification system.

The thesis closes with the description of a potential implementation process for Performance Measurement and Management, along with its issues and benefits for a company. This closing discussion focuses on the possibility of implementing a uniform methodology for Performance Measurement as well as on the usage of a Business Intelligence Tool for collecting and processing performance information. The described implementation strategy was developed through a case study of a mid-sized shipmanagement company.

The thesis draws the conclusion that the Shipping KPI Standard and the TMSA can be merged and that the Shipping KPI Standard can be used as a platform to establish an intra-company KPI Standard. A KPI platform based on the Shipping KPI Standard provides a uniform performance methodology and could form the foundation for an industry wide benchmarking approach. In addition it has been shown that the use of a Business Intelligence Software could assist a company in not only the standardising its internal Performance Measurement and Management methodology, but its data collection processes as well.

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Abbreviations

BI .... Business Intelligence

CDI .... Chemical Distribution Institute

COA .... Contract of Affreightment

cp. .... compare

CPI .... Department Performance Indicators

CTPM .... Container Terminal Performance Measures

CTQI .... Container Terminal Quality Indicator

DWT .... Deadweight Tonnage

ESPO .... European Sea Port Organisation

HACCP .... Hazard Analysis and Critical Control Points

HR .... Human Resources

MARPOL .... International Convention for the Prevention of Pollution from Ships

mt .... Metric Tonnes

OCIMF .... Oil Companies International Marine Forum

i.e. .... id est/ that is

IMO .... International Maritime Organisation

ISM .... International Safety Management

ISO .... International Organisation for Standardization

ISPS .... International Ship and Port Facility Security Code

IT .... Information Technology

KPI .... Key Performance Indicator

MoU .... Memorandum of Understanding

O/H .... Off Hire

PIs .... Performance Indicators

P&I .... Protection and Indemnity

PMS .... Revise Planed Maintenance System

PPRISM .... Port Performance Indicators Selection and Measurement

PSC .... Port State Control

SMS .... Safety Management System

SOLAS .... Safety of Life at Sea Convention

SPI .... Shipping Performance Indicators

SIRE .... Ship and Barge Inspection Report Exchange

STCW .... International Standard of Training, Certification and Watch-keeping

T/C .... Time Charter

TMSA .... Tanker Management and Self Assessment

TMSA2 .... Tanker Management and Self Assessment 2 - second version

TQM .... Total Quality Management

USA .... United States of America

USD .... United States Dollar

V/C .... Voyage Charter

QMS .... Quality Management Systems

Chapter 1

Introduction

During the last decades the shipping industry and especially the tanker industry has experienced a significant change in the direction to a quality orientated industry. It can be said that this was caused by the dramatic ship and especially tanker accidents in the 1980s and -90s (cp. Chapter 3). This change in industry behaviour has led to different tools in order to ensure quality with regard to a safe and environmental friendly operation of vessels. Vetting of tankers is a crucial part of this, also the **International Safety Management Code** [hereinafter referred to as: ISM Code] has to be considered as an important part of this new quality orientated industry. Furthermore has the tanker industry established during the years the **Tanker Management and Self Assessment** [hereinafter referred to as: TMSA] in order to ensure that the tanker operators are complying with the ISM Code and additionally to mandatory high-level tanker industry standards (cp. Section 3.1).

As already mentioned above major changes within the legal and non-legal framework applicable to international shipping has been always realised after dramatic ship disasters. This started with the introduction of the "International Convention of Safety of Life at Sea" [hereinafter referred to as: SOLAS] in 1914, as a direct consequence of the Titanic disaster. A comparable old convention was the **International Convention on Load Line Convention** from 1930 which was introduced after multitude accidents occurred with overloaded vessels. These first international conventions were focusing on technology/ construction and safety. The environmental protection came not on the agenda until the **International Maritime Organisation** [hereinafter referred to as: IMO] adopted **MARPOL**[1] in 1973 and 1978 respectively. Consequential the following

[1]**International Convention for the Prevention of Marine Pollution from Ships** [hereinafter referred to as: MARPOL]

decades were concerned with the renewal of technical and safety related conventions as well with a strong focus on the establishment of international conventions focusing on environmental protection and regulation of compensation claims after accidents which have harmed the marine environment.

At the same time the industry became aware of its partly bad public perception. Especially the tanker industry was concerned about the increasing environmental pollution which became severe for the marine environment, due to the dramatic growing ships and the therewith growing sizes of pollutions. This assured the awareness that the industry had to be changed significantly. In addition to the growing size of pollution the dramatic changes in communications, especially within the globalisation of media, underpinned the requirement for a major change of industry behaviour. This example obtained a renowned exemplification with the disaster of the EXXON-Valdez, which obtained public attention which has been rarely seen by then.

All these aforementioned developments and additionally the introduction of quality standards in other industries peaked for the shipping industry within the mid 1990s in the introduction of the ISM Code, by the IMO in 1994. In fact, this scheme can be seen as an international mandatory quality standard for the whole international shipping industry. Consequently also other shipping markets, than the tanker market, had to become more quality focused (cp. Section 2.1.2).

The introduction of quality aspects in recent decades went hand in hand with the development of performance measurement and management. For the shipping industry this became most apparent with the introduction of the TMSA and just recently with the establishment of the Shipping KPI project.

Nevertheless, it can be said that during the last decades more and more compulsory and non-compulsory industry standards are calling for performance measurement and performance management without having established a common industry approach. Today as the globalised world is turning faster than ever and thus management decisions have to be made within ever shorter time frames, the fast and reliable access to the right information becomes fundamental for today's 24 hours and 7 days a week shipping business. Therefore this thesis focuses on the questions:

How could a tanker operator use the new established Shipping KPI Standard in order to ensure a more uniform methodology on the level of applicable standards, especially the TMSA, and how can a Business Intelligence Software be

used in processing data for performance measurement. What are the challenges, benefits and possible drawbacks?

In order to answer this research question this thesis will start with an introduction of the applicable standards in the shipping industry, focusing on the introduction of the new established Shipping KPI standard. Furthermore it is tried to merge the TMSA and the Shipping KPI Standard in order to achieve a uniform methodology. Within the last chapter of this thesis is a implementation possibility with regard to a Business Intelligence Software is described.

As the scope of this thesis is laid on a relatively non-researched topic, the author found it important to describe first the underlying principles which leaded to this quality and environmental focused industry. Consequently are the first Chapters, 2 & 3, the actual introduction to the topic, however, it has to be stressed that the literature within the maritime sector is rather weak and partly outdated. Therefore, and due to the tight time schedule for this thesis, it was not possible for the author to go deeper into this underlying topic. Furthermore, the time pressure was also a major drawback in the establishment of the main part of this thesis, the merging of the TMSA and the Shipping KPI Standard and its implementation, consequently can this thesis just be an underlying research work. Continuative work within this area would be recommendable, also with regard to the assessment how to implement other performance measurements, e.g. commercial, within this one methodology. At last, it was also, due to the aforementioned drawbacks, only possible to describe the implementation possibility just as a case study, further research or academical accompanied realisation would, therefore, be recommendable.

Chapter 2

Quality Management

The development in the shipping industry which led to Performance Measurement and Performance Management and consequently to the TMSA started with the fundamental change to focus more on quality aspects within the operations of ships. This shall not mean that quality shipping has not existed before; however, the industry started using international quality standards and became later also subject of a mandatory quality assurance scheme. The latter is the underlying requirement for Performance Measurement in general and thus the underlying reason why it is necessary to establish an uniform measurement approach.

In order to get into the subject, this chapter will give the reader the necessary overview of applicable quality standards in the shipping industry. It is the authors opinion that without these underlying principles, the introduction of Performance Measurement and its necessity would be of low value. The last part of this chapter will show the link between Quality Management and Performance Measurement.

2.1 Integrated Management Systems

Integrated Management Systems are normally based on internationally accepted standards that regulate the minimum standards and enable a systematic implementation up to the certification by an accredited certification authority, which, for the shipping industry, are normally the classification societies. A definition of an **Integrated Management System** for shipping companies, from an academical perspective, was given by Biebig:

> **Integrated Management Systems** comprise the organisational structure, the responsibilities, procedures, processes and wherewithal for the management

> of quality, safety, security, environmental and average protection at the company. Further issues, like risk management, food safety (HACCP) et al. could be included if required.
>
> (Biebig, et al. 2008, p. 226)[1]

The principle of a Management System is the fulfilment of requirements (quality, environment, safety) from the moment of the development of a product/ service and not in retrospect. This should lead to controllable conditions and a working environment in which a constant improvement is achieved. The necessary documentation of such a system is done by handbooks, handling-, working-, verifying instructions and through demonstration documents, like inspection and test records (Biebig et al. 2008, pp. 266-267).

The ultimate benefit of Management Systems, as mentioned by Biebig (2008, pp. 266-267), lies in the proof that a company is able to perform on a high level of quality assurance which is the precondition to be part in several tenders. With regard to the tanker industry, we can see that the oil majors are looking for such high quality focused companies and, therefore, **vet**[2] tanker operators according to, in fact mandatory, industry standards (Knowles 2010). Consequently it is the case in the aforementioned industry that a non-participation would ultimately disqualify a shipowner from the market, as we will see in Chapter 3.

With regard to Management Systems the following international standards are accented by Biebig (2008, p. 266) as the important ones for the maritime industry.

- ISO 9000
- ISM Code
- ISO 14000

As these standards are the underlying principles for the shipping industry they will be subject of further explanations within the following sections.

[1] Freely translated from the German original (Biebig et al. 2008, p. 266) by the author.

[2] For the sake of clarification, "to **vet**" a vessel or the execution, "**vetting**", is a process within the shipping industry if a tanker vessel is inspected by or on behalf of a potential charterer, being an oil or chemical company. However the whole **vetting process**, is not only the physical inspection of the respective vessel, in fact, the performance of the tanker operator is also being vetted, by his track record and, nowadays, also by the TMSA (cp. Section 3.1). The inspection results and the track records of the operator are than all assessed and additionally also other public available reports, e.g. PSC reports, are being used, in order to assess whether a vessel is suitable to be chartered by the respective party or not.

Furthermore it has to be said that it seems that the Occupational Health Management System (OHSAS), ISO 18001:2007, is gaining more importance within the maritime industry. This might be caused by the development of the Maritime Labour Convention, which convention is established by the International Labour Organisation (ILO) and provides rights and protection at work to the seafarers (ILO n.d.). Due to the time constraint of this thesis is this new standard, unfortunately, not further described within this thesis.

2.1.1 ISO 9000 Standards

ISO 9000 Standards until 2000

Since 1987, the **ISO 9000:2000**[3] standard deals with the development of **Quality Management Systems** [hereinafter referred to as: QMS], which secures the compliance with defined, agreed and preconditioned requirements in regard to a product or service (Biebig et al. 2008, p. 266) (Seghezzi 2003, p. 219). Outside of the shipping industry, this standard was adapted by many companies within a short period, because for years, customers had already been demanding sectoral specialised quality systems. This was normally solved on a national basis, but due to globalisation these could have been just an interim solution because these national solutions could have been seen as non-tariff barriers and, consequently, the necessity for a international regulation standardisation became essential[4]. Finally, this demand for an international standard was fulfilled with the introduction of the ISO 9000 standards by the **International Organization for Standardization** [hereinafter referred to as: ISO] in 1987. (Seghezzi 2003, pp. 219-220)
According to Seghezzi (2003, pp. 220-221)[5] the three most important standards of the 9000 series of standards were the following[6]:

[3]For the sake of clarification, the first figure - 9000 - is an identification number of the standard the second figure - 2000 - is the year of publishment, this year can change because the standards are subject to continuous revisions. For this thesis, the author will use both figures wherever it is necessary, if the year is not especially mentioned, the statements should be seen in general and not dependant on the version of the standard.

[4]For clarification purposes, the main problem with non-tariff barriers is that since the introduction of the General Agreement on Tariffs and Trade (GATT), and, thus, its successor the World Trade Organization (WTO), non-tariffs barriers are de facto prohibited for its members. Marrewijk (van Marrewijk, Ottens & Schueller 2007, p. 243) stated as "the main reason ... that, although the imposition of a tariff influences the market, its operation does not affect the market mechanism. Moreover, it is easier to negotiate on tariff reductions than on the removal of other trade measures [e.g. non-tariff barriers], which are more difficult to quantify".

[5]Freely translated from the German original by the author (Seghezzi 2003, pp. 220-221).

[6]The author of this thesis is still introducing these standards because in the day-to-day business, these standards are still be seen and referred to, especially in the maritime literature which is not as often updated as other general literature.

- **ISO 9001** Quality Management Systems - A model for the quality assurance/ quality management - demonstration in design, development, production, assembly and maintenance.
- **ISO 9002** Quality Management Systems - A model for the quality assurance/ quality management - demonstration in production, assembly and maintenance.
- **ISO 9003** Quality Management Systems - A model for the quality assurance/ quality management - demonstration for the final testing and inspection.

(Seghezzi 2003, pp. 220-221)

In the broadest sense, these standards included models for the quality management and quality assurance and defined in detail the requirements for these systems. The requirements were subdivided in 20 points, howsoever, due to the focus of this thesis, a further detailed description would be beyond the scope of this thesis, for further information compare Seghezzi(2003, pp. 220-221).

The first standard, **ISO 9001**, described a QMS for a company that dealt with the whole value creation chain, from design until "after sales services". The standard **ISO 9002** was meant to be for companies which are dealing as component suppliers. Seghezzi (2003, pp. 221-223) stated here that especially for companies which are supplying an already developed product or service, this QMS shall ensure that the supply of a product or service is everytime done according to the same quality standards. If the last standard, **ISO 9003**, is considered too, it can be concluded that this standard was just meant to be for final testing and production and has experienced just a small number of implementations (Seghezzi 2003, pp. 220-221).

After the elaboration of the main particulars of the above mentioned standards, we can conclude that the relevant standard for the shipping industry was the **ISO 9002** because a shipping company is "just" the supplier of the transportation mode and is consequently only a component supplier.

Seghezzi (2003, pp. 223-224) stated that even for experts, the fast acceptance and implementation of the ISO 9000 standards have been surprising, especially since the standards are written in the "language" of industrial engineers, and, consequently, it is challenging to implement these standards in other industries without the support of consultants, especially for service providers. Howsoever, the expert's support is an expensive path to establish an QMS. Due to a lack of examples, the author can only highlight Seghezzi's example, whereby the costs for a USA based industrial enterprise with 250 employees are approximately 250,000 USD.

ISO 9000 Standards after 2000

The revision of the 9000 series of standards by the ISO in the year 2000 was, according to Seghezzi (2003, pp. 225-233), awaited by the whole economy because the revised series of standards became process orientated rather than functional orientated as it was before. This development was necessary because companies were being reorganised according to process-orientated structures.

During this process of modernisation, the old standards ISO 9001:1994; ISO 9002:1994 and ISO 9003:1994 have been replaced by the new standard **ISO 9001:2000**. If we consider that the old standards had focused on the degree of integration in the value added chain, it seems, at the first view, astonishing that these standards have been replaced by a single standard. Nevertheless, the new standard allowed a customisation according to the internal requirements and became, hence, more user focused. Nevertheless, this new standard is based on eight underlying principals which should be addressed regardless to the degree of customisation:

- Customer focus
- Leadership
- Comprehension of persons
- Process orientated approach
- System orientated management approach
- Continual improvement
- Issue-related approach for the decision making process
- Win-win situation between supplier and company

(Seghezzi 2003, pp. 226-227)[7]

It has to be stressed that only with the revision, the aim of a continuous improvement became part of the ISO 9000 series of standards, which, as it will be seen within this thesis, has become more and more important.

It is a fact that both standards, ISO 9000 and ISO 14000, are having their place in today's (summer 2011) shipping business. Especially the former had found a wide range

[7] Translated from the German original by the author.

of implementations, but due to the increasingly environmental awareness also the ISO 14000 standard is increasingly implemented. Consequently both standards are having a big influence in the maritime and shipping industry.

For the sake of completeness, it has to be said that the standard **ISO 9001-2000** has been revised by the **ISO 9001-2008** (ISO 2011). The difference between these both standards are just minor changes, for example the introduction of verification requirements. This means that after a target has been set, the effectiveness of the same has to be checked after a reasonable period of time. Nevertheless, according to industry sources, this revision involves no major or substantial changes within the ISO 9001 standard.

2.1.2 ISM Code

The **ISM Code** can be seen as the the formalisation of a safety and environmental awareness culture in the shipping industry. Its implementation was the first formal quality focused legal requirement for the shipping industry and is consequently the underlying principle for today's quality, safety and environmental awareness in the general shipping industry. Furthermore, it forms the asis of the TMSA. Due to these facts, a short introduction to the ISM Code is given within this section.

Basically the ISM Code originated after the disasters of the MV Hareld Free Enterprise[8], the MV Scandinavian Star[9] and the MV Estonia[10]. With its establishment by the IMO in in 1994[11], this international regulation was the first one of its kind focusing on the "software" and its malfunctions within the ship operations rather than in the hardware failures. In more detail, this means that after having established regulations forcing shipping companies to load their vessels properly (International Convention on Load Lines) and to design vessels in a safe and environmental friendly manner (SOLAS and MARPOL respectively; cp. Chapter 1), the IMO, as the legislative body, focused for the first time within the ISM Code on the human element in ship operations (Hemmelskamp 2010*a*, p. 1) (Chauvel 1997, pp. 5-6) (Jessen 2009).

Jessen (2009) classified the software of the maritime industry as the human element

[8]1987, 193 victims, cause: water leakage and capsizing (Jessen 2009)

[9]1990, 158 victims, cause: fire and smoke emission (Jessen 2009)

[10]1994, 852 victims, most severe ship accidents after World-war II; Cause: not definitely investigated, in any case water leakage and sinking (Jessen 2009)

[11]For the sake of completion, it has to be mentioned that the ISM code was integrated into SOLAS and finally became mandatory for ships over 500 gross tonnes on the 1 July 2002. Howsoever, at this time, the ISM code had already been applicable for five years for tankers, bulkers, passenger vessels and high-speed crafts. (Biebig et al. 2008, p. 266) (Ziemer 2011, pp. 205-206)

in the operations of ships and with all consecutively organisation of a shipping company's working force. For the ISM Code, the whole organisation, its working instructions and sequence of operations has to be considered in order to "support and encourage the development of a safety culture". This focus on the "software" and human element respectively was necessary because 80 percent of maritime accidents are caused by human error and only 20 percent by technical default.

Within the ISM Code, a ship operator[12] is required to set up a **Safety Management System** [hereinafter referred to as: SMS] which should help the operator to achieve an incident free operation. The introduction of the ISM Code can be seen as a link between QMS according to ISO and the shipping industry; in fact, the realisation of the ISM Code has to be seen as the implementation of a mandatory QMS. Due to the fact that without a safe operation of ships, both from the shore side as well as from the ships side, it is logical that it cannot be spoken about quality shipping. The introduction of the ISM Code was, thus, the last impulse to a quality orientated shipping industry (Chauvel 1997, p. 3). Therefore, it is arguable to say that the first step in direction to more quality assurance in shipping was the above mentioned incorporation of the ISM Code in the SOLAS Convention in 1994. (Stopford 2009, pp. 680-681)(Biebig et al. 2008, p. 266) It might seem to be strange that a safety management tool is considered to be a mandatory QMS. But as it has been seen within this chapter, QMS are basically output orientated and this is also valid for the ISM Code. Because the ISM Code target the objective to improve the vessel operation and due to the focus on the human element within this standard the close link to crew and passenger safety is obvious. Nevertheless, Chauvel (1997, p. 3) has already stated that this does not mean that prior to the ISM code no quality shipping was in existence. In fact, "many shipping companies operated without accidents and have an impeccable safety record". Nevertheless, the introduction of this Code could not change the attitudes of all shipowners. In fact, there is a distinction between ship operators who just fulfil the minimum requirements of the ISM Code and such which incorporate the soul of same into their corporate behaviour. This is the underlying reason for the introduction of the TMSA as it will be discussed within Chapter 6. However, it is arguable that since the implementation of the ISM Code, the gap between quality focused and less quality focused shipping companies has decreased (OCIMF 2008, p. 1). Additionally in the same time the number of companies with audited QMSs has significantly increased, probably due to the close connection to the ISM Code, the additional

[12] For the sake of clarification, within the ISM code, the responsible party is the **ISM Manager**. The author uses the expressions ship/ tanker operator and ISM manager as synonyms, that shall mean wherever the ship/ tanker operator is mentioned this should be interpreted in the context of the ISM Code with the same meaning as the ISM Manager

benefits for the marketing of a company and the requirements on the part of the supply chain integration process.

2.1.3 ISO 14000 series

The last applicable standard is the **ISO 14000** standard, which is concerned with the development and certification of **Environmental Management Systems**. The structure of this standard is similar to the ISO 9000 series of standards so that consequently a high level of comparability was achieved. (Biebig et al. 2008, p. 266) Howsoever, this comparability can only be found on the level of the standards themselves. Seghezzi (2003, pp. 241-245) stated that the standards were established in 1996 on the line of the ISO 9000 series. For that reason **ISO 14001** illustrates the general requirements for an Environmental Management System, and the **ISO 14004** is a general guideline for the fundamentals, objectives, etcetera, as was the case with ISO 9004 until the revision of 2000.

Contrary to this general set-up which is between the series of standards ISO 9000 and 14000 similar, the structure of the **ISO 14001** model is different to the old and revised edition of the ISO 9000 series of standards. The structure starts at the environmental obligations of the companies and their individual environmental policy, which has to state what level should be achieved by the company's environmental management system. The second step would then be to plan the implementation of the agreed company's environmental goals. This implementation is, as a third step, at any time measured and evaluated. On this basis, the system is then assessed and consequently improved where possible or required. These five steps which are operated within a cycle are leading to a continuous improvement - the ultimate objective of all management systems (Seghezzi 2003, pp. 241-245).

According to Seghezzi (2003, p. 244), the rate of companies which have introduced an Environmental Management System is only at a level of 10 percent of the companies which have implemented a QMS according to the ISO 9000 series of standards. But this shall not derogate the success of this management system.

However, it has to be said that today the environmental focus within the shipping industry is significantly increased and therefore it can be expected that the numbers of implantations of an Environmental Management System will rise, cp. hereto also the possible environmental focus of a newly revised TSMA as mentioned in section 6.13.

2.2 Total Quality Management

The **Total Quality Management** [hereinafter referred to as: TQM] is a concept in order to achieve long-term success in business, also known as **business excellence**, through the enhancement of the quality management and is, consequently, an advancement of the QMSs. This enhancement concerns all functions and processes within a company, and consideration of the stakeholder's objectives. Furthermore, it replaces and adds, respectively, audits through self assessments (Biebig et al. 2008, p. 268).
The goals of the TQM are:

- Maximal customer satisfaction
- Highest possible and long-term success in business
- Motivated employees
- Maximal benefit for the society

(Biebig et al. 2008, p. 268)[13]

Chauvel (1997, pp. 127-128) is addressing the same points; however, he circumscribes them as follows:

> [TQM is focused on] winning customers loyalty by providing quality services. Making adequate profits for continual investment in research and new efficient equipment while giving fair returns to shareholders, and fair wages to those who contribute to company success.
>
> (Chauvel 1997, p. 128)

This prolongation of the quality aspects within the company leads to a stage where also employees are considered, a flexible structure of the company is achieved and both supplier and customer satisfaction is targeted. Consequently, the whole value added chain is considered, and only if this has been reached can a company speak about TQM. Basically, it is tried within the TQM concept to optimise customer focus within the value added chain, from supplier to customer (Rois 1999, pp. 26-27). Herewith a holistic approach of the value adding chain can be seen which is a similar approach to what can be experienced today in logistics, where an attempt is made to consider the whole supply chain in order to gain a supply chain optimum; the only difference between both

[13] Translated from the German original by the author of this thesis.

is that TQM focuses on quality rather then on costs. However, it has to be said that also the quality aspect becomes more and more important in a supply chain.

A TQM can be achieved by incorporating the following six fundamentals in a company:

- Customer focus
- Process mastering
- Continuous optimisation
- Inclusion of employees
- Cooperation with suppliers
- Continuous support by the management

(Schnauber et al. 1999, p. 2/3-2/5)

With regard to the ISO standards it can be said that these above-mentioned fundamentals are covered already by the ISO 9001 Standard and its eight underlying principles as mentioned on page 8. This shows the close connection between both and that the implementation of a TQM is dependent on an effective ISO 9001 QMS as mentioned below.

Due to the socio-economic fundamentals, the whole company behaviour has to be changed, quality must get a high priority and, thus, must be accepted by the board of directors, management and workforce in order to ensure an effective TQM. Of course this is also valid for "ordinary" QMS, but within the TQM, it becomes even more important because the business has to change its whole working culture to a more holistic approach and to an even longer-term focused point of view. Consequently it is arguable that the long-term perspective and strategies respectively should outweigh short-term profits and short-term thinking. The perspective changes from a short-term revenue maximisation attitude to a market share maximisation strategy and, thus, long-term profit maximisation.

Within the below list measures for a terminal operator are mentioned to ensure a TQM:

- Effective ISO 9001 QMS as basis
- Development of a quality attitude amongst the managers and employees

- Defining detailed and strict quality requirements
- Extensive and continuous training
- Quality inspector and quality supervisor on board
- Regular quality workshops with customers

(Biebig et al. 2008, p. 270)[14]

The difference for a shipping company is that it would have to additionally consider the relevant international applied conventions (e.g. ISM Code) and compulsory industry standards (e.g. TMSA). Consequently the close link between the scope of this thesis and the TQM can be seen, without considering these industry standard a TQM would be not possible.

For the sake of completion, the author wants to stress that TQM is only one method to "upgrade" a company's QMS. The other methods are the **Lean Management** and the **Kaizen Philosophy**, where the former is focused on a strict process orientation and the later on a strong employee orientation in order to achieve business excellence.(Seghezzi 2003, p. 228)

2.3 From Quality Management Systems to Performance Measurement

Within this chapter, it could be seen that from the introduction of Quality Management Systems until the development of Total Quality Management, the aspect of continuous improvement has been given an increasing weight. Howsoever, in order to implement a continuous improvement cycle, it is of utmost importance to measure the actual performance in order to get a feeling of the continuous improvement on the way to the set targets. Consequently, a Performance Measurement is of ultimate necessity in order to have a workable QMS or even a TQM. Therefore, Chapter 4 will be concerned with a short introduction to performance measurement in general and performance measurement in shipping. Nevertheless, the next chapter will, first of all, give an introduction to the Tanker Vetting procedure and its driving forces into the development of quality shipping.

[14] Translated from the German original by the author of this thesis.

Chapter 3

Tanker Vetting

Within the previous chapter, the applicable standards for the international shipping industry have been identified. In the following chapter, the more specialised industry standard of tanker vetting is introduced and parallels are shown were applicable. However, it has to be stressed that vetting has to be seen in the context of quality awareness (cp. Chapter 2) because it was the first scheme to ensure that a specific level of quality is maintained. During the second halve of this chapter, the necessity for performance measurement and management will become apparent.

Vetting[1] is not subject to a common industry definition, but it can be said that in respect to the tanker industry, the inspection of vessels by the charterer or an assigned third party is referred to as vetting. Consequently, the vetting process is a quasi mandatory inspection of the individual vessel by the oil and chemical industry respectively and, therefore, has to be seen as industry requirement. In fact, it is a compulsory industry audit and, thus, absolutely independent from other inspections regimes, like Port State Control[2] [hereinafter referred to as: PSC], ISM audits, etcetera.

For the oil industry these vetting inspections are, in general, undertaken by the individual oil major (e.g. Shell, Exxon-Mobile, BP). However, in order to assure some degree of harmonisation, the **Oil Companies International Marine Forum**[3] [hereinafter

[1]For a definition and explanation of "vetting" see page 5.

[2]The **Port State Control** is an instrument for the coastal states to inspect foreign ships calling their ports whether or not these vessels are in compliance with relevant maritime conventions, e.g. SOLAS, MARPOL, STCW. Within Europe, and other countries, the PSC is jointly regulated and coordinated under the Paris MoU.

[3]"The **Oil Companies International Marine Forum (OCIMF)** is a voluntary association of oil companies having an interest in the shipment and terminalling of crude oil and oil products. OCIMF is organised to represent its membership before, and to consult with the International Maritime Organization and other governmental bodies on matters relating to the shipment and terminalling of crude oil and oil products, including marine pollution and safety (OCIMF 2008, preface).

referred to as: OCIMF], as the industry organisation, has established the internet based database **Ship and Barge Inspection Report Exchange**[4] [hereinafter referred to as: SIRE] System, and within this system the vetting reports, which were obtained by the individual oil major or by inspectors commissioned by them, are stored and accessible for potential charterers. Regardless of the fact that OCIMF is also open for members from the chemical industry, the same has been established the **Chemical Distribution Institute**[5] [hereinafter referred to as: CDI]. In contrast to the SIRE system, the CDI vetting inspections are done by independent but accredited auditors. The processing of data is performed in a similar manner to the SIRE system: they will be stored at an electronic database in order to make the inspections reports available for every member. Howsoever, under both schemes the database comprise only the raw-data, and, consequently, the judgement whether or not a vessel is suitable to be chartered is left to the individual member (Haralambides 1998, p. 78). Even it has to be said that this is de facto also correct for the SIRE system; however, the latter has one main difference, as the inspections are not done by independent auditors, at least the some oil majors are requesting their own inspection in order to not rely on the inspections done by their competitors.

Beside this individual judgement, OCIMF has set up common vetting procedures through the introduction of the following **vetting modules**[6]:

- Vessel Inspection Questionnaire
- Uniform SIRE Inspection Report
- Vessels Particulars Questionnaire
- SIRE Enhanced Report Manager

(Sauerbier 2009)

The underlying objective for vetting lies in the verification if tankers are complying with the compulsory international regulations as well as with industry standards and is, thus, a rather unique tool within the maritime industry (Kaps 1999, p. 3). It gives the charterer a tool to vet a chartered vessels' performance and, in fact, how it complies not

[4]This meaning of SIRE has been taken form OCIMFs TMSA Glossary (OCIMF 2008, p. 92). However, it has to be stressed that also OCIMF is still using another wording "Ship Inspection Report Exchange" (OCIMF 2008, p. 1), this might be caused by the fact that barges just became part of SIRE within a revision of same. The reader should therefore not be confused by different meanings of the abbreviation SIRE.

[5]"The **Chemical Distribution Institute** is an independent, non-profit-making organisation created to provide participating chemical companies with risk-assessment systems for shipping and the storage of liquids at third-party terminals." (OCIMF 2008, p. 90)

[6]The author is focusing here on the relevant modules for the deep-sea tankers ("vessels") and is, thus, omitting the modules for barges which have been introduced into this vetting process in 2004 (Malmberg 2008, p. 15).

only with the aforementioned international regulations but also with much more strict industry requirements and guidelines[7] before it is actually chartered.

The whole vetting procedure was introduced in the tanker industry during the 1980s. Until this time, it was consensus that the safe carriage of cargo lied under the sole responsibility of the shipowner and the ship operator respectively; therefore, it was commonly accepted that the charterer had very few measures available to secure a safe and successful voyage performance (Knowles 2010, p. 1).
Knowles (2010, pp. 1-2) stated that "while this situation changed, there appears to have been no single reason for the development and introduction of tanker vetting". Howsoever, the author of this thesis notes that this change in behaviour concurs with the point in time where the oil majors were withdrawing their involvement from owning of ships to consequently mainly charter the required tonnage from independent, third party owners and operators respectively.[8] Compare also Oldham in (Haralambides 1998, p. 63), he stated that in the mid 1990s less than 10 percent of the global tanker fleet were owned or chartered[9] by the oil majors. This development from ship owning to "just" chartering a vessel shows the necessity of the vetting programs from the oil major perspective. As the oil majors were not longer in direct control of the fleet, it was of utmost importance for them to ensure specific safety standards, and this led to the establishment of the vetting procedure.

As the underlying reason for vetting, Knowles (Knowles 2010, pp. 1-2) highlighted the "growing awareness of the potential damage caused by pollution" and the "fear of large scale pollution". Charterers, i.e. the oil majors, became aware that there was an insufficient supply of well, safely managed vessels. He further states that this was not due to a lack of regulations, it was caused more by the lack of enforcement. Oldham (Haralambides 1998, p. 61) had already stressed this lack of enforcement and required to "make life difficult for the offenders". Today, it can be said that life has been made difficult, not only for the offenders. Through the fact that the vetting procedure has first to be passed before a vessel can be chartered, it can be concluded that the oil industry has set up a unique and effective "chartering 'filter'" (Knowles 2010), which pushes operators to manage their vessels safely and to improve their performance continuously, if they do not want to jeopardise their business.

[7]OCIMF is publishing different guidelines for the tanker industry, e.g. "Clean Seas Guide for Oil tankers", "International Safety Guide for Oil Tankers and Terminals", "Ship to Ship Transfer Guide", just to mention a few. In addition, also other industry associations, as for example INTERTANKO, are publishing guidelines, which can be called Industry Guidelines.

[8]This is also strengthened by Malmberg (Malmberg 2008, p. 14).

[9]From the context in the book it becomes clear the Oldham must have meant long time charters, like Time Charter or Bareboat Charter contracts.

Howsoever, it has to be mentioned that 99.8 percent of all voyages are undertaken without any "serious incidents" (Knowles 2010, p. 3). But what has happened with the remaining 0.2 percent, has the vetting procedure contributed to a safer industry? By looking at the below given Graph 3.1, it can be seen that compared to the beginning of the 1980s, a significant decrease of the number of total losses has occurred. To be more

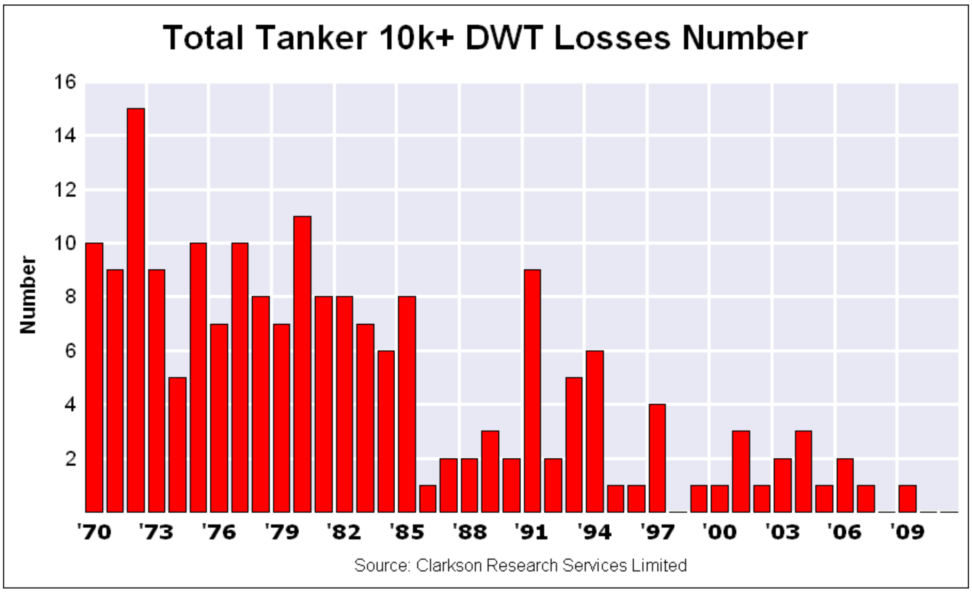

Figure 3.1: Total Tanker Losses by Number

(Clarkson 2011)

precise, the number of vessels lost during the period from 1970 until 1985 was on average 8.6, this number decreased to approximately 2 during the period after 1986. This is contrary to the fleet development (also in numbers of vessels Graph 3.2) where the amount of tankers in service more than doubled within the last 26 years. Following the aforementioned, it can be concluded that the relative number of losses decreased even stronger. It has to be kept in mind that this data has two main drawbacks. First of all, it is the authors opinion that also technical development (e.g. double hull) has contributed to reducing the number of total losses, and, in addition, it has to be kept in mind that these are "just" the numbers of total losses and, thus, there are no information about the development of tanker accidents. However, the author is confident that the graphs are showing a general industry trend, and that, today, the tanker industry has becoming a relatively safe industry and maybe one of the safest within the shipping business. Nevertheless, it has to be kept in mind that through the hazardous characteristics of the

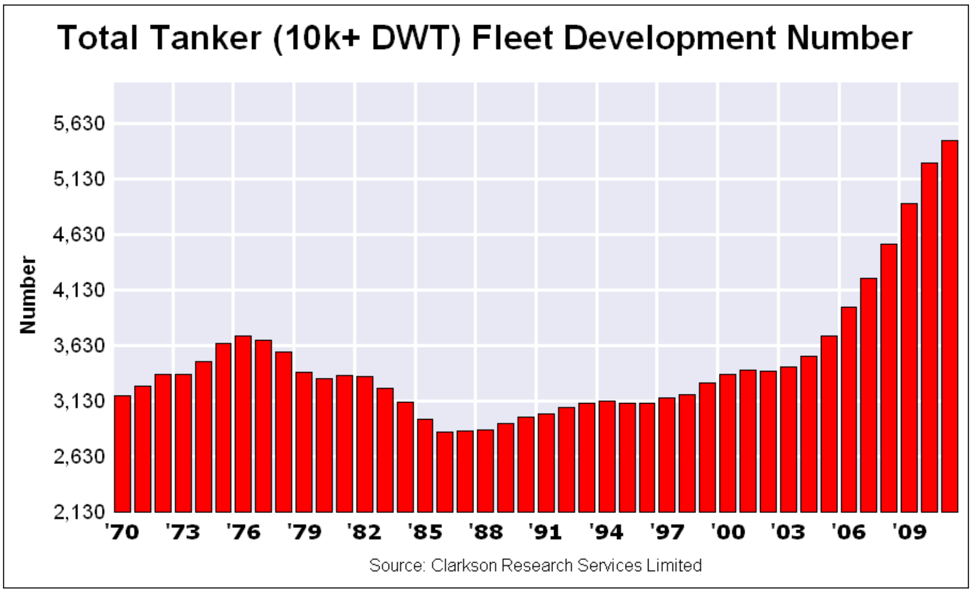

Figure 3.2: Total Tanker Development by Number

(Clarkson 2011)

cargo, the tanker industry cannot rest on their laurels.

For the oil majors, the whole vetting procedure raised one main drawback which was already highlighted by Knowles and which has to be seen in connection to the fact that the charterer becomes liable for the actual performance of the chartered vessel and, thus, for its crew and shore personal.[10]

> ... the harder they [charterers] try to select tankers that meet high acceptance criteria, the more some organisations will seek to hold them responsible in incident occurs.
>
> (Knowles 2010, p. 3)

Within this section it has been showed that the vetting inspections were the first instrument in order to ensure a quality focus within the tanker shipping industry. This

[10]This liability has to be seen in a wider context than the pure legal framework. Through the revolution in communication, an accident will be globally public within short time, and such an event will put pressure not only on the shipowner and ship operator, in fact, it will also put pressure on the charterer, i.e. the oil major because this is most likely a well known multinational company and, thus, much more present in the public perception. Consequently, the oil major may decide to pay compensation just because he wants to avoid negative press about him. Nevertheless there are two conventions in force which would, at least, force the oil industry to contribute to oil damages; these are the **CLC Fund Conventions from 1992 and 2003** . Within these conventions, the every company has to contribute if it had received or shipped more than 150,000 mt of oil. Thus, it can be concluded that the oil majors/ charterers have a financial interest that at the possibility that accidents are occurring is reduced.

basic role of vetting has also not changed with the introduction of the general QMSs, as mentioned in Chapter 2. In fact, the vetting schemes created, after the establishment of a mandatory QMS - the ISM Code (cp. Section 2.1.2), an additional scheme to ensure the properly fulfillment of the ISM Code. Therefore this vetting tool, the TMSA, will be described further within the following section.

3.1 Tanker Management and Self Assessment

As mentioned within the previous sections, the TMSA has to be seen in connection with the before described tanker vetting. It was developed to include also the tanker operator into the vetting process. Turker (Turker & Er 2008, p. 129) stated that the need for a scheme focusing on the tanker operators was necessary due to the criticism which was given that the requirements of the ISM code were not being followed properly.

According to Knowles (2010, p. 21), the TMSA was originally developed by a single oil major, which was not further named, and then adopted by OCIMF as a best practise guide in 2004. In 2008, the TMSA was revised and, thus, a second version was published referred to as TMSA2. He also mentioned that ...

> ... OCIMF believes that TMSA2 provides a comprehensive and invaluable tool to help ship operators measure and improve their safety management systems. It encourages ship operators to assess their safety management systems against listed key performance indicators (KPIs) as a guide and measure of best practise.
>
> (Knowles 2010, p. 21)

Within the above quotation the direct link between the TMSA and the ISM Code and its SMS respectively can be seen. In addition to this internal use for performance improvement of a ship operator, it has to be said that the TMSA, since its introduction, is playing a major role in the vetting process. Because this scheme gives, as mentioned above, the oil majors the first tool to assess the operator's shore operation and has been playing a major role in the vetting process since its introduction. This does not mean that this had not been considered by the oil majors in the pre TMSA era. In fact, a ship operator's management capability and performance is playing an important role in the vetting regimes since its appearance, but the TMSA allows the charterer to the judge an ship operator's self assessment, and, thus, the awareness of an tanker operator against his actual performance, as validated by the vessel's inspections rather than to base an operator's assessment only on the overall performance of his fleet.

Knowles (Knowles 2010, pp. 22-23) states that an increasing number of vetting organisations and, consequently, charterers are requiring the TMSA. Furthermore, it is expected by these vetting organisations that the companies who are preparing the TMSA will use same for a performance measurement and consequently for the improvement of their shore based organisation and especially to improve their SMS. Due to the fact that the TMSA encourage a continuous improvement it is not only a tool like the ISO standards, in fact it is, due to the continuous improvement, already in-line with the ISM Code, which is of course understandable because it was established to monitor a companies ISM Code compliance.

Whereas the tanker vetting is a compliance examination and is, therefore, done on a fail or pass basis, the TMSA audit should lead, through the attribute of continuous improvement, to a more systematic assessment by the oil majors. That implies that the TMSA audit cannot be done on a pass or fail basis because the self-assessment is evaluated, and, thus, it is inspected whether or not the shipowner has incorporated the soul of ISM Code and continuous performance improvement or if he is just running his business on minimum requirements.

3.1.1 Elements of the TMSA

The TMSA is split into 12 different subjects or "key elements of management practise" (Turker & Er 2008, p. 131) [hereinafter referred to as: Elements]. These Elements can be seen in list given below and consist of the main objectives or aim (mentioned next to the Element heading in the listing below), the key performance indicator [hereinafter referred to as: KPI] and the best-practise guidance.

1. Management, Leadership and Accountability
   "Provide direction and clearly define responsibilities and accountabilities at all levels within the organisation."
2. Recruitment and Management of Shore-based Personnel
   "Ensure that the fleet is supported by competent shore-based staff who are committed to a high standard of fleet management."
3. Recruitment and Management of Vessel Personnel
   "Ensure that all vessels in the fleet have competent crews who fully understand their roles and responsibilities and who are capable of working as effective teams."

4. Reliability and Maintenance Standards
   "Establish maintenance standards so that all vessels in the fleet are capable of operating safely without an incident or detention."
5. Navigational Safety
   "Establish and consistently apply navigational practise and bridge procedures in line with regulatory and company policies."
6. Cargo, Ballast and Mooring Operations
   "Establish and consistently apply planning and operational practise and procedures that support regulatory and company policies."
7. Management of Change
   "Establish procedures for evaluating and managing changes to operations, procedures, vessel equipment or personnel to ensure that safety and environmental standards are not coherent systems for managing both temporary and permanent changes."
8. Incidents Investigation and Analysis
   "Use effective investigation, reporting and follow-up methods to learn from significant near misses and incidents, and thus prevent recurrence."
9. Safety Management
   "Develop a proactive approach to safety management, both on board and ashore, that includes identification of hazards (including exposures to substances hazardous to health) and the implementation of preventive and mitigation measures."
10. Environmental Management
    "Develop a proactive approach to environmental management that includes identification of sources of marine and atmospheric pollution, and measures for the reduction of potential impacts, both on board and ashore."
11. Emergency Preparedness and Contingency Planning
    "Establish an emergency-preparedness system and regularly test it to ensure an ongoing ability to react effectively to an incident."
12. Measurement, Analysis and Improvement
    "Establish and implement appropriate measurement and feedback processes to focus on and drive continuous improvement."

(OCIMF 2008)

Furthermore, it has to be said that OCIMF published an "Energy Efficiency and Fuel Management" element which, at the moment, is not part of the TMSA2 but which could become mandatory as a 13^{th} element as from the next revision of the TMSA. This would be in-line with the recent environmental developments in the shipping sector, as mentioned in Section 2.1.3. Consequently, it would be recommendable that this potential Element is already being used by the ship operator internally in order to be prepared for the future when this may become mandatory.

> 13 Energy Efficiency and Fuel Management
> "The Company maximises Energy Efficiency to minimise CO_2 emissions onboard its vessels through an auditable Energy Management Policy, and takes appropriate actions to ensure effective onboard implementation.
>
> (OCIMF n.d.)

These aforementioned elements are subdivided into four different stages, whereas the first two stages are, according to Turker (Turker & Er 2008, p. 132), very similar to the applicable ISM Code measures of a tanker operator who has implemented the ISM Code in its true spirit and not only proforma. The last two stages would require a "restructuring and/or remodelling of the Safety Management System" of the operator (Turker & Er 2008, p. 132). Furthermore, it can be said that oil majors are also using these stages for the assessment of how deep the degree of cooperation can be committed between a charter and a owner, even though this is not officially confessed. According to industry sources, some oil majors are defining these cooperation stages, non officially, as listed below:

- TMSA Stage 1 $\longrightarrow$ The tanker operator is suitable for V/C.
- TMSA Stage 2 $\longrightarrow$ The tanker operator is suitable for COA[11]..
- TMSA Stage 3 $\longrightarrow$ The tanker operator is suitable for T/C
- TMSA Stage 4 $\longrightarrow$ The tanker operator is suitable for a joint venture with the oil major.

[11]Within this thesis, the author understands "**Contract of Affreightments** as a contract between a carrier and a charterer, by which the carrier is committed to transport a certain quantity within a certain period of time and where he is responsible to provide a suitable vessel or vessels within the required laydays of the charterer" (Hemmelskamp 2010*b*, p. 6)

Unfortunately, this list cannot be confronted to any official definition because OCIMF is just supplying the TMSA as a framework and the judgement is subject to the individual oil major, as mentioned above, and they are not making their interpretations and definitions respectively public available.

Within the given flowchart, it can be seen how the process within a TMSA self-assessment should be conducted. It can also be seen that a failure to fulfil stage 1 would have to lead to a revision of the SMS and the ISM Code incorporation within the company.

However, it has to be said that this flowchart was taken from the TMSA1 and is no longer part of the TMSA2. But the basic idea that the Elements are assessed according to this downstream structure is still being followed by the majority of the oil majors. Nevertheless, there are some oil majors who are not asking for a fulfilment in succession; in fact, they are requiring that special stages have been met, irrespective if they have fulfilled previous stages or not. Thus, it can be said that their requirements are jumping through different stages of elements, and, consequently, a uniform stage-to-stage development is disrupted. This is a problem as the TMSA is only once submitted via the OCIMF TMSA internet platform to oil majors, which have been beforehand identified by the tanker operator. This can lead to the fact that the oil majors for which the majority awaits to get a self assessment stating one stage getting a self assessment referring to different stages in different Elements. Consequently, the TMSA becomes to a bigger bureaucratic burden than it would have to, and the stage-to-stage continuous improvement process is therefore jeopardized because the focus falls on the

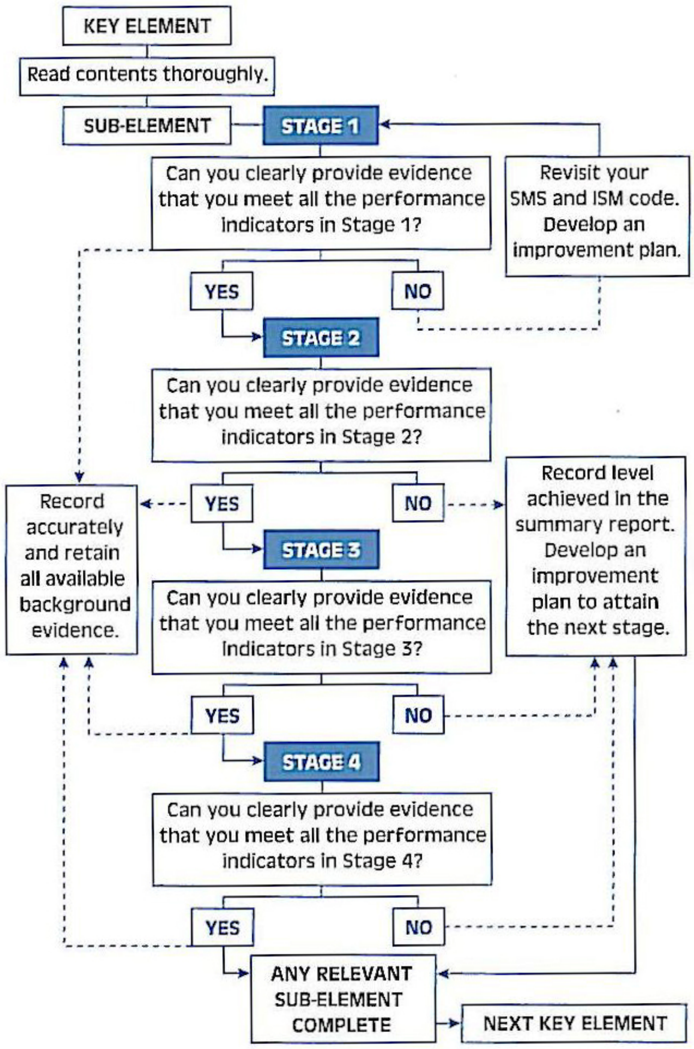

Figure 3.3: TMSA1 Stages Flowchart

fulfilment of requirements rather than on a straightforward self assessment. This is a major problem which has to be solved and in the practise in a manner which is not ideal. Nevertheless, the industry experience shows that the majority of the oil majors are requesting the completion of the stages in succession, and, therefore, this is also the approach which is being assumed within this thesis.

Changes within the company and/ or organisational structure should be changed immediately, otherwise the TMSA report should be regularly reviewed, at least annually (OCIMF 2008, p. 9).

Turker (Turker & Er 2008, p. 132) stated, as already discussed, that "the TMSA is in fact a quality management system standard" because it shows similarities to ISO 9001. With regard to the "Plan-Do-Check-Act" process and the underlying principle of continuous improvement, the TMSA is addressing issues beyond the ISM Code. Especially the focus within the TMSA on a continuous stage-to-stage improvement, the necessity of performance measurement and management becomes obvious because in order to improve itself, a company must know where it stands. This is also true for the general vetting procedure, as operators do not like negative surprises after a vetting inspection, it is of utmost importance to monitor the own performance.

It has been seen in the last two chapters that the performance measurement and management is of extreme importance and therefore the next chapter will introduce some basis of performance measurement in general and in shipping in particular.

Chapter 4

Performance Measurement

> Measurement is complex, frustrating, difficult, challenging, important, abused and misused.
>
> (Sink 1991)

4.1 Performance Management in General

Starting this chapter with such a negative epigraph might seem to be strange, but this citation from Sink is quite provocative, and at the same time, it summarises the bias a lot of people have. Nevertheless, the word "important" shall be the part on which this section of the thesis is based.

Following the statement from Lebas that "[m]anagers are continually measuring or requesting that measures be provided" (Lebas 1995, p. 23), the togetherness of **Performance Measurement** and **Performance Management** can already be seen. In fact, both could hardly exist without the other. But what do both of these both actually mean? It is commonly known that within companies, measurement is used to transform difficult, complex circumstances into an indicator which can be quickly and easily absorbed. Nevertheless, what is actually measured - Performance, what does it mean? Lebas (1995, pp. 23-24) analysed that performance can be anything from efficiency to return on investment, with reams of definitions which are never fully specified. And to make it even worse, is performance about the past or the future? Within this thesis, the author follows Lebas' (1995, p. 23) approach after which the performance in terms of management should be seen more in terms of future possibilities and capabilities than about past achievements. This seems logical as the management should be concerned with shaping the future of the company and all its stakeholders, whether internal or external. This is not contradicting to the TMSA and Shipping KPI Standard as these standards are using past achievements in order to increase future performance by a continuous improvement process.

Actually the **Performance Management** and **Performance Measurement** have to be seen as associated, and that they cannot be separated without abolishing the underlying objective of continuous improvement. Consequently, they "feed and comfort one another" as it can be seen in the picture, which is similar to the continuous improvement cycles within management systems, as stressed in Chapter 2.

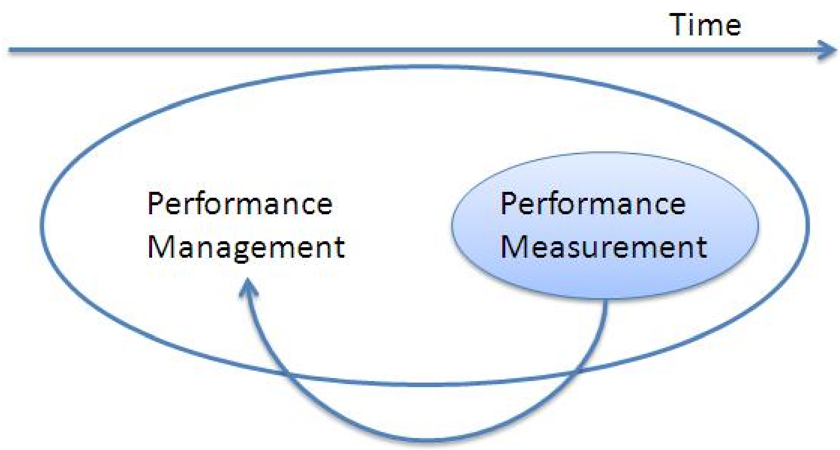

Figure 4.1: Performance Management and Measurement

according to Lebas (1995, p. 34)

As aforementioned, the Performance Measurement was, for a long time, trapped within the accounting department and had only dealt with the measurement of the backward looking financial parameters of a company. Within the late 1970s and 1980s the academia were calling for change because this backward looking financial focus was aiming to minimise a potential variance rather than to look for continuous improvement. Furthermore, this Performance Measurement was not externally focused enough and lacked an alignment with companies' strategies (Unahabhokha, Platts & Tan 2007, p. 77).

Within the next decade, it was proposed to balance Performance Measurement between external and internal, financial and non-financial indicators. This lead to the development of Kaplan's and Norton's (Kaplan 2006) Balance Scorecard (cp. Section 4.1.2) which focused within their approach on "financial, customer, internal business, and innovation and learning perspectives" (Unahabhokha et al. 2007, p. 78). Additionally, "authors" (Unahabhokha et al. 2007, p. 78) started arguing that Performance Measurement should follow a strategy and not vica versa. Therefore, the concept of leading and lagging indicators became of utmost importance (cp. section 4.1.1). Nevertheless, the step from **backward looking - lagging - indicators** to **forward looking** or **predictive** respectively **Performance Measurement** is a difficult road. Unahabhokha (Unahabhokha et al. 2007) established a predictive Performance Measurement for a textile company based on a fuzzy expert approach, which will not be further explained within this thesis, but it has to be said that he detected different challenges for the implementation of such a forward looking Performance Measurement. Due to the fact that this thesis is not aiming on the development of a predictive Performance Measurement, this will not be further evaluated, even though it would be another interesting subject for further research projects.

Within the next section, a short overview of Performance Management and Measurement tools is given, firstly focusing on the general applications and in the second part of this chapter on examples from the shipping business.

4.1.1 Key Performance Indicators

Key Performance Indicators are not new as a tool used within the management of companies. This applies especially for financial KPIs which have been used for ages, even if they were not named KPIs, Return on Investment is such an example. In addition to the financial aspects of performance measurement in recent decades, the industry has begun to measure also quality aspects through KPIs which promise a comparative advantage for the respective company. According to Brown (1997, p. VII), today most managers are engaged with the analysis of data 25 percent of their time . This shows the extreme importance which is assigned to data capture and to KPIs in particular.

As KPIs are the focus of this section, the author will stick to MARINTEKs (2010, p. 7) definition of KPIs, in which KPIs are:

- a numerical, objective measurement of performance
- a key to the strategic business objective
- actionable and influenced by the relevant stakeholder/ manager
- accountable to stakeholder/ manager
- output orientated, not focused on the input or activity
- possible to calculate with limited efforts and within limited time

(MARINTEK 2010, p. 7)

In literature, it is stressed that a company should not have too many KPIs, the ideal number which is often referred to is around 20 indicators. It is important that a company identifies the critical success factors for its venture, then would it even possible to steer a company with just a few measurement categories, cp. also (Seidenstücker 2010). This shall not mean that a company is only measuring 20 different data points, in fact they should measure as much data as necessary for the success of the company. The core objective should be, however, to acchieve a KPI system which is balanced in terms of a Balanced Scorecard approach (cp. section 4.1.2). Consequently the ultimate goal of a company should be to establish a dashboard kind of KPI system and Performance Measurement System. This would reduce the workload of an individual person and ensure the focus on the core success factors. Brown (1997, p. 4) gave the example of a dashboard in a car, some indicators have to be observed continuously whereas it is enough for others that they are just existing as an alert type indicator. Such alerts might not be critical success factors which must be monitored on a regular basis, but it might be of utmost importance to ensure a specific level (Brown 1997, pp. VII-15).

Additionally to the establishment of the right amount and correct KPIs for a company, it is of extreme importance that these KPIs are first defined for the highest management level in order to break these KPIs down to the individual departments and employees. This is important in order to ensure that the employees are working in-line with the management objectives. However, this shall not mean that the employee should not be involved in the development process. In fact, the literature states that the employees should be encouraged to participate in the development of a KPI system in order to ensure the workability and the motivation of the employee. This is not in contrast to the bottom-up method described above, due to the fact that the final development of the dashboard should be in-line with company objectives and, thus, has to be done on the level of top management (Brown 1997, pp. VII-15).

The measurement itself is an easy task, contrary to this, the intention to measure the right and disregard uninteresting data is a difficult challenge. It has already been stressed that the **critical success factors** must be identified; however, in order to achieve this, it must be clear what the intended goal of the organisation is, and what the ultimate objective of the company is. If this is clear, the **critical success factors** can be identified, and on this basis, a KPI standard can be established with the help of a **Balanced Scorecard model**. Furthermore, the company should define goals for the individual KPI or indices respectively and follow the strategies as to how these goals can be achieved. Nevertheless, it has to be stressed that if the underlying principles within the company change, e.g. the change of a company's objectives due to a change of ownership, it is of crucial importance that also the performance measurement system is revised or adapted (Brown 1997, pp. VII-15).

The ultimate goals or objectives respectively of a KPI should be based on research rather than on arbitrarily set figures. This will ensure that the company's employees are motivated to reach the set targets, in contrast arbitrarily set targets are quickly identified by the personnel, and, consequently, the motivation to achieve this figures decreases (Brown 1997, pp. VII-15).

Following characteristics of a successful Performance Management System based on KPIs was stated by Brown:

- Measure few key factors instead of many non-relevant
- Define KPIs which are linked to critical success factors
- KPIs should address the past, present and future
- KPIs should abut on stakeholders interests
- KPIs should start from the top management and should be addressed in every hierarchical level.
- Several KPIs can be concentrated in one KPI or index respectively
- If the precincts or the company's strategy changes then the KPI system should also be adapted
- The goals and objectives of KPIs must rest on research not on arbitrariness

(Brown 1997, pp. 3-4)

Brown (1997, pp. 15-17) stated that both a reduction in time spent for management meetings as well as the establishment of company reports are practical benefits of a strategic Performance Management System. Furthermore, he stated that the individual manager can save a significant amount of time, daily, due to the fact that he is focused on the company's critical success indexes. (Brown 1997, pp. VII-15)

If the company implements such a system, it would change its KPI system from sole Performance Measurements focused to Performance Management focused, as discussed in the introduction of this chapter.

Within this section, the Balanced Scorecard concept was already mentioned without going further into detail. As this concept has been already addressed and will further be of interest for this thesis, the next section gives a short introduction to the principles of Balanced Scorecard system.

4.1.2 Balanced Scorecard

The **Balanced Scorecard** [hereinafter referred to as: BSC] is a management tool for the concretion, demonstration and tracking of strategies in order to enhance the feasibility of specific strategies. The concept was developed under the leadership by Professor Robert S. Kaplan[1]in the beginning of the 1990s. The BSC concept was intended as a counterbalance to the management systems in the USA which strongly focused on financial aspects and should add a non-monetary focus, thus, generating a more "balanced" management system. Howsoever, after the introduction, it became evident that the BSC approach is very well suited to demonstrate strategic goals rather than to implement defined measurement categories (Partners 2007, pp. 2-3). Morgan (2007, p. 258) summarised the core objectives of the BSC as follows:

> - The performance measurement system should be balanced and not be dominated by one single measurement perspective;
> - The performance measurement system should be designed in such a way that there is alignment of all measures with the organization's strategy;
> - There are four basic business perspectives that should be measured - the financial perspective, the customer perspective, the internal business process perspective, the learning and growth perspective; and
> - The performance measurement system should be a dynamic and ever changing system that reflects the strategic responses of the organization to its market.
>
> (Morgan 2007, p. 258)

As already touched in point 3 of above list, the BSC provided originally the below given framework, these perspectives can be customised in line with the requirements of an industry and company respectively.

- Finance
- Customers
- Internal process perspective
- Learning and growth/ potential for the future

[1]Baker Foundation Professor, Harvard Business School (Kaplan 2006, preface)

The evenly consideration of these perspectives in the development process for a strategy leads to a balanced goal orientation and thus to a Balanced Scorecard. To set up a BSC, the strategic goal, indicator, the target value and the strategic actions for the above mentioned perspective must be defined. From the below exemplary table of a shipping company it can be seen that a BSC is not necessarily complicated.

Balanced Scorecard	**Strategic goal**	**Indicator**	**Target value**	**Strategic actions**
Financial perspective	Decrease variance of the cashflow	$\frac{T/CIncome}{V/CIncome}$	30%	bringing more vessels under T/C
Customer perspective	Fewer O/H days	$\frac{DaysO/H}{Daysinoperation}$	$\leq$ 1%	Revise PMS
Internal process perspective	More interdisciplinary team meetings	Meetings per month	1	Meetings are scheduled by managers
Potential perspective	Internal suggestion system	Incoming suggestions per capita	0.1	Setting up a suggestion system, based on benefits by saved costs

Table 4.1: Balanced Scorecard example table

on the basis of (Partners 2007, p. 4)

4.2 Performance Management in Shipping

Up to here, the Performance Measurement and Management respectively have been introduced from a rather general point of view. In order to show the recent developments within the maritime industry, this section will be concerned with a brief introduction of some performance related systems established within the maritime industry in recent years.

4.2.1 Port Performance Indicators Selection and Management

In recent years the port industry has seen a wave of privatisations or, better said, corporatisation of whole port complexes. This has not changed the ultimate ownership, but the former public organised ports have changed their face in a private company one. Through this private approach, the ways of working had to be changed at the port authorities, and their management information systems had to be used more intensively because the pressure from external and internal stackholders was increasing. Following this development, the European Commission called for the **Port Performance Indicators Selection and Measurement** [hereinafter referred to as: PPRISM] project, in order to monitor the overall performance and to benchmark ports among themselves. Within this project, "relevant transparent and realistic indicators" should be indentified in order to "form the basis of European port 'observatory'" (Verhoeven 2011). The PPRISM project differentiate between the following categories of indicators:

Figure 4.2: PPRISM logo

- Market trends and dynamics
- Socio-economic factors
- Environmental factors
- Logistic chain and efficiency
- Governance (including financial)

(Dooms 2011, slide 6)

The PPRISM project is coordinated by the **European Sea Port Organisation** [hereinafter referred to as: ESPO] secretariat, the ESPO Technical Committees together with the academical research partners[2].

The aim of the PPRISM project is to establish a limited number of indicators, within the above described categories, and to set up a dashboard of same. The respective indicators for the different categories are the following:

- **Market trends and dynamics:**
  Maritime traffic, Vessel traffic, Concentration ratio, Load rate, Call size, Modal split, Vertical market concentration, Containerisation degree.
- **Socio-economic:**
  Employment, Added value, Direct gross added value per FTE, Financial health, Training per FTE, Investment.

[2]University of Aegean, University of Atwerp - ITMMA, Vrije Universiteit Brussel, Cardiff University, Technical University of Eindhoven, (Dooms 2011)

- **Environmental:**
  Energy Consumption, Water consumption, Carbon footprint, Environmental management, Waste per type, Biodiversity and habitats, Water quality, Existing inventory of environmental aspects/ monitoring programme.
- **Logistic chain and efficiency:**
  Maritime connectivity, Intermodal connectivity, On-time performance - deep sea, On-time performance - hinterland, Mean-time customs clearance, Availability of Port Community Systems, Ship turnaround time.
- **Governance (including financial):**
  Integration port clusters, Extant of performance management, Formal reporting CSR, Market openness, Port authority (investment), Safety/ Security, Port authority (employment productivity), Autonomous management.

(Dooms 2011, slide 14)

From the above list, it can be seen that the Performance Measurement deviated from sole financial indicators to a more quality based approach and indices focusing on external and internal stackholders, which was the ultimate goal of the previous described general developments as mentioned in the above sections.

The PPRISM project is now (Summer 2011) at the third stage, the practical application, running a pilot at European Union level. For December 2011, the establishment of a European Port Observatory is planed.

4.2.2 The Container Terminal Quality Indicators System

Also among the container terminal operators, the awareness of the necessity of performance measurement and benchmarking has grown. The first step forward was undertaken by the Global Institute of Logistics which in cooperation with the Germanischer Lloyd formed the Hamburg committee[3], in 2007, in order to launch an international standard for the terminal industry, the so called "**Container Terminal Quality Indicator** [hereinafter referred to as: CTQI] for measuring the efficiency of container terminals". This scheme was finally launched in February 2008 (**?**).

[3]The so-called Hamburg Committee was formed by companies like, amongst others, Germanischer Lloyd, Global Institute of Logistcs, Yantian International Container Terminals, Eurogate, HHLA, PSA and industry stakeholders like HPA, MSC, Hamburg Süd CMA CGM and World Shipping Council. (**?**)

Why is this standard needed within this industry? According to Garica (**?**), the terminal and port users are requiring "a more reliable marine transport system" in order to increase a holistic supply chain efficiency, and as the "terminals have been said to be the weakest and least transparent link in the supply chain", it can be concluded that this link in the transport chain has a great potential to increase its performance.

Consequently, the ultimate objective of the CTQI is to develop an internationally accepted standard, with regard to terminology and performance measurement. Furthermore, terminal performance and impact on the supply chain shall be audited, and, finally, best practise shall be identified and rewarded. However, the ulitmate goal of the CTQI is, as depicted in the above epigraph, to improve rather than to prove (**?**).

The CTQI is focusing on four core elements, mentioned below, which are consulted within the performance measurement process.

- Management System
- Internal Factors
- External Factors
- Performance Evaluation (KPIs)

Overall, the CTQI defines 80 **Container Terminal Performance Measures** [hereinafter referred to as: CTPM] which are calculated on a period of one year. The actual benchmarking is achieved through the core elements, in which the CTPMs are aggregated by means of a BSC approach. In addition to the benchmarking, the container terminal will be awarded a CTQI certification after a successful auditing which is focusing on a quality conformance check. (**?**)

With the first two Performance Measurement examples from the maritime and, in particular, port industry it can already be seen how the behavioural changed to more quality awareness, as mentioned in Chapter 2, has changed the Performance Measurement and Management to be more non-financial focused.

As the CTQI is not the core objective of this thesis, the last section was only a short introduction to the same. However, within the following section, we come closer to the actual developments in the shipping business which have a closer link to the actual aim of this thesis.

4.2.3 Key Performance Indicators for a Dry Bulk Tramp Operator

Besides the port industry, the research and literature about KPIs in general and Performance Measurement Seidenstücker (2010) wrote his bachelor thesis about the subject "**Key Performance Indicator for a dry bulk tramp operator**" [hereinafter referred to as: **Bulker KPIs**]. Within his thesis, Seidenstücker established 14 different, customised KPIs. It can be be seen from this fact that KPIs and their use in the maritime business are of emerging importance and that they have not been researched sufficiently for this sector. Nevertheless Seidenstücker focused within his thesis on classical and in the majority financial KPIs, compared to the KPIs which have been developed by the Shipping KPI standard and KPIs which have to be used within the TMSA. Within his research Seidenstücker established the following KPIs:

1. EBITDA-Turnover-Yield
2. ROIC - Return on Invested Capital
3. Voyage profitability
4. Budget
5. SG & A (Selling, General and Administrative) Turnover Ratio
6. Profits per employee
7. Share of costs [subdivided in Bunker Costs and Hire]
8. Protection and Indemnity (P& I) Insurance
9. Employment of the tonnage [subdivided in Time Charter and Voyage Charter]
10. Tonnage Growth rate
11. Vessel Performance [subdivided in Speed Claims and Off-hire]
12. Port performance
13. Demurrage vs. Despatch
14. Baltic Handysize Index Comparison

(Seidenstücker 2010)

Seidenstücker (2010, pp. 57-58) also stressed the already increasing focus on environmental conventions, safety regulations and additionally the strongly increased transported volume of goods had made Performance Measurement necessary. Furthermore, the rising interest in Performance Measurement is demonstrated by the feedback from the industry. Nevertheless, has Seidenstücker predominately considered financial KPIs and has consequently not linked this classical approach to a holistic and thus also quality focused standard. Therefore is with Seidenstückers approach a balanced and holistic reflection of a company's performance not possible.

However, with regard to the KPIs in the maritime industry and especially for the commercial side of the shipping industry Seidenstückers work has to be seen as a fundamental and interesting work.

Within this thesis we will revert to these Bulker KPIs later in Chapter 7.

4.2.4 Shipping Key Performance Indicators

Within the last years, the **Shipping Key Performance Indicators** standard has been established in order to fill the gap of an internationally accepted Shipping KPI Standard and, thus, to establish an internationally recognised Performance Measurement and Management system. In comparison to the Seidenstückers Bulker KPIs this standard is established around non-financial KPIs, as it will be seen within this thesis.
MARINTEK, one of the developers, stated the main objectives as follows:

- measure for continuous improvement
- measure for internal and external benchmarking
- measure to set incentives

(MARINTEK 2010, p. 7)

For the reason that this standard plays a major role within this thesis, this standard is addressed within the following Chapter 5 in more depth.

4.2.5 Tanker Management and Self-Assessment

As it could have been seen in Section 3.1, the **TMSA** is, in fact, also a kind of Performance Measurement System. Of course, this system does not measure performance on its own, but in connection with a good KPI system, it reflects a company's position within the industry and, thus, shows areas where the company has to improve its performance. However, the TMSA has already been addressed in Chapter 3.1 and will be the subject of further research in the Chapter 6. Therefore, please revert to these chapters for in-deep information.

Chapter 5

Shipping Key Performance Indicators

> If you cannot measure it, you cannot control it.
> If you cannot control it, you cannot manage it.
> If you cannot manage it, you cannot improve it.
> Harrington as cited in (**?**)

As mentioned within the research question, the objective of this thesis is to evaluate to what extent the Shipping KPI project can be used in order to assist the mandatory TMSA. Before this question is addressed within Chapter 6, this chapter will be concerned with the introduction of this international standard. Additionally, some remarks have been made which came up during the research of this thesis.

The **Shipping Key Performance Indicator** [hereinafter referred to as: Shipping KPI] project was launched by **InterManager**[1], **MARINTEK**[2] and the **Research Council of Norway** in 2006. The objective is it to set up an internationally accepted industry standard in order to measure a company's performance and, thus, increase the "transparency on quality , safety and environmental performance in ship operation" (InterManager n.d.*b*). It is expected that this will improve the performance within the maritime industry and provide a platform for the shore based and onboard performance measurement. The expected benefits are the raise of public awareness, the potential intra-company improvements, an industry wide benchmarking and finally a potentially "performance based contracting". (InterManager n.d.*b*)

[1] **InterManager** is the association of shipmanagement companies (InterManager n.d.*a*)

[2] **MARINTEK**, the Norwegian Marine Technology Research Institute, "is a limited company ... that performs research, development and research-based advisory services in the maritime sector for companies in the field of marine technology" (MARINTEK n.d.).

After the successful completion of a pilot project in 2005, the Shipping KPI project was launched in January 2006 by a group of 18 leading shipmanagement and ship owning companies[3] [hereinafter referred to as: **Project Steering Committee**]. During the last years, the standard was set up, benchmarking procedures were established and industry awareness was raised. (InterManager n.d.*b*) At the end of 2010, a milestone was reached, the development phase of the KPIs was formally finalised and all interested parties were invited to start using the Shipping KPIs.

After establishing the relevant Shipping KPI and its structure, the last phase of the project was launched. This phase started in November 2010, is scheduled for 24 months and is concerned with the operational realisation of the project. Within this phase, the project will establish communication channels, set up a internet based software to upload the data and thus to benchmark the industry input. After the 24 month it is expected that the web-based project will be self-supporting through the fee shipmanagers and other users will have to pay (Lloyd's List 2010). According to Lloyd's List (2010) these users could include "shipping companies, owners with in-house management, third party managers, oil majors and other stakeholders". In December 2010, there were 270 ships participating within the Shipping KPI project and, thus, providing data for the ultimate goal of benchmarking (Lloyd's List 2010). Howsoever, it can be concluded that this could have been only the starting point because for the benchmarking, much greater and, in fact, also more widespread vessel types are needed to set up a reliable and trustworthy benchmarking environment. How much the critical mass will be to ensure the success of the project has to be answered by the future. Nevertheless, during the summer of 2011, an important step was done for the project's future. The Shipping KPI project uploaded a new internet side[4] which is no longer only focused on providing information; in fact, this platform is now also suitable to provide the primary use of data collection and benchmarking.

5.1 The Concept

The Shipping KPI standard is established on 66 **Performance Indicators** [hereinafter referred to as: PIs], 34 **Key Performance Indicators** [hereinafter referred to as: KPIs] and 7 **Shipping Performance Indexes** [hereinafter referred to as: SPIs]. Whereas the structure is as indicated by the picture given below.

[3]The actual list of participants can be found in Annex A

[4]`www.shipping-kpi.com`, accessed on the 16 July 2011

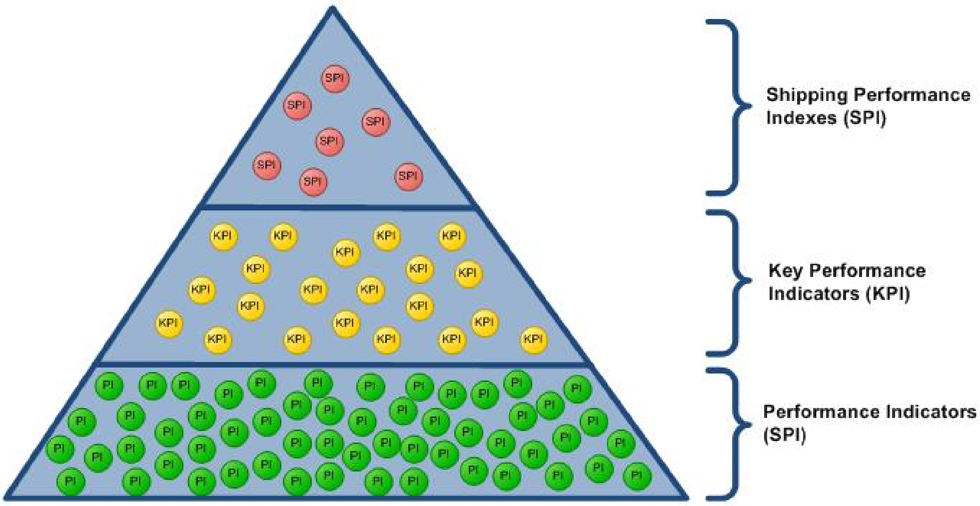

Figure 5.1: Shipping KPI structure

(InterManager n.d.*b*)

As it can be seen from the Picture 5.1, the PIs are used on the lowest level to collect the data, and, therefore, these data can be used repeatedly to calculate specific KPIs. Consequently, the amount of data is reduced and one common basis is formed which reduces the risk of continuative errors. These PIs are then consolidated to specific KPIs. On the level of the KPIs, a normalisation takes place, and the KPIs are using a performance scale from "unacceptable" to "outstanding performance" (MARINTEK 2010).

After the KPIs have been obtained, the finale step is to calculate, on their basis, the SPIs. These SPIs are weighted averages of the used KPIs within a particular area and should be used to depict the overall performance of a vessel in the following main areas:

- Environmental Performance (2.1)[5]
- Health and Safety Management and Performance (2.2)
- HR Management Performance (2.3)
- Navigational Safety Performance (2.4)
- Operational Performance (2.5)
- Security Performance (2.6)
- Technical Performance (2.7)

[5]For the sake of clarification, these numbers in parentheses after Shipping PIs, KPIs or SPIs are taken from the Shipping KPI Standard's Table of Contents as depicted in Annex C. This has been done within the whole thesis in order to allow an easier cross reference to the Shipping KPI Standard as shown in Annex C. The SPIs are having the coding 2.x, the KPIs the code 3.x and the PIs having the coding 4.x.

(MARINTEK 2010, p. 6)

A detailed Shipping KPI hierarchy with detailed structure can be found in Annex B, in which it can be seen that the SPIs can be complex, as for example the Operational Performance SPI, or relatively unimpressive, as for example the Security Performance SPI which consists only of two KPIs and four PIs.

In trying to establish a common industry standard, an agreed definition of the PIs, KPIs and SPIs [jointly hereinafter referred to as: **Measurement Tools**] must be provided in order to assure a common approach to these Measurement Tools. The so-called "KPI Depository" (MARINTEK 2010, p. 8) contains a detailed description of the Measurement Tools, its data capture, objectives, formula, etcetera. For the projects duration, This KPI Depository is under the sole control of the Project Steering Committee. After this, InterManager will be responsible for maintaining the Shipping KPI project and, thus, the respective depository.

In order to benchmark the vessels in the correct group and to combine data for statistics, the Shipping KPI project also collects the so-called "**Meta Data**". This is general information about a vessel ranging from the physical dimensions, via the classification society, information about the ISM auditor, ISM and ISPS certifications authority to the nationalities of crew and insurance details, hull and machinery insurer as well as the P&I Club. (InterManager n.d.*b*)

The author will refer to a more detailed description of individual measurement tools in Chapter 6, during which the "merging" of the Shipping KPI Standard and the TMSA is executed.

5.2 Remarks to the Standard

Even though it is impressive that this first industry standard has been established within the last 5 to 6 years, the author will give, within this section, some remarks to the standard which came up during the engagement with the same. This shall not devaluate the standard; in fact, it may be necessary to clarify some definitions, and, in other situations, it may display the constraints of this standard.

By looking at the Shipping KPI standard, as depicted in Annex B, it becomes obvious at different points that same was established by pure shipmanagement companies. This can be seen in the fact that the Shipping KPI standard does not always provide a holistic and life-cycle approach. This is explainable by the fact, that in general, a shipmanagement company has to renew its service contract with the shipowner annually, and, consequently, he has a lesser interest in the life-cycle approach than a shipmanager who is managing the vessels "in-house" of a shipping group. In the latter example, the "Budget performance" Shipping KPI might be considered to be not as important as for the third party shipmanager because the in-house shipmanager is considering the life-cycle costs rather than an annual budget.

5.2.1 Emission Efficiency - CO_2, NO_x and SO_x

Another example of this third party shipmanager approach can be seen at the end of the Shipping KPI Hierarchy (cp. Annex B), which comprises the KPIs which have not been used for the calculation of any SPI. It is the authors opinion that the KPIs "CO_2 efficiency" (3.5), "NO_x efficiency" (3.21) and "SO_x efficiency" (3.30) would be highly relevant for a holistic measurement of the SPI "Environmental Performance" (2.1). Because this SPI contains absolutely non emission based KPI, which are playing an important role in today's discussions about the environmental footprint of transportation, thus, part of these discussions are e.g. CO_2 trading, fuel taxation, Emissions Control Areas. However, if we consider again that the shipmanager is a third party organisation and has consequently no direct or indirect influence on the vessel's speed, which is the main variable for the emissions, this approach is comprehensible.

According to the projects internet page (InterManager n.d.*b*), this mismatch had also been seen by the Shipping KPI project itself, but they provide that

> "[u]ntil commercial decisions and market situations are taken into account, these KPIs ... remain inconsistent as an expression of the ship managers' performance".
>
> (InterManager n.d.*b*)

As already mentioned, under consideration that the shipmanager has no commercial influence on the speed, this approach can be understood. Nevertheless, if the Shipping KPI project is used to assess the individual vessel rather than the shipmanager, it would be logical to include these Shipping KPIs in the respective SPI. Within the next Subsection 5.3, it can be seen how this holistic approach could become part of an altered SPI within the in-house use of a shipping company[6].

[6]The author is referring within the below section to a shipping company as a traditional shipping company, which is dealing with everything in-house.

The above are considerations which have to do with the approach and attitude of the shipowner: whether the ship owning is driven by financial interest, as it is, for example, the case with KG schemes, or if the ship owning is the core base of a business - the maritime transportation business. Within the latter example, it can be said that ships are ordered upon demand of the individual shipowner and market respectively and mostly operated for a whole life-cycle. Whereas for the first example, the ship exists only as a financial instrument, and, thus, a budget orientation is much more present because the ship maybe sold within a short time if this would bring the highest yield. This shows the discrepancies within the shipping industry between life-cycle orientation and a pure annual budget orientation.

5.2.2 Technical Remarks

Next to these points which have their source in the development of the Shipping KPI project or in the general question of attitude in the shipping business, also more technical questions came up in which the Shipping KPI project requires a clearer structure or explanation. In the coming sections, the author has identified such technical remarks.

Shipping KPI "Vetting deficiencies"

Such a technical question of the Shipping KPI Standard is, for example, whether deficiencies, for the KPI "Vetting deficiencies" (3.33), which are not justified but counted should become part of this KPI or not.

An example could be a deficiency caused by the absence of an oil mist sensor. This absence of the oil mist sensor would be noted within the inspection procedure because as explained in Chapter 3 the vetting inspection is just a conformity check. In of this it would not make a difference if the absence of the oil mist sensor could be, technically, justified by higher intra-company standard. This leads to the drawback that features with a higher standard are still counted as "deficiencies"; whereas it is hard to argue that a higher intra-company standard would lead to drawbacks for the operator. Because such "design" deficiencies can easily account for two deficiencies per vetting, the range of the respective Shipping KPI, 0 to 5 (cp. Annex B) becomes already very narrow. Therefore the question arise whether it would then be justified to abstract this deficiency if a much higher standard is achieved through a new or other constructions which makes a ship safer than one with a sensor.

In general it can be said that these deficiencies can arise when a vessel has a special, individual technical feature which makes another feature unnecessary. Consequently could the absence of a standard feature (the oil mist sensor) be enough to count this as a deficiency, even if an individual technical feature makes the same unnecessary. The sole fact that an industry solution, which is, in this example, to be seen as of lower or at least same quality, is missing qualifies the vetting inspector to count this as a deficiency. Consequently, something has been negatively vetted which was replaced, in good faith, by a higher quality solution. In the author's opinion, the KPI "Vetting inspection" (3.33) does not provide any clarification for this uncertainty as the KPI definition just provide the following:

> ... The KPI counts the number of deficiencies (including any sub standard act, practise or condition) and negative observations, recorded during vetting inspections. The number of deficiencies and negative observation is then made relative to the total number of vetting inspections.
>
> (MARINTEK 2010, p. 77)

It has to be said that, in the authors opinion, also the wording "sub standard" cannot clarify this matter because, in fact, a distinct solution has not to be sub standard. It could, furthermore establish a new future standard because this solution is a hands-on approach and is much more suitable.

Additionally, there are owners who are adjusting their vetting deficiencies on the basis of statutory and contractual obligations, and due to the fact that not all found deficiencies are based on either of the aforementioned, these owners can easily manipulate their deficiencies statistics. Would this be in-line with this KPI, or not? Therefore it has to be concluded, that this Shipping KPI and the respective PI should get a stricter and more transparent definition in order to allow a more reliable comparison and benchmarking.

Furthermore, it is noted that the Shipping KPI Standard is based on quarterly calculated KPIs. However, it is questionable whether it is suitable to measure the KPI on a quarterly basis, because vetting inspections are not done on a threeTherefore month basis. It can be said that ships in the international trade with the approval of the five big oil majors are having on average two to five vettings per year, and vessels in the short sea trade are having approximately five vettings per year. Consequently, a quarterly reflexion could result in an imbalance of the quarters of a year. Therefore, the KPI could be further improved if the basis is changed from a three month measuring period to at least a yearly basis. Another solution would be to use this KPI occurrence-based rather than time-based. This would mean that the deficiencies are not "deleted" after a certain time period which, in the Shipping KPI Standard, is three months. They would first be taken out of the calculation after a certain amount of vetting inspections have been done.

Shipping KPI "Port State Control Deficiencies"

A similar technical problem arises regarding the deficiencies of Port State Controls: according to industry experience approximately five percent of all PSC deficiencies are not justified. Consequently, the same question arises here as above: Should a shipmanager subtract such not justified deficiencies or not? In contrast to the above sections lies the problem here in the fact that the PSC inspectors made misjudgements. The main reason for these misjudgements are the amount of maritime regulations, especially for tankers, and the therewith involved incorrect decisions. However, within the PSC procedure such misjudgements can be plead before another level of authority.

Therefore it is the author's opinion that such deficiencies should be subtracted in order to secure a common approach within the industry and to avoid the case of some shipmanager doing so and others not. Also here, the respective PI definition is neither clear enough nor provides any clarification with regard to unjustified deficiencies, cp. (MARINTEK 2010, p. 128).

If the time period for data capture is critically reviewed, it can be said that basically the same problem could arise as seen in the previous example, with one exception; for this KPI a quarterly observation could be even worse than for the KPI "Vetting deficiencies". This is due to the inspection interval times within the Port State Memorandum of Understandings [hereinafter referred to as: MoU], e.g. PARIS MoU. On the one hand, a quality ship with excellent inspections and an excellent shipmanager can have PSC inspections only every twenty-four months, whereas a vessel considerable poor within the inspections can have same every six months or even every port call. Hereby it could be said that the statistics are manipulated, and, due to this, a punishment of these ships and the respective shipmanager is done, whereas only a benchmarking should have be done. A small example describes this in more detail. If we consider that a shipmanager has 10 high quality ships under management which are inspected every 24 months and 10 ships which are inspected every 6 months, it can be said that the bad ships are contributing more to the statistics and, thus, causing a poorer impression of the shipmanager than justified.

Within this KPI, the same solution as for the previous KPI could be arguable in which the data capturing is time based but PSC occurrence based. This means that the old data is kept until a certain aMoUnt of new PSCs have been done.

PI "Number of failures of critical equipment and systems"

Another technical definition problem can be found regarding the PI "Number of failures of critical equipment and systems". Here, the PI is defined as follows:

> The number of failures to equipment and systems in the critical list as defined in the company's Safety and Environmental Management System.
>
> (MARINTEK 2010, p. 109)

This definition seems to be straight forward, but if the PIs of a tanker and a containership would be compared, it can be expected that these PIs are everything but not comparable. The mismatch lays here in the detail - what equipment is a critical onboard of a containership and what is critical onboard of a tanker. It can be said that a tanker has potentially more critical equipment just because the oil majors are requesting some equipment to be critical which would not be so onboard a containership. Therefore, the Shipping KPI project should clarify how the benchmarking procedure is actually done and describe possible sub benchmarking groups.

5.3 Sole Use in a Shipping Company

5.3.1 Department Performance Indicators

The Shipping KPIs and what was discussed until now is focused on the usage as industry standard. Nevertheless, the Standard could also be used for internal purposes. This would mean that if the PIs and KPIs should be used solely within a company, it is imaginable to alter the SPIs in order to focus them on a respective department and, thus, to get one general indicator for a whole department. Consequently, it is arguable to alter the the SPIs in **Department Performance Indicators** [hereinafter referred to as follows: DPIs] with the following distinction and with the following alteration compared to the SPIs. This is not in contrast to the actual benchmarking, as the difference is just the processing of the raw data (PIs and possibly also KPIs) by special IT software, cp. Chapter 7, and same is easily to achieve.

1. **Operational Performance**
2. **Technical Performance**
3. **HR Management Performance**
   Additional changes within the Shipping KPIs:
   The Shipping KPIs could be further divided in order to take into consideration self-employed/ direct employed and indirect employed employees, i.e. personal employed via a crewing agency. Furthermore, a split by nations and age it could be considered. Howsoever, this is dependent on the company's needs and the company's possibilities.
4. **Health, Safety and Security Performance**
   No additional Shipping KPIs but a jointly view on the SPIs "Health and Safety Management and Performance", "Navigational Safety Performance" and "Security Performance" are required.
5. **Environmental Performance**
   Additional Shipping KPI used:
   - CO_2 efficiency
   - NO_x efficiency
   - SO_x efficiency

With the above given segmentation, it has become artless to dedicate the DPIs to the respective departments within a shipping operator. The last two DPIs, 4 and 5, could have to be included into a DPI for the technical department; however, as these are important DPIs, it can be said that these are also important for other departments. For example, the DPI number 4 could be interessting for the HR Department, and DPI number 5 for the Operational and Chartering Department due to the fact that the environmental performance is very closely related to the actual speed a vessel is sailing, and this is influenced by the last mentioned department.

Department	Core DPI	Informational DPI
Operations/ Chartering	1	3 & 5
Technical	2	4 & 5
HR	3	4

As the Shipping KPI Standard is collected on a vessels basis it is the authors opinion that it would be an easiest to calculate from this the average and thus to arrive at a single KPI which can be used for the calculation of the DPI.

5.3.2 Zero Tolerance KPI

Furthermore, it would be supposable to set up an "Zero Tolerance" dashboard or KPI respectively which would include PIs which are, for the respective shipping company, of such importance that they would like to have them not occurring. With regard to a tanker operator, such a Zero Tolerance KPI could include:

A Number of cargo related incidents (4.18)

B Number of cases where drugs or alcohol is abused (4.20)

C Number of contained spills of bulk liquid (4.24)

D Number of explosions (4.28)

E Number of fatalities due to injuries (4.30)

F Number of fatalities due to sickness (4.31)

G Number of fire incidents (4.32)

H Number of releases of substances covered by MARPOL, to the environment (4.53)

I Number of severe spills of bulk liquid (4.55)

The respective formula would then be as follows and should be, under all circumstances, equal to zero. Consequently, any value greater than zero should result in a beforehand agreed scenario, most likely involving senior management and a review of company procedures.

$$A + B + \ldots + H + I \equiv 0 \qquad (5.1)$$

5.3.3 A Company's Paris MoU 'Port State Control' Performance KPI

It was the author's idea that a tanker operator could maybe use the Shipping KPI Standard in order to calculate its Company Performance with regard to the PSCs conducted within the area of the Paris MoU. The Paris MoU has made a Company Performance

Calculator available on their internet page[7] for companies which wish to benchmark its performance against the average off all PSCs. The Calculator requires the following numerical input:

- Number of PSC inspections within the Paris MoU region
- Number of detentions during these inspections
- Number of Non ISM deficiencies during these inspections
- Number of ISM deficiencies during these inspections

The problem with this input is that it is for the Shipping KPI Standard too specific, that means that, first of all, the differentiation in MoUs is not intended within the Shipping KPI Standard. An additional challenge is that the deficiencies according to the Shipping KPI Standard are not split into ISM and Non ISM deficiencies.

Therefore the question is whether a company would see benefits in using this Company Performance Calculator and, thus, using another benchmarking possibility or whether the possibility for benchmarking with the Shipping KPI Standard are sufficient. The benefit of using the web-based Calculator would be that this statistics include the data of all inspections and not only the voluntarily given Shipping KPI data.

It is the author's opinion that the additional data capturing would not result in a serious amount of extra-work. But it has to be stressed that the processing cannot be done automatically because a person still has to consult the Paris MoU internet based calculator by hand.

Consequently should a company carefully consider if this additional and manual work is paying off, especially under the consideration that the whole performance measurement system could be done automatically, cp. Section 7.1.

Additionally to this intra-company application it may be conceivable for the Steering Committee to consult the averages of the Paris MoU in order to validate their data and, thus, to verify the trueness of the given data or to check if the participants are an average of the shipping business.

[7] `http://www.parisMoU.org/Inspection_efforts/Inspections/Ship_risk_profile/Company_performance/Company_performance_calculator/`, accessed during August 2011

Chapter 6

Merge Shipping KPIs and TMSA

Within this chapter, one of the core questions of this thesis shall be answered: Whether it is possible to use the Shipping KPI standard for the TMSA, and, if so, to what extent is this of assistance. Therefore, the author has identified KPIs which are requested by the TMSA and has tried to match same with the already existing KPIs within the Shipping KPI standard or to show similarities between the required TMSA KPI and a possible Shipping KPI template in order to allow a maximal uniform methodology within a tanker shipping company. However, the TMSA KPIs referred to by the authors are only such KPIs requiring a numerical evidence. It has to be kept in mind that the TMSA is also referring to "Key Performance Indicators" if it "just" requires a written policy or the like. Wherever the author of this thesis was confident that the use of Shipping KPIs could be useful to support these soft/ written KPIs, he has described the situation and defined the respective KPIs. But it has to be kept in mind that a company has to evaluate carefully if they would use additional information within the creation of a TMSA because with every disclosure of information beyond the requirements, the likelihood rises that the oil majors will find discrepancies. Consequently the additional information should only be used where the management is sure that this will strengthen the company's position. Nevertheless, this difficult consideration cannot be done in general, and, therefore, this thesis can only highlight stages where possibilities for further support by the Shipping KPI standard exist; however whether they are actually used or not must be subject to the respective company.

For clarification, the numbers of the stages within this chapter have got annexes like .1, .2, .3 and so forth. This is not according to the TMSA, but was done by the author in order to identify the different requirements under a certain stage. The fields of requirements were numbered consecutively by the author of this thesis, based on the

TMSA2 (OCIMF 2008). Following this, the number **stage 3.1** should be read as stage 3, box one of requirements.

6.1 TMSA Element 1

> **Main objective**
> Provide direction and clearly define responsibilities and accountabilities at all levels within the organisation.
>
> (OCIMF 2008, p. 16)

6.1.1 1 Management, leadership and accountability

Element 1 Management, leadership and accountability

Stage		TMSA requires? KPI	Benchmarking	Shipping KPIs	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2		NO	NO	N/A	NO	
Stage 3	.1	YES	NO	3.28	NO	
	.3	NO	NO	N/A	2.1/ 2.2/ 2.4/ 3.5/ 3.21/ 3.30	Additionally used.
Stage 4	.2	YES	NO	2.1/2.2/2.4	3.5/ 3.21/ 3.30	

Table 6.1: Element 1 - Merging Result Table

Stage 3.1 The stage 3.1 is asking for the implementation of standards and performance assessment of same. The Best-Practise Guidance mentions exemplary KPIs as "pollution incidents, number of audit findings resolved, number of near-miss reports and number of best practices identified". (OCIMF 2008, p. 17) Suitable Shipping KPIs could be:

- Releases of substances as defined by MARPOL Annex 1-6 (3.28)
  The respective PIs are:
  - Number of releases of substances covered by MARPOL, to the environment(4.53)
  - Number of severe spills of bulk liquid (4.55)

The other KPIs, as mentioned above, must be defined on a customised basis and cannot follow any specific framework within the Shipping KPI Standard.

Stage 3.3 This stage does not provide for any specific KPI, but, nevertheless, it requires that "[l]eadership is visibly demontrated at every level. Strong, effective and visible leadership is needed to establish and sustain long-term improvements towards safety and environmental excellence" (OCIMF 2008, p. 17). It can be said that the use of the Shipping KPI Standard could function as evidence of an excellence leadership, especially when these KPIs are monitored on a regular basis and company's goals and visions respectively within safety and environmental performance are established on the basis of them. Due to the focus on safety and environmental performance, the following SPIs are supposable:

- Environmental Performance (2.1)
  The respective KPIs are:
  - Releases of substance as defined by MARPOL Annex 1-6
  - Ballast water management violations
  - Contained spills
  - Environmental deficiencies

- Health and Safety Management and Performance (2.2)
  The respective KPIs are:
  - Flawless Port State Control performance
  - Lost Time Injury Frequency
  - Health and Safety deficiencies
  - Lost Time Sickness Frequency
  - Passenger Injury Ratio
- Navigational Safety Performance(2.4)
  The respective KPIs are:
  - Navigational deficiencies (3.19)
  - Navigational incidents (3.20)

With regard to the environmental performance the following KPIs could be included within the Environmental KPI, as discussed in section 5.2.1.

- CO_2 efficiency (3.5)

- NO_x efficiency (3.21)
- SO_x efficiency (3.30)

Stage 4.1 Stage 4 .1 is asking for formal "[s]afety and environmental performance targets", which are monitored by staff using KPIs and at least quarterly reported to management (OCIMF 2008, p. 17). The same KPIs as in the previous stage could be used for this task with the only difference that performance targets must be defined. For the list of KPIs compare the previous stage.

6.1.2 1A Management, leadership and accountability

Element 1A Management, leadership and accountability

Stage		TMSA requires? KPI	TMSA requires? Benchmarking	Shipping measurement	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2		NO	NO	N/A	NO	
Stage 3		NO	NO	N/A	NO	
Stage 4	.1	No	YES	2.1/ 2.2/ 2.3/ 2.4/ 2.5/ 2.6/ 2.7	NO	Shipping KPI project used for benchmarking
	.2	NO	NO	TBD	N/A	Shipping KPI project used for support

Table 6.2: Element 1A - Merging Result Table

Stage 4 .1 Stage 4 .1 requires a benchmarking to identify further "improvements to the Safety Management System" in the fields of "safety, environmental and management practise". The company is using the benchmarking as a core part in the continuous improvement process and is aiming at "ever-improving best practises" (OCIMF 2008, p. 18). Consequently could a overall benchmarking be imported, as it can be achieved with the participation in the Shipping KPI project (cp. Chapter 5).

Stage 4 .2 This stage requires a verification plan of the safety management system. Here, it could be conceivable to include different KPIs as alerts or to show a long-term improvement by displaying KPI trends. However, as a SMS is a highly individual tool, the author is the opinion that the establisher or a responsible person within a company should assess which measurement tools can be of assistance. Nevertheless, the author is confident that the Shipping KPIs can be a support for the responsible person ashore.

6.2 TMSA Element 2

Main objective
Ensure that the fleet is supported by competent shore-based staff who are committed to a high standard of fleet management.

(OCIMF 2008, p. 22)

6.2.1 2 Recruitment and management of shore-based personnel

Element 2 Recruitment and management of shore-based personnel

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2	.4	YES	NO	NO	3.22	KPI used as framework
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Table 6.3: Element 2 - Merging Result Table

Stage 2.4 Due to the facts that this Element is concerned with the shore-based personnel and that the Shipping KPI project does not provide measurement tools of the shore-based employees, the Shipping KPI Standard is not suitable for this Element. Nevertheless, because this Element is asking for a "job retention rate for key staff" KPI, the Shipping KPI project can provide a framework to establish a company customised KPI because the Standard contains an "Officer retention rate" KPI (3.22).

A "Shore-based Key Staff Retention Rate" KPI can, however, be established using the following PIs:

A Number of shore-based key stuff terminations from whatever cause

B Number of unavoidable shore-based key stuff terminations

C Number of beneficial shore-based key stuff terminations

D Average number of shore-based key stuff employed

The formula to be established would have to look like[1]:

$$100 * (1 - \frac{A - (B + C)}{D}) \geq 70\% \quad (6.1)$$

This approach will assure a uniform methodology within the company and, thus, should lead to an intuitive handling of KPIs if the respective person has become familiar with the Shipping KPI Standard.

6.3 TMSA Element 3

Main objective
Establish maintenance standards so that all vessels in the fleet are capable of operating safely without an incident or detention.

(OCIMF 2008, p. 34)

6.3.1 3 Recruitment and management of vessel personnel

Element 3 Recruitment and management of vessel personnel

Stage	TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1 .4	NO	NO	N/A	4.20	PI additionally used
Stage 2	NO	NO	N/A	NO	
Stage 3	NO	NO	N/A	NO	
Stage 4 .3	NO	NO	N/A	4.39/4.40	

Table 6.4: Element 3 - Merging Result Table

Stage 1.4 This stage stipulates that the company has a "drug and alcohol policy" (OCIMF 2008, p. 27) and a suitable system in place to monitor same regularly. Within the Shipping KPI project, the following PI can be directly used without the need of modifications:

- Number of cases where drugs or alcohol is abused (4.20)

[1]Based on the formula within the TMSA for "Officer retention rate" (3.22) (OCIMF 2008, pp. 55-56)

Due to the fact that within the tanker industry a zero alcohol and drugs policy is mandatory, this PI should ideally show zero cases. However, as it could happen that cases of abuse occur, it could be arguable to establish a new KPI in which the PI is set against the total number of crew serving on vessels under management. Unfortunately, the Shipping KPI Standard does not provide a PI "total number of crews on vessels under management" and thus same would have to be established on a customised basis.

This suggestion has to be seen as a supportive KPI in order to show the relative frequency of alcohol and drug abuses. The author is confident that it has not to be further explained that the number of abuses is dependent on the number of crew serving on vessels under management. Consequently, this KPI could help to explain a single abuse within a fleet.

Stage 4.3 This point provides the requirement that the tanker operator has a written policy in place according to which he is employing "senior officers who have appropriate experience and training on the particular type and size of vessel" (OCIMF 2008, p. 28).

Within this point, the TMSA is not asking for a specific KPI but it could be conceivable to include the below-mentioned PIs:

- Number of officer days onboard all vessels under technical management (DOC) (4.39)
- Number of officer experience points (4.40)

However, it has to be kept in mind that the vetting procedure also has specific officer experience requirements; hence, same should be considered in order to insure a uniform approach and no confusion within the company and vetting authority. This could be achieved by using the same raw-data, compare Chapter 7.

6.3.2 3A Recruitment and management of vessel personnel

Element 3A Recruitment and management of vessel personnel						
	TMSA requires?		Shipping	Additonal/	
Stage	KPI	Benchmarking	KPI	altered KPIs	Remarks
Stage 1 .2	NO	NO	N/A	4.20	Supportive use
Stage 2 .1	NO	NO	N/A	4.42	Supportive use
Stage 3 .2	YES	NO	3.22	N/A	difference just in the threshold
Stage 4 .2	YES	NO	3.22	N/A	

Table 6.5: Element 3A - Merging Result Table

Stage 1.2 Within this stage, procedures are required to ensure that the working and rest hours of personnel are according to STCW or other relevant guidelines. The Shipping KPI Standard provides a PI for this which can be supportively used within this stage:

- Number of violations of rest hours (4.60)

Stage 2.1 Within this stage, the company is required to "provide initial and refresher training for all ranks" (OCIMF 2008, p. 29) in excess of the requirements by STCW or other relevant Standards. For this stage, an attempt could be made to establish the mandatory training man days. If this is possible, this number could be opposed to the following PI:

- Number of officer trainee man days (4.42)

Of course, this PI is just considering the officer trainee days, and, consequently, other ranks are not considered. Therefore, another PI for the crew rank would have to be established using the example of the here mentioned PI.

Stage 3.2 This requirement is concerned with the retention rate of senior officers, and it provides that a "80 % retention rate for senior officers over a two-years period" (OCIMF 2008, p. 29) has to be achieved. The following Shipping KPI can be directly used:

- Officer retention rate (3.22)
  Respective PIs are:

A Number of officer terminations from whatever cause

B Number of unavoidable officer terminations

C Number of beneficial officer terminations

D Average number of officer employed

Although this requirement is only asking directly for the retention rate of the officers, the corresponding best-practise guidance advises to monitor the retention rates for different ranks and nationalities. Consequently, it would be advisable to monitor these additional retention rates on the same methodology as used by the PI "Officer retention rate".

Stage 4.2 This stage provides the same KPI as in the previous stage 3.2 with the alteration of the threshold, which was set to be "greater than 80 % over a two-year period" (OCIMF 2008, p. 29). For all other information and discussions, compare stage 3.2 of this Element.

6.4 TMSA Element 4

> **Main objective**
> Establish maintenance standards so that all vessels in the fleet are capable of operating safely without an incident or detention.
>
> (OCIMF 2008, p. 34)

As this Element is mainly concerned with maintenance and technical performance, most of the required TMSA KPIs and best-practise guidance respectively cannot be fulfilled by the Shipping KPI Standard. However, the necessary measurements should be possible with a good Planned Maintenance Software [hereinafter referred to as: PMS]. Consequently, the author of this thesis has identified just such KPIs and PIs of the Shipping KPI Standard which can be used additionally and maybe to check the PMS software (cp. also problems during the implementation in Chapter 7).

6.4.1 4 Reliability and maintenance standards

Element 4 Reliability and maintenance Standards

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.3	N/A	N/A	N/A	4.23	
Stage 2		NO	NO	N/A	NO	
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Table 6.6: Element 4 - Merging Result Table

Stage 1.3 This stage requires that all conditions of class are monitored and closed as soon as possible. As already explained in the preface, within this Element the Shipping KPI Standard cannot be of great assistance on its own. But it can be of assistance with the following PI in order to evaluate the number of conditions of class and to check whether the PMS is working properly or not.

- Number of condition of class (4.23)

This PI might not be of constant necessity, but it could be helpful during the implementation process of a Performance Measurement System, cp. Chapter 7.

6.4.2 4A Reliability and maintenance standards

Element 4A Reliability and maintenance Standards

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2	.1	NO	NO	N/A	4.29	additionally used
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Table 6.7: Element 4A - Merging Result Table

Stage 2.1 The requirement of this stage that the shore management is informed when there is a failure of critical equipment can be assisted by the following PI:

- Number of failures of critical equipment and systems (4.29)

However, this does not support the actual reporting and information policy, but it could be worthwhile to follow this PI on a time-scale in order to explore vessel trends which might be based on insufficient maintenance on board the respective vessel.

6.4.3 4B Reliability and maintenance standards

Element 4B Reliability and maintenance Standards

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	YES	NO	N/A	NO	Shipping KPIs cannot be used
Stage 2	.1	YES	NO	N/A	NO	
Stage 3	.1	YES	NO	N/A	NO	
Stage 4	.1	YES	NO	N/A	NO	

Table 6.8: Element 4B - Merging Result Table

In every stage, this sub-element is requiring the number of outstanding planned maintenance tasks of non critical equipment. The Shipping KPI Standard cannot be of assistance. This must be solved through the PMS or a Business Intelligence Software using the data of the PMS, cp. Chapter 7.

6.5 TMSA Element 5

Main objective
Establish and consistently apply navigational practices and bridge procedures in line with regulatory and company policies.

(OCIMF 2008, p. 42)

6.5.1 5 Navigational safety

This Element does not require any numerical KPIs and, in addition, it would not be recommendable to include any numerical KPIs because this Element is mostly calling for internal procedures which have not to be supported. Whether a pure internal use of some KPIs, e.g. KPI (3.19) and (3.20), would be considered is not part of this chapter, but the author is confident that it could be conceivable.

6.6 TMSA Element 6

> **Main objective**
> Establish and consistently apply planning and operational practices and procedures that support regulatory and company policies.
>
> (OCIMF 2008, p. 46)

6.6.1 6 Cargo and ballast operations

This Element requires only procedures, available plans and policies respectively, consequently, the Shipping KPI Standard cannot provide any assistance.

6.6.2 6A Mooring operations

As already within the first part of this Element, also the second part does not require any numerical KPI.

6.7 TMSA Element 7

> **Main objective**
> Establish procedures for evaluating and managing changes to operations, procedures, vessel equipment or personnel to ensure that safety and environmental standards are not compromised.
>
> (OCIMF 2008, p. 52)

6.7.1 7 & 7A Management of change

It has to said that the Shipping KPI Standard is not helpful to this Element, as this Element only provides for procedures and plans respectively and does not require any further numerical KPIs.

6.8 TMSA Element 8

Main objective
Use effective investigation, reporting and follow-up methods to learn from significant near misses and incident, and thus prevent recurrence.

(OCIMF 2008, p. 58)

6.8.1 8 Incidents investigation and analysis

This part of Element 8 does not requires numerical KPIs on their own, but the Shipping KPI Standard could provide SPIs and KPIs to support required company's procedures and implementations.

Element 8 Incidents investigation and analysis

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	NO	NO	N/A	3.4/ 3.7/ 3.13/ 3.20	
Stage 2		NO	NO	N/A	No	
Stage 3	.1	NO	NO	N/A	3.4/ 3.7/ 3.13/ 3.20	KPIs used as additional reporting tools
Stage	.2	NO	NO	N/A	2.2/ 2.4	SPIs used additionally in statistics and bulletins/ circulars
Stage 4		NO	NO	N/A	NO	

Table 6.9: Element 8 - Merging Result Table

Stage 1.1 Within this stage, the company is required to have a procedure in force that ensures "reporting and investigations of all incidents, accidents and near misses" (OCIMF 2008, p. 59). Additionally, this procedure shall provide that the review or investigation is done within a specific timescale. This requirement does not, by itself, require any numerical KPIs, but it could be conceivable to use the below mentioned PIs as supportive measurement tools:

- Cargo related incidents (3.4)

- Contained spills (3.7)
- Fire and Explosions (3.13)
- Navigational incidents (3.20)

It has to be assessed by the company if these PIs are of any help because they would not support the ultimate reporting and investigation, in fact they would only display the amount of incidents that have occurred. Furthermore, the PI "Cargo related incidents" should be evaluated carefully if all these incidents are relevant in terms of a company's incidents reporting standard according to the ISM Code are the underlying principle of TMSA stage 1.

Stage 3.1 The ultimate goal of this stage is to "ensure that the root causes and factors to an incident or accident are clearly identified" (OCIMF 2008, p. 59). This does not lead to any KPIs within the Shipping KPI Standard, but as the best-practice guidance provides that "the company safety culture encourage detailed reporting, especially of near misses and incidents" (OCIMF 2008, p. 59), it could be arguable to include the below-mentioned KPIs in order to make the shore-based personnel aware of related accidents and, thus, stimulate the amount of contributions made by shore-based to the investigations or to improvement suggestions in order to avoid further incidents.

- Cargo related incidents (3.4)
- Contained spills (3.7)
- Fire and Explosions (3.13)
- Navigational incidents (3.20)

Of course, the use of these KPIs will not help within the reporting process, but they could be used, as mentioned above, to raise awareness within the shore-based personnel.

Stage 3.2 This stage provides that the lessons learned from incidents are communicated amongst the fleet by safety bulletins or circular letters receptively, by senior officer seminars and by periodical safety performance statistics. It could be considered to include the following two SPIs as additional information and to measure them along a time line in order to depict the development of same.

- Health and Safety Management and Performance (2.2)
  Included KPIs are:
  - Flawless Port State Control Performance
  - Lost Time Injury Frequency
  - Health and Safety deficiencies
  - Lost Time Sickness Frequency
  - Passenger Injury Ratio
- Navigational Safety Performance (2.4) Included KPIs are:
  - Navigational deficiencies
  - Navigational incidents

6.8.2 8A Incidents investigation and analysis

This sub-element does not require any numerical KPIs, and the Shipping KPI Standard cannot be of additional help.

6.9 TMSA Element 9

> **Main objective**
> Develop a proactive approach to safety management, both on board and ashore, that includes identification of hazards (including exposures to substances hazardous to health) and the implementation of preventive and mitigation measures.
>
> (OCIMF 2008, p. 64)

6.9.1 9 Safety management - shore-based monitoring

Element 9 Safety management - shore-based monitoring

Stage	TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	NO	NO	N/A	NO	
Stage 2	NO	NO	N/A	NO	
Stage 3	NO	NO	N/A	NO	
Stage 4 .2	NO	NO	N/A	2.2/ 2.4/ 3.13/ 4.30/ 4.31	additionally used

Table 6.10: Element 9 - Merging Result Table

Stage 4.2 Within this part of Element 9, safety publications are required in order to raise the safety awareness within the company and, thus, try to avoid future incidents. However, the TMSA does not require any specific numerical KPIs, and, consequently, the ultimate decision whether to include the mentioned Shipping KPIs should be subject to management approval, as already mentioned above. But it is the author's opinion that the below listed Shipping SPIs and KPIs could have a supportive function within such safety publications.

- Health and Safety Management and Performance (2.2)
  Included KPIs are:
  - Flawless Port State Control Performance
  - Lost Time Injury Frequency
  - Health and Safety deficiencies
  - Lost Time Sickness Frequency
  - Passenger Injury Ratio
- Navigational Safety Performance (2.4) Included KPIs are:
  - Navigational deficiencies
  - Navigational incidents

Additionally to the above depicted SPIs, it could be worthwhile to consider the following KPI and PIs for the above-mentioned safety publications.

- Fire and Explosions (3.13)
- Number of fatalities due to injuries (4.30)
- Number of fatalities due to sickness (4.31)

6.9.2 9A Safety management - fleet monitoring

This sub-element does not require any numerical KPIs and, additionally, the Shipping KPI Standard cannot be of assistance.

6.10 TMSA Element 10

> **Main objective**
> Develop a proactive approach to environmental management that includes identifications of sources of marine and atmospheric pollution, and measures for the reduction of potential impacts, both on board and ashore.
>
> (OCIMF 2008, p. 72)

6.10.1 10 Environmental management

Element 10 Environmental management

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	NO	NO	N/A	3.28	Used additional
Stage 2	.1	NO	NO	N/A	3.5/ 3.21/ 3.30/ 4.15/ (3.28)	Used to depict set targets
Stage 3	.2	NO	NO	N/A	3.5/ 3.21/ 3.30/ 4.15/ (3.28)	Used to depict set targets
Stage 4	.2	NO	NO	N/A	2.1	Used to support long-term plan
	.3	NO	YES	2.1	NO	

Table 6.11: Element 10 - Merging Result Table

Stage 1.1 This stage requires a zero-spill statement by the company which is posted onboard their vessels. Due to the fact that the below-mentioned KPI measures releases of bulk liquid as well as substances covered by MARPOL to the environment, it would be supposable to underpin this zero-spill policy by the KPI:

- Releases of substances as defined by MARPOL Annex 1-6 (3.28)

Stage 2.1 The company shall provide, under this stage, a time-scale action plan for further reduction of marine and atmospheric pollution. For this stage, the following KPIs could be used:

- CO_2 efficiency (3.5)
- NO_x efficiency (3.21)
- SO_x efficiency (3.30)
- Releases of substances as defined by MARPOL Annex 1-6 (3.28)

Furthermore, the below-mentioned PIs could additionally be used:

- Number of ballast water management violations (4.15)

Whether it would be conceivable to include these KPIs and PIs within this stage depends on the actual performance of the company in the related area. Due to the fact that the current stage is requiring a reduction of pollution, it has to be assed a-priori whether a company can actually improve these measurement tools or not. This is also the reason why, within this stage, the author has not mentioned the KPI "Releases of substances as defined by MARPOL Annex 1-6". It is the author's opinion that this KPI should be part of a zero-tolerance policy, as mentioned in Section 5.1, and, consequently, this KPI could not emerge within an improvement plan.

Stage 3.2 This stage is a stricter application of the previous stage 2.1 with the difference that this stage is requiring defined reduction targets and not only action plans without specific targets. Consequently, the same KPIs should be used as under stage 2.1. Additionally, the same discussion is valid for the KPI "Releases of substances as defined by MARPOL Annex 1-6" (3.28) as under stage 2.1.

Stage 4.2 In comparison to the previous stages, the company is required to "develop and maintain a long-term environmental operations and business plan" (OCIMF 2008, p. 67). Due to the fact that this is a long-term development and a "greater picture" is necessary, the author would suggest to use the following SPI:

- Environmental Performance (2.1)
  Which includes the following KPIs:
  - Releases of substances as defined by MARPOL Annex 1-6 (3.28)
  - Number of ballast water management violation (4.15)
  - Number of contained spills of bulk liquid (4.24)
  - Number of environmental related deficiencies (4.27)

Whether or not the emission KPIs should be included within this SPI, as dicussed in Section 5.2.1, should be subject to management decision and if management wants to benchmarks its set targets with industry averages under the Shipping KPI Standard, which would require a pure SPI. However, if the SPI is customised, it would be advisable to subtract the KPI "Releases of substances as defined by MARPOL Annex 1-6" (3.28) as discussed within stage 2.1 of this Element.

Stage 4.3 This stage explicitly requires the benchmarking of the environmental performance "across the fleet and against the oil/marine industry as a whole" (OCIMF 2008, p. 73), but a specific numerical KPI is not mentioned. Therefore, it is supposable to use the below-mentioned SPI and to benchmark the same within the Shipping KPI Standard.

- Environmental Performance (2.1)
  The respective KPIs are:
  - Releases of substances as defined by MARPOL Annex 1-6 (3.28)
  - Number of ballast water management violation (4.15)
  - Number of contained spills of bulk liquid (4.24)
  - Number of environmental related deficiencies (4.27)

6.10.2 10A Environmental management

Element 10A Environmental management

Stage	TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1 .3	NO	NO	N/A	2.1/	Used to ensure compliance with policy
Stage 2	NO	NO	N/A	NO	
Stage 3	NO	NO	N/A	NO	
Stage 4	NO	NO	N/A	NO	

Table 6.12: Element 10A - Merging Result Table

Stage 1.3 The company should provide a system for monitoring the compliance with existing company policies. Due to the fact that it has been shown within the first part of this Element that the SPI "Environmental Performance" (2.1) can be used for intra-company policies, targets and so forth, this SPI should be monitored in order to assure that the fleet is within the set target range and to identify vessels where the performance has to be improved.

Additionally, if a company has established a zero-tolerance policy and the respective KPI, as mentioned in Section 5.1, it would be supposable to monitor same on a fleet basis too.

6.11 TMSA Element 11

Main objective

Establish an emergency-preparedness system and regularly test it to ensure an ongoing ability to react effectively to an incident.

(OCIMF 2008, p. 78)

6.11.1 11 & 11A Emergency preparedness and contingency planning

As this Element is focusing on emergency plans, its application and drill, this Element does not require any numerical KPI, and, furthermore, the Shipping KPI Standard is not of any assistance for this Element.

6.12 TMSA Element 12

> **Main objective**
> Establish and implement appropriate measurement and feedback processes to focus on and drive continuous improvement.
>
> (OCIMF 2008, p. 84)

According to the above mentioned main objective it could be reasoned that quite an amount of Shipping KPIs could be used within this Element. But by consulting the TMSA it becomes obvious that this Element is mostly calling for intra-company's procedures and requirements and, in fact, not for a single numerical KPI. However, as it can be seen from the below table the author is confident that at least within two stages KPIs can be additionally used.

6.12.1 12 Measurement, analysis and improvement

Element 12 Measurement, analysis and improvement

Stage	TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	NO	NO	N/A	NO	
Stage 2 .2	NO	NO	N/A	3.27/ 3.33	Internal use
Stage 3 .1	NO	NO	N/A	3.27/ 3.33	Mandatory comparison
Stage 4	NO	NO	N/A	NO	

Table 6.13: Element 12 - Merging Result Table

Stage 2.2 Within this stage, the company is required to measure the "level of compliance with company and industry requirements" (OCIMF 2008, p. 85) which are discovered during an intra-company inspection. This has to be done according to a standard which is equivalent to a vessel inspection standard issued by industry bodies. As this stage requires a split in company and regulatory requirements and a measurement of same, it could be conceivable to use the following PIs for internal comparison only:

- Port State Control detention (3.27)
- Vetting deficiencies (3.33)

By its nature, the Port State Control detention KPI could be used to validate the self-found regulatory detentions, and the vetting deficiencies could be carefully used to assess the compliance with company policies. However, with regard to the last one, it has to be carefully assessed whether or not it is beneficial to compare the vetting results with the intra-company deficiencies, but it could be interesting, to see to what extent such comparisons match or mismatch respectively.

Stage 3.1 Within this stage the aforementioned internal comparison between intra-company inspections and third-party inspection becomes mandatory with the objective to review and improve the intra-company inspections. Thus, the procedure of stage 2.1 of this Element has to become part of the TMSA. The procedure and the usable PIs are the same as under the previous stage. However, the same discussions and remarks are valid as under the previous stage.

6.12.2 12A Measurement, Analysis and Improvement

This sub-element does not require any numerical KPI and also does not allow the Shipping KPI Standard to be used as an additional support.

6.13 Potential TMSA Element 13

> **Main Objective**
> Develop a proactive approach to Energy Efficiency and Fuel Management that includes improvement of vessel and voyage efficiencies aimed at reducing the CO_2 emitted from vessels by the use of auditable, prioritised methodologies.
>
> (OCIMF n.d.)

6.13.1 Potential 13 Energy efficiency and fuel management

Even though this is just a guidance with regard to Energy Efficiency and Fuel Management it is already being used in the framework of the TMSA, and, consequently, it could be expected that this might become part of a newly revised TMSA3. Therefore, this guidance has been addressed in the following as if it would have already been a 13^{th} Element of the TMSA. If a company is using this Element already, it might be an advantage if this would become a mandatory part of the TMSA, and if not, the company can show that they do their utmost to improve its performance beyond the industry standards. In both ways, it represents a benefit to the company if this "Element" is been used internally.

Potential Element 13 - Energy efficiency and fuel management

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.3	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 2	.1	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
	.3	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 3	.1	YES	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 4	.2	NO	YES	N/A	3.5/ 3.21/ 3.30	

Table 6.14: Potential Element 13 - Merging Result Table

Stage 1.3 This stage is requires that a system is in place to monitor and record data which are close determinants of the energy consumption. Such consumption data could composed of: whether the vessel is on a ballast or laden trip, weather, sea state and wind direction. As this stage is exemplary in asking for consumption data, it would be a relatively easy task to include, as an addition to the Shipping KPI Standard, the following KPIs:

- CO_2 efficiency (3.5)
- NO_x efficiency (3.21]
- SO_x efficiency (3.30)

As the consumption data is already recorded, the only additional data needed in order to calculate these KPIs are the revolutions per minute and the sulphur content of the bunker. To obtain and process these data should be no problem because they should be available from the technical management department.(OCIMF n.d.)

Stage 2.1 This stage requires that a management tool is used setting baseline criteria in order to assist performance improvements. As this Element is concerned with the Energy Efficiency it would be conceivable to use the same KPIs as mentioned in stage 1.3. On their basis a minimum criteria should be established and continuously improved, furthermore can this improvement opposed to the benchmarking results and, thus, the actual performance of the company can be displayed.

Stage 2.3 The requirement of this stage is that "regular periodic reviews [of individual vessels] are undertaken". As one parameter of these reviews shall address the fuel consumption of the vessel, it would be an easy task to also include the KPIs like under stage 1.3 of this Element, (OCIMF n.d.) within this stage.

Stage 3.1 Within this stage, it is required that targets are set and reviewed by the management; these targets shall be based on voyage management and vessel optimisation. A "continuous improvement of efficient use of energy" shall be demonstrated. It could be arguable to also include the aforementioned KPIs within this stage (cp. stage 2.1), especially when additional technical and operational efforts are done to reduce emissions.

Stage 4.2 As this stage explicitly requires an external benchmarking with regard to energy efficiency, it could be arguable to benchmark at least the above-mentioned KPIs (cp. stage 1.3) within the Shipping KPI Standard.

However, it has to be stressed that this might not be enough in order to benchmark the energy efficiency, especially since these are just pure numbers and not in context with the horse power of the engines. Furthermore this stage requires that this is done by a third party which has also to compare the management systems. Consequently, it is questionable whether the current KPI Standard would be enough to fulfil these requirements. Therefore, another benchmarking tool must be used, or the Shipping KPI Standard has to be extended. Nevertheless, the benchmarking of the aforementioned KPIs under the Shipping KPI Standard could be a starting point, and if the benchmarking option of the Shipping KPI Standard is used, this would also be without much additional work.

6.14 Backward pass - are numerical TMSA KPIs not be considered?

In order to validate the above-mentioned merging results, the author of this thesis has underdone a "backward pass": he analysed whether the TMSA has numerical KPIs which have not been considered.

Throughout the TMSA the author was able to identify that only the Element 4B "Reliability and Maintenance Standards (Close-Out Performance)" (OCIMF 2008, p. 37) had a numerical KPI which could not be depicted by the Shipping KPI Standard. As mentioned on page 60 of this chapter the TMSA 4B is requiring the number of outstanding planned maintenance task of non-critical equipment. Due to the fact that this requires specialised data from a shipmanager planned maintenance system. The Shipping KPI Standard does not provide a related KPI and consequently this numerical KPI is, in fact, the only TMSA KPI which cannot be depicted. Nevertheless, a uniform implemented Business Intelligence Software could process this data in the manner that this would not be a significant drawback, cp. Chapter 7.

6.15 Interim Conclusion

Within this chapter, it has been seen that the Shipping KPI Standard can be used in order to support a company's TMSA. Even though there is a limited number of TMSA KPIs which can be covered by KPIs from the Shipping KPI Standard, nevertheless the Standard can be of assistance for a significant amount of elements and stages respectively. Consequently, it can be concluded that the Shipping KPI Standard can be of additional assistance for a company's TMSA. Especially when a shipmanagement company wants to introduce the Shipping KPI anyway, in order to benchmark its general performance with an industry average, the additional use of the Standard for the TMSA is not to be underestimated! Consequently, this "merging" of these two Standards can allow a uniform methodology and, thus, a decrease of the workload.

However, whether the limited assistance of the Shipping KPI Standard justifies the sole usage of the Shipping KPI Standard just for the TMSA is questionable because it has been shown that the Standard does not always fit perfectly to the TMSA requirements, and, additionally, a lot of other KPIs are needed which are not covered by the Shipping KPI Standard. Thus is the Performance Management in respect to the TMSA still a challenge even if the Shipping KPI Standard is being consulted.

Within the next chapter, the implementation of the Shipping KPI Standard in a Performance Management system is analysed and some recommendations are given.

Chapter 7

Implementation of Performance Measurement in an Organisation

Within the last chapters, it has been seen how Performance Measurement and Management has changed throughout the time. Within this process, the development of quality awareness during the last decades has influenced Performance Measurement, and the focus is no longer on pure financial aspects. Consequently, with Performance Measurement and especially with Performance Management, there is much more involved than just a sole financial interest. It has been seen throughout the previous chapters (cp. Chapters 2 & 3) that the quality, safety and environmental focus of the maritime industry is contributing strongly to the actual Performance Measurement and Management respectively. It can be concluded that the maritime and especially the shipping industry has reached an era in which the performance is much more than the pure financial soundness of a company. Therefore, the Performance Measurement System, today, is a much more complex construct than it was before. Today, the Performance Measurement System has to trace and connect data from different departments of a company. The pure financial figures are obtained from the accounting department in cooperation with the operational and chartering department. However, as quality, safety and environmental data are needed, the involvement of other departments has become necessary. These departments, as for example, the crewing and the technical department, are normally running on software packets that differ totally from those used in the commercial department. Consequently, it is a great challenge for today's business to establish a Performance Measurement System using or working together with all of these different software solutions. Within this chapter, the author will give an exemplary solution to this problem obtained from a case study of a medium-sized shipmanagement company.

As this thesis is focusing on the merging of the TMSA and Shipping KPI Standard, and, therefore, the focus lies more on the quality, safety, environmental and technical performance, the financial performance, e.g. accounting and chartering, has been omitted within this chapter.

The first part of this chapter will show a possible solution for the Performance Measurement and Management within a shipmanagement company. This solution has been obtained from the above-mentioned case study. Even though the author is confident that this is a straight and conceivable solution, each and every company would have to assess whether or not this is a suitable solution for itself. Due to the fact that this is just the description of one possible solution, this is not part of the recommendation because it was not possible, on account of the short time frame of this thesis, to analyse other potential possibilities. In contrast, the second part is concerned with some general thoughts about the implementation of a Performance Measurement System from a human or employee's perspective. This shall encourage the reader to gain insight into the implementation procedure and also use unconventional implementation paths.

7.1 BI Software as an Implemented Technical Tool

As this thesis' objective is to merge the TMSA and Shipping KPI Standard and, furthermore, to assess how a **Business Intelligence** [hereinafter referred to as: BI] **Software** can be used in processing the required data, this chapter will not consider the set-up of Performance Measurement Systems from scratch. In fact, the required measurement is mostly prescribed by the TMSA, which has to be fulfilled anyhow, and the Shipping KPI Standard, which is used in order to ensure a uniform methodology and for benchmarking. Therefore, this section will be concerned with the technical implementation, such as the technical data capturing and processing. As mentioned already in the preface of this chapter, this part is based on a case study and, consequently, will reflect the necessities arising from experiences of the same.

The major challenge of most shipping companies is that they do not have one company software packet; in fact, most departments have their own software solutions. This raises the necessity that these different software products have to be intertwined in order to establish a holistic Performance Measurement System. This is caused by the fact that the shipping industry is significantly specialised in sub-markets, as for example the tanker market. This results in total different requirements for the IT and consequently supports niche solutions. These niche solutions are normally not a part of a uniform IT system and therefore the link between these programs is a major challenge.

Within this section, the exemplary solution of the case study shall be described. The mid-sized shipmanagement company has decided, due to the above stated problem of different software solutions within the departments, to use a BI Software. This software shall be used to access the raw data from the different departments and to process same on one common platform in order to use the same for the actual Performance Measurement. Consequently, the BI Software is being used as software for the common **intra-company Performance Measurement System**. This will replace the "chaos" within the data capturing process as depicted in the below picture 7.1. This picture shows the necessary intra-software connections for the different usages of Performance Measurements.

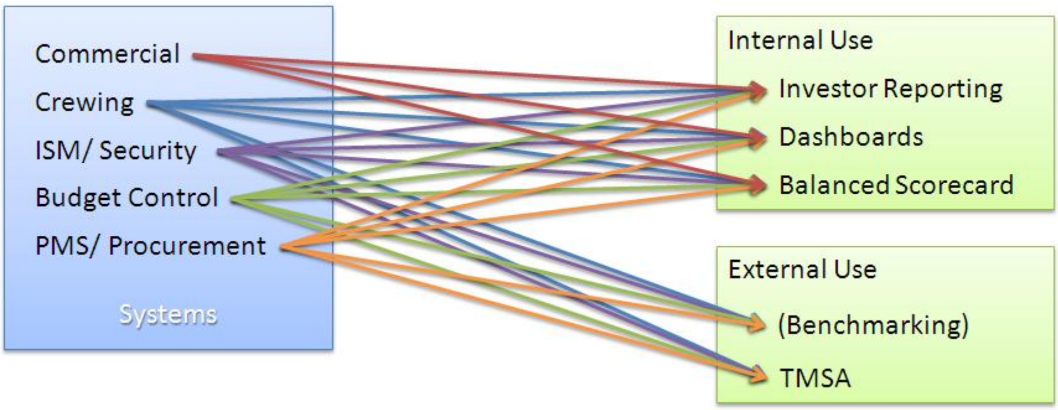

Figure 7.1: BI Software Implementation I

The TMSA and the Shipping KPI Standard do not require on their own one common basis, but the BI Software, as a common framework, could help to overcome the above depicted complicated interfaces between the different software, cp. Picture 7.1. Furthermore is a BI Software a good solution with regard to a possible customisation, i.e. a BI Software can be of more benefit due to the high possibility to integrate same according to a company's requirements into its Performance Measurement System. Consequently a BI Software can be of more assistance as a pre-fabricated software; the only similar benefit, compared to a BI Software, can be achieved by a pure custom-built software solution, which would probably exceed the resources of most ship operators.

It can be seen from the above Picture 7.1 that the purpose for the application of the Performance Measurement can be split for this case study into **external use** and **internal**

use. The internal use can be described in general by management tasks, be it investor reporting, dashboards for monitoring purposes or the use for BSC methods in order to evaluate and set company strategies and targets respectively (cp. sections 4.1.2 & 4). It can be assumed that in many companies, the collection of the required data with regard to each of these practical applications of Performance Measurement is collected somehow on its own. There might be support by the individual software with the set-up of given KPIs, but the link between these different applications is rather weak and manpower intensive. Also this system does not allow an up-to-date reflection of the company's performance; in fact, a reference date must be set to which a person is collecting all the required data by hand from the different software sources. This manual data migration can lead to various and serious problems. These could be for example inaccurate temporal updates, causing miss-understandings and miss-interpretations within a company, as well as incorrect data migration caused utterly by human error. Therefore, it can be reasoned that this manual data processing is rather time consuming, thus costly and has a significantly number of error sources.

Before using a BI Software, the idea is to overcome some of these drawbacks described and seen in picture 7.1 by using the Shipping KPI Standard as much as possible. This is done in order to in-line the methodology used within a company, as described earlier within this thesis (cp. Chapter 6). As the Shipping KPI Standard is concentrated around non-commercial Performance Measurements and this thesis is focused on the TMSA and Shipping KPI Standard, the commercial performance is unattended within the following sections. It can be seen from Picture 7.2 that already the concentration on the Shipping KPI Standard would establish a common methodology within the different departments of a company.

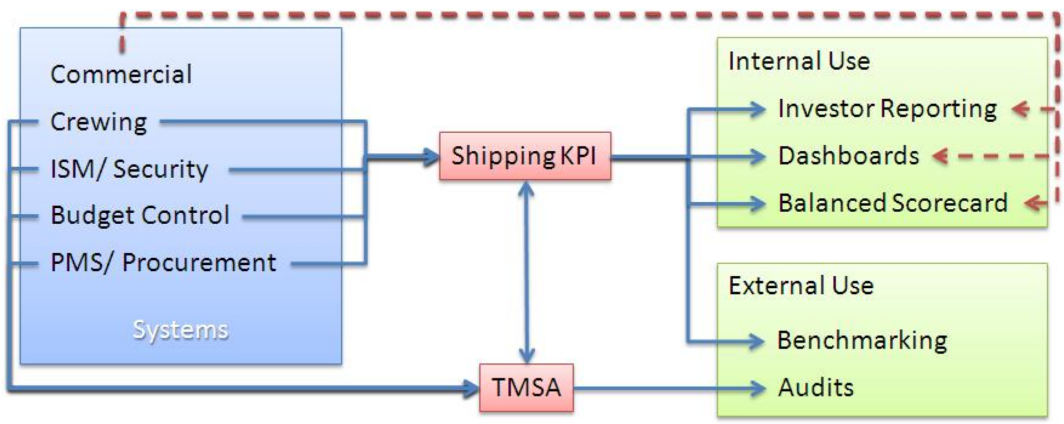

Figure 7.2: BI Software Implementation II

However, as it has been seen within Chapter 6, the sole concentration on the Shipping KPI standard might not be possible because further KPIs are needed; therefore, this Shipping KPI box has been seen as an intra-company Shipping KPI system. Of course, this system should be based on the Shipping KPI Standard in order to achieve the possibility to benchmark same on an industry level, but it would be necessary to establish an intra-company KPI system around this basis that is beyond the hitherto established Shipping KPI Standard. If such an intra-company KPI standard is established, cp. Picture 7.2, it can be seen that the establishment of the Performance Measurement is given a tool and framework which can be "tapped" by the different users, external such as internal. The only system which is still a part in this context is the TMSA. As it has been shown in Chapter 6, the Shipping KPI Standard can be of great support for the TMSA but, nevertheless, the TMSA needs further information going beyond a numerical Shipping KPI system. The Picture 7.2 depicts the potentially and clear structure which can be achieved by a single, coherent and inter-departmentally accepted methodology. However, the ultimate goal of this common methodology should be to reduce the KPIs as much as possible to common substantial KEY Performance Indicators which can be used beyond the "boarders" of the departments and, thus, intra-company wide.

If this common methodology is established and workable, the problem of the data gathering and processing will still not be solved. The manner as to how the required KPIs are structured would be commonly accepted, but the processing would still be time consuming and prone to errors due to the fact that the KPIs have to be calculated somehow within this "KPI division".

As mentioned above, the data gathering and processing, that is the calculation, is a time consuming and consequently expensive undertaking. Furthermore, as it is a complex task the processing of the data with an adjacent set-up of KPIs has a high possibility of errors occurring. This is caused more by the complexity due to this amount of data points rather than the individual mathematical calculations. These drawbacks of any Performance Measurement System could be solved by the introduction of a BI Software, as mentioned before and depicted in Picture 7.3.

Such a BI Software would have to gather the data from the different departments' software and process these data following the intra-company methodology established beforehand. As this BI Software is an intra-disciplinary tool, it would be conceivable that everything which is somehow concerned with Performance Measurement and Management (cp. Chapters 2, 3 & 4) shall be processed by this software solution. Conse-

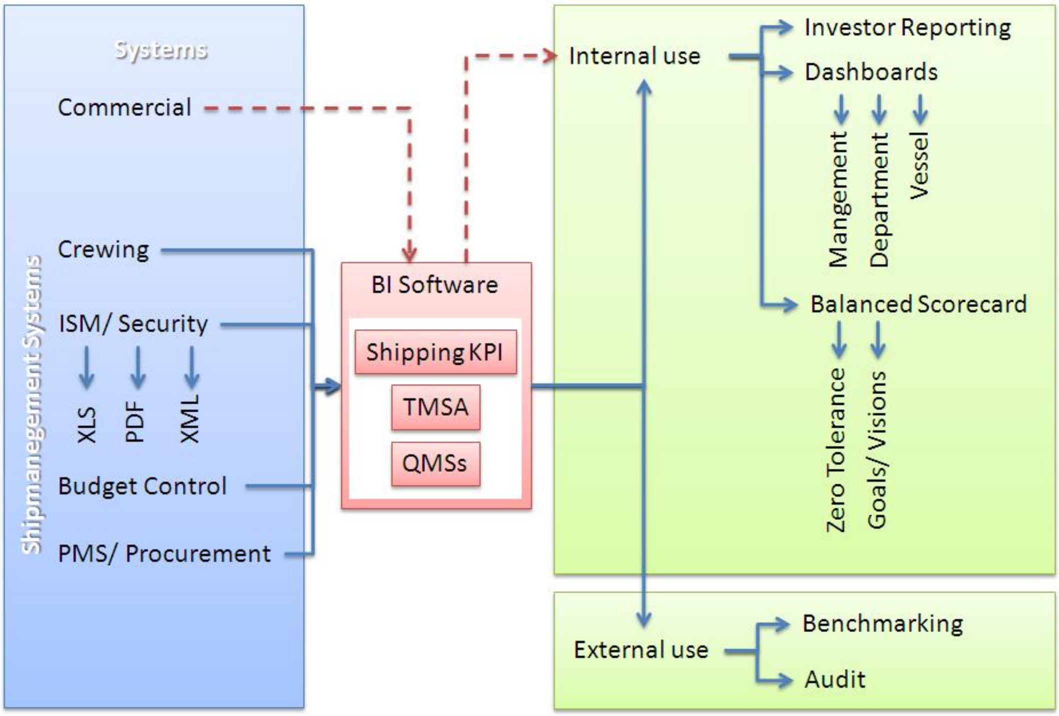

Figure 7.3: BI Software Implementation III

quently, a commercial performance analysis could also be conducted via this tool, as depicted in picture 7.3. As mentioned above, in order to close the circle to the QMSs, the BI Software should then also be used for the QMS. This would be possible due to the fact that a company should obtain its data for all systems that require a degree of Performance Measurement from the BI Software , and the company should attempt to set targets within the QMSs on basis of the intra-company KPI Standard. This would not only have the advantage of achieving a common methodology within the company but also the advantage of establishing a whole common tool for the Performance Measurement System which would contain all available information that may, at some stage or from some user, be required, be it from external or internal stackholders. Consequently, the BI Software would act as a customised Performance Measurement tool providing a pool of data, which is somehow required within the company's Performance Management System. In order to also look behind the pure Performance Measurement, the BI Software could further show trends and developments; show the progress of the company with regard to set targets and would steer the company from Performance Measurement to a Performance Management attitude (cp. Chapter 4) and, thus, could support the company's TQM (cp. Section 2.2)

As it would not be appropriate if all users of the BI Software would use the same interface with all the information that the BI Software provides, there is the possibility to establish as many user interfaces as the company requires. Not only can a different content be displayed, the users can also be assigned different rights. Thus, it would be possible for the senior management to access all data, whereas an external TMSA auditor would only have the right to see the KPIs required by the TMSA. Consequently, it could be possible to set up as many user interfaces as needed for internal and external use, cp. Picture 7.3. A depiction of possible interfaces that may be required and helpful to the user can be seen in Picture 7.4.

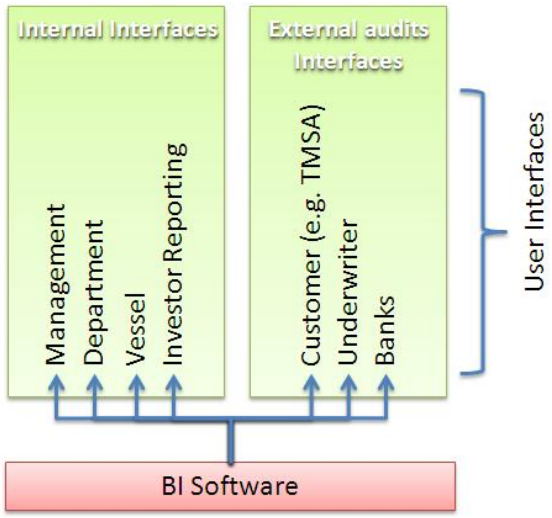

Figure 7.4: BI Software Implementation - Interfaces

With regard to the scope of this thesis, it has to be said that this would, most likely, require the establishment of a Management, Department, Vessel, and TMSA interface. Other interfaces, as for example, the investors interface would be interesting and helpful, but in order to achieve the full benefits, this would require the incorporation of a commercial performance system, as exemplarily mentioned in Section 4.2.3. However, this would require that the respective company would establish its own commercial KPIs, or that it would use, for example, Seidentücker's commercial KPIs, as described in Section 4.2.3. Due to the fact that the implementation of a Performance Measurement System is a complex task, it is the author's opinion that it would be conceivable to use Seidenstücker's approach. This would reduce the time for the implementation process, and, as it will be subject of the next section, it is important to get the implementation process to progress. Nevertheless, these commercial KPIs could also be revised later on if the company considers this necessary. Which interfaces with which KPIs a company wants to establish should be carefully considered in order to reduce the number of interfaces and KPIs respectively. This is of utmost importance in order to reduce the workload and to be result-orientated, cp. also Section 4.1.1.

7.1.1 Business Intelligence Software Implementation - Challenges and Drawbacks

The above-described implementation of a BI Software seems to be ideal; however, before such a solution is considered, it has to be carefully assessed whether or not the data connection between the departments' software and the BI Software can be achieved. Without going into detail, the author of this thesis wants to highlight some difficulties and drawbacks the user of a BI Software can encounter.

As mentioned before, the BI Software is retrieving the data directly from the individual department's software. This is possible because nearly all software are using a kind of database for storing the raw data; that means, the input is stored as inserted into the system. Consequently, the BI Software can be programmed to find specific data within the database and can then use these raw data in order to make its own predefined calculations, e.g. establishing the necessary KPIs, without changing any information within the department's software's database. This has the advantage that the input of data only has to be entered once into the department's original software. Furthermore, all information is available at all times, and, therefore, the KPIs can be calculated more or less in real-time. Consequently, the single carving out of data by an employee is not longer necessary, and, therefore, this eliminates the double work as it was depicted in Picture 7.1.

However, this implies that the BI Software can easily access the database of the software, and, in fact, this is not always the case. Within the case study, the company had experienced all cases, from easy access to really obstructed access. For the latter case, the reason lay mainly in the fact that the software supplier was not providing any description of the database and, consequently, the position of the raw data, e.g. table, row and column had to be found individually within the database. In fact, this was only possible by a "try and error" approach and, consequently, required a lot of time and, thus, money. However, the reason for an easy access in the former case lay in the fact that the software supplier provided a detailed description of the database. Therefore, it has to be concluded that a company is highly dependent on the degree of cooperation that is shown by the software suppliers. But, nevertheless, the author attended a workshop during which representatives of the BI Software supplier, independent IT consultants and employees of the company had shown that the connection between the BI Software and the most difficult software was possible, even though this entails an enormous workload for establishing the connection or finding the raw data within the database respectively, as mentioned above.

7.2 Implementation - the Human Element

As the development of Performance Measurement System is, in itself, a challenge, the motivation of employees is an equally challenging and important mission. The long-lasting implementation phase is bearing the risk that employees, who might be motivated for this project at the start, are getting "lost" during the process. This might happen due to the long implementation phase, especially when a common methodology and an intra-company software tool have to be established, as was discussed in the above Section 7.1. In order to avoid the aforementioned negative developments, Meekings (1995, pp. 7-8) stated the following implications for a Performance Measurement implementation:

1. The implementation process should be conducted progressively rather than in a "big bang" move. This encourage a learning by doing environment and thus takes the employees through the implementation process in contrast to setting them in front of an already implemented and established Performance Measurement System.
2. The persons in charge of the implementation process should take the time to understand which is the correct way for leading the learning by doing process.
3. It is of utmost importance to obtain the support from a critical mass of people in order to reach the point where the whole implementation process becomes unstoppable. This can be achieved by moving "people along a path of least resistance". [1]

Following the recommendation, this would lead to a **developmental implementation process** which, at first sight, looks counter-intuitive. In fact, Meekings (1995) suggested to use such a developmental implementation process rather than a **sequential implementation process**. He stated that the latter, based on sequential execution of

[1] Compare also the necessity of a sufficient critical mass of vessels being part of the Shipping KPI Standard, as mentioned in Chapter 5

the stages preparation, design, implementation and use would have its problems in achieving the above-mentioned implications. He suggested, in contrast, to use the developmental approach during which a concept is launched and a provisional design is established that is used or tested respectively and, in the end, subject to a permanent development stage. With regard to the last stage, it can be concluded that this is also in line with the necessary permanent review of a Performance Measurement System, as mentioned in Chapter 4. Meekings (1995, p. 8) stated that this last approach would be "more akin to human development" and is, therefore, recommendable.

The author of this thesis would follow Meekings suggestions in general and would, furthermore, highlight that such a developmental implementation approach would also be suitable with regard to the establishment of functioning software solutions, as described within the above Section 7.1. Recalling that the whole subject from Performance Measurement, Performance Management, establishing the linkages between different sources which require Performance Measurement (e.g. TMSA and Shipping KPIs, cp. chapter 6) and setting up a common Performance Measurement System, from common definitions to common data processing (cp. chapter 7.1) is a major challenge, then it seems that such a developmental approach is much more feasible than an attempt to establish everything as a workable finalised solution. Additionally, it has to be said that the aforementioned permanent review of the Performance Measurement System (cp. section 4) could disrupt the effort to establish a finalised and workable Performance Measurement System. In fact, it is the author's opinion that such systems will never be completed due to the ever-changing environment in which a company is operating and, therewith, the ever-changing expectations that the external as well as internal stakeholders have about such a system.

7.3 Interim Conclusion of the Implementation Possibilities

Even when considering the drawbacks during the incorporation of a BI Software, it is the author's opinion that this would pay off as the company has a real-time business performance measurement and management tool at hand. Of course, the costs have not to be underestimated. However, as quality awareness becomes more and more important, (cp. Chapters 2 & 3) it is hard to evaluate the costs of the same against the benefits. If taken negatively, QMS and all the related activities, e.g. vetting, seem to be huge cost factors, but, nevertheless, these activities also enable the company to save money. It can be said that a high quality performing company is probably saving money due to lower insurance rates, less off hire periods, etcetera, and according to literature this is outweighing the costs of such a system by far. Additionally, it has to be said that for the shipping industry, the question whether to become quality-focused or not is, since the introduction of the ISM Code, (cp. Section 2.1.2) not a question to be answered individually. Here, the tanker industry plays a special role, as mentioned in Chapter 3 and, thus, has somehow learned to accept such initial costs as the fix-costs of business, and, therefore, has learned to incorporate same into their business plans. Nevertheless is the path to a uniform and integrated Performance Management a challenging one, even if it becomes easier through the use of BI Softwares.

Chapter 8

Conclusion

This thesis shows that the maritime and, in particular, the international shipping industry have undergone a major change in attitude over the last decades. A focus on quality, safety and, ultimately, the environment has developed in this industry driven by serious incidents, both involving humans and the environment. The development of tanker vetting schemes (cp. Chapter 3), the increasing employment of Quality Management Systems which were set up by the International Standardization Organisation (cp. Chapter 2) and the establishment of an international mandatory quality standard for the shipping industry, the International Safety Management Code reflect this change in attitude. These developments have stretched out for over more than two decades. At first, the main focus was on the safe operation of vessels, but within the last years, it has swung to contributing to the sustainable use of the world's resources and, therefore, to environmental management systems (cp. Sections 2.1.3 & 6.13).

Another development that took place was the change from a financially orientated performance measurement to a performance measurement which was less centered on finance. The introduction of non financial performance measurements was necessary due to the new quality awareness resulting in the practice of continual improvement. Chapter 4 clearly showed that all maritime industries, whether the port and terminal or the shipping industry, e.g. with the establishment of the Bulker KPIs or the Shipping KPI Standard (cp. Section 4.2 & Chapter 5), were giving this issue more and more attention and resources. The TSMA also has to be seen, in many respects, as a Performance Measurement System, especially due to its background as an assessment of a tanker operator's compliance to the ISM Code and its performance under the ISM Code.

In contrast to other areas in the shipping industry that are, more or less, quickly regulated on a global basis through international conventions, the sector of shipping performance measurement and management has not seen any uniformity of regulations. The only two outstanding schemes are the TMSA required by the tanker industry and the newly established Shipping KPI Standard. In fact, the TMSA requires a performance measurement without clearly dictating how this should be done in most of the cases.

The Shipping KPI Standard has been introduced from shipmanagement companies and is consequently rather focused on the ship management perspective. As the TMSA is also concentrated on the ship management it becomes self-explanatory why it the attempt has been laid, within the first part of the research question, to use the Shipping KPI Standard for the TMSA.

As it has been tried to answer this subquestion within the thesis' analysis part, conducted within Chaper 6, it became evident that the Shipping KPI Standard can be of utmost assistance for the TMSA. Also if the direct consulting of Shipping KPIs was not often the case, the Shipping KPI Standard was of great use to establish on its framework customised KPIs or to implement the original Shipping KPIs as an additional and supportive measurement tool. The last findings, that the Shipping KPI Standard can be used most of the time additionally or as a framework, should not be under-evaluated, in fact this allows to establish a uniform intra-company KPI standard beyond the scope of the Shipping KPI Standard. Of course, this can also be achieved if a shipping company establishes a KPI Standard on its own; however, would this disqualify the respective company from an intra-industry benchmarking possibility, which is obtained by the use of the Shipping KPI Standard.

Consequently, it can be concluded that the Shipping KPI Standard is not the Holy Grail of performance measurement in shipping, but it is, in fact, a good standard for ship management companies and a good framework to establish an intra-company KPI Standard. As mentioned, the Shipping KPI Standard is, in fact, a ship management KPI standard, and if the Project Steering Committee would like to establish a holistic Standard for the shipping industry, it has to be concluded that the existent standard has to be altered to allow a more holistic performance measurement. This would also involve the comments made in this thesis with regard to the emission based KPIs (cp. Section 5.2.1), to the budget performance (cp. Section 5.2) and a possible inclusion of financial performance indicators as established, for example, by Seidenstücker (cp. Section 4.2.3). Of course, the latter will not be used for a benchmarking procedure, but as today's shipping industry is also be entered by non-traditional shipping companies, as for example issuing banks, the author of this thesis is confident that a more transparent reporting to investors would be beneficial to companies that financially perform well. The consideration whether the Shipping KPI Standard could become a real Performance Measurement System for the whole shipping community is subject to the Project Steering Committee's perception. Nevertheless, there are a few areas within the Shipping KPI Standard which would require some degree of clarification or revision (cp. Section 5.2). However, this is not exceptional for such a multinational and fundamental, preparatory project. In fact also the TMSA2 is not perfect or, better said, could require some clarification or alteration. For example, it is not favourable that the flowchart of TMSA1 was removed during the revision of the TMSA. A more uniform approach with regard to the stage-to-stage development would have been conceivable for the whole tanker industry, and, therefore, it would been better if the TMSA2 would have called for a strict stage-to-stage development as depicted on the flowchart of TMSA1 (cp. Picture 3.3 & Section 3). This would have made the TMSA clearer and easier to undertake. Especially the non-uniformity within this underlying principle causes a lot of trouble for the tanker shipping companies, they have to "artistically" deal with a matter that normally, cannot be solved because the TMSA is only submitted once to the parties that either require a stage-to-stage development or have "cherry picking" requirements. Consequently, it is the author's opinion, that this challenge should get the utmost urgency. However, considering the market power of the oil majors and their non-manoeuvrability, the author is concerned that this will not change within a short time, but hopefully the shipowners together can convince the oil majors that they can be "moved" eventually to a more common requirement.

Nevertheless, it was possible to merge the Shipping KPI Standard and the TMSA and, thus, establish a uniform methodology on this basis for a ship management and shipping company. This formed therewith the basis to establish an intra-company KPI Standard. The merging of these standards was just one challenge of this thesis, the other was the assessment of whether a Business Intelligence Software could be used within the data processing. Chapter 7 demonstrated that it would be of utmost necessity to introduce not only a uniform methodology for the performance measurement, in fact, a uniform data processing would also be beneficial to a company. This twin approach to a uniform performance measurement methodology would allow a, more or less, real time reproduction of the performance information, would decrease the workload if the system is implemented, and this, in turn, would generally result in a decrease of the working hours and, thus, of money spent. However, the case study showed that the implementation of a Business Intelligence Software is not without challenges. In fact, it can be difficult to connect the software and the data. Therefore, a company has to assess, a priori, to which extent the connectivity can be taken as given or whether major problems have to be expected. This assessment is vitally important to a company in order to judge whether the implementation process would pay off in a reasonable period of time or not.

Regardless of all the challenges and possible drawbacks, it is the author's opinion that the use of the Shipping KPI Standard for the TMSA, which would form a uniform methodology within a company, and the implementation of a Business Intelligence Software as a company's Performance Measurement and Management tool would lead to more benefits than drawbacks. Therefore, the author comes to the conclusion that it could be conceivable to implement the here described approach within a shipmanagement and shipping company respectively.

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Appendix A

Shipping KPI Project's Participants

- Aboitiz Jebsen Bulk Transport Corp.
- A.P. Møller-Maersk
- Bernard Schulte Shipmanagement
- BW Gas ASA
- Columbia Shipmanagement Ltd
- ConsultISM
- EMS Ship Management
- Høegh Fleet Services AS
- Intermanager
- Marfin Management S.A.M.
- MARINTEK
- Meridian/PB Marine
- NewsLink Services
- NYK Shipmanagement Singapore
- Seaspan Ship Management Ltd
- Thome Ship Management Pte Ltd
- Tsakos Shipping & Trading
- V.Ships Shipmanagement
- Wilhelmsen Ship Management
- Wilh. Wilhelmsen ASA

Appendix B

Shipping KPI Hierarchy

Within the next two pages, the Shipping KPI hierarchy is displayed as obtained from the Shipping KPI internet page. This hierarchy depicts the SPIs and which KPIs are used to calculate same. Furthermore, the formulae for the KPIs are also shown; thus, a SPI can be broken down to the base of the PIs.

Shipping KPI

SPI	KPI	KPI Value Formula*	$KPI_{LowLimit}$	$KPI_{Excellent}$	PI
Health and Safety Management and Performance	Flawless Port state control performance	$\frac{A}{B}$	0.33	1	A: Number of PSC inspections resulting in zero deficiencies
					B: Number of PSC inspections
	Lost Time Injury Frequency	$\frac{A+B+C+D}{E*10^{-6}}$	2.5	0.5	A: Number of fatalities due to injuries
					B: Number of lost workday cases
					C: Number of permanent total disabilities (PTD)
					D: Number of permanent partial disabilities
					E: Total exposure hours
	Health and Safety deficiencies	$\frac{A}{B}$	5	0	A: Number of health and safety related deficiencies
					B: Number of recorded external inspections
	Lost Time Sickness Frequency	$\frac{A+B}{C*10^{-6}}$	2.5	0.5	A: Number of cases where a crew member is sick for more than 24 hours
					B: Number of fatalities due to sickness
					C: Total exposure hours
	Passenger Injury Ratio	$\frac{A}{B}$	2	0.2	A: Number of passengers injured
					B: Passenger exposure hours
HR Management Performance	Crew disciplinary frequency	$\frac{A+B+C+D+E}{F}*24*365$	0.02	0	A: Number of absconded crew
					B: Number of charges of criminal offences
					C: Number of cases where drugs or alcohol is abused
					D: Number of dismissed crew
					E: Number of logged warnings
					F: Total exposure hours
	Crew planning	$A+B$	15	0	A: Number of crew not relieved on time
					B: Number of violation of rest hours
	HR deficiencies	$\frac{A}{B}$	5	0	A: Number of HR related deficiencies
					B: Number of recorded external inspections
	Cadets per vessel	$\frac{A}{B}$	0	3	A: Number of cadets under training with the ship manager
					B: Number of vessels under technical management (DOC)
	Officer retention rate	$\frac{A-(B+C)}{D}*100\%$	70	95	A: Number of officer terminations from whatever cause
					B: Number of unavoidable officer terminations
					C: Number of beneficial officer terminations
					D: Average number of officers employed
	Officers experience rate	$\frac{A}{4*B}$	60	90	A: Number of officer experience points
					B: Number of officers onboard
	Training days per officer	$\frac{A}{B}$	0	0.5	A: Number of officer trainee man days
					B: Number of officer days onboard all vessels under technical management (DOC)
Environmental Performance	Releases of substances as def by MARPOL Annex 1-6	$A+B$	1	0	A: Number of releases of substances covered by MARPOL, to the environment
					B: Number of severe spills of bulk liquid
	Ballast water management violations	A	1	0	A: Number of ballast water management violations
	Contained spills	A	3	0	A: Number of contained spills of bulk liquid
	Environmental deficiencies	$\frac{A}{B}$	5	0	A: Number of environmental related deficiencies
					B: Number of recorded external inspections
Navigational Safety Performance	Navigational deficiencies	$\frac{A}{B}$	5	0	A: Number of navigational related deficiencies
					B: Number of recorded external inspections
	Navigational incidents	$2A+B+2C$	1	0	A: Number of collisions
					B: Number of allisions
					C: Number of groundings
Operational Performance	Budget performance	$\frac{\lvert A-(B-C)\rvert}{A}*100\%$	10	2	A: Last year's running cost budget
					B: Last year's actual running costs and accruals
					C: Last year's AAE (Additional Authorized Expenses)
	Drydocking planning performance**	$T=\frac{B-A}{A}$; $M=\frac{D-C}{C}$; $if\left(\frac{B-A}{B}\ or\ \frac{D-C}{C}\right)>0$	10	2	A: Agreed drydocking duration
		$T=\left\lvert\frac{B-A}{A}\right\rvert-0.1$; $M=\left\lvert\frac{D-C}{C}\right\rvert-0.1$; $if\left(\frac{B-A}{B}\ or\ \frac{D-C}{C}\right)<-0.1$			B: Actual drydocking duration
		$T=0$; $M=0$; $if\left(\frac{B-A}{B}\ or\ \frac{D-C}{C}\right)\in<-0.1,0>$			C: Agreed drydocking costs
		$DrydockingPlanningPerformance=(T+M)*100$			D: Actual drydocking costs
	Cargo related incidents	A	2	0	A: Number of cargo related incidents
	Operational deficiencies	$\frac{A}{B}$	5	0	A: Number of operational related deficiencies
					B: Number of recorded external inspections
	Passenger injury ratio	$\frac{A}{B}$	2	0.2	A: Number of passengers injured
					B: Passenger exposure hours
	Port state control detention	A	1	0	A: Number of PSC inspections resulting in a detention
	Vessel availability	$\frac{(24*365-B)-A}{24*365-B}*100\%$	97	100	A: Actual unavailability
					B: Planned unavailability
	Vetting deficiencies	$\frac{A}{B}$	5	0	A: Number of vetting deficiencies
					B: Number of vetting inspections
Security Performance	Flawless Port State Control performance	$\frac{A}{B}$	0.33	1	A: Number of PSC inspections resulting in zero deficiencies
					B: Number of PSC inspections
	Security deficiencies	$\frac{A}{B}$	1	0	A: Number of security related deficiencies
					B: Number of recorded external inspections
Technical Performance	Condition of class	A	1	0	A: Number of conditions of class
	Failure of critical equipment and systems	A	1	0	A: Number of failures of critical equipment and systems

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SPI	KPI	KPI Value Formula	$KPI_{LowLimit}$	$KPI_{Excellent}$	PI
These KPIs has no assosisatino to an SPI	CO2 efficiency [g/tonmile]	$\frac{A}{B * 10^{-6}}$	84	36	A: Emitted mass of CO2[ton] B: Transport work
	Fire and Explosions	$A + B$	1	0	A: Number of fire incidents B: Number of explosion incidents
	NOx efficiency [g/tonmile]	$\frac{A}{B * 10^{-3}}$	2.2	0.9	A: Emitted mass of NOx[kg] B: Transport work
	Port state control deficiency ratio	$\frac{A}{B}$	8	0	A: Number of PSC deficiencies B: Number of PSC inspections
	SOx efficiency [g/tonmile]	$\frac{A}{B * 10^{-3}}$	1.5	0.6	A: Emitted mass of SOx[kg] B: Transport work

The Rating and Aggregation formulas

Shipping KPI

KPI Rating Formula	$KPI_{Rating} = 100 * \frac{KPI_{Value} - KPI_{LowLimit}}{KPI_{Excellent} - KPI_{LowLimit}}$	The KPI_{rating} formula is valid for all KPI_{values} and will convert the KPI_{value} into a rating between 0-100.
SPI	$SPI = \frac{1}{n} * \sum_{i=1}^{n} KPI_i$	An SPI is calculated as the average of the KPI_{rating} which is incorporated in the SPI

NOTE:

$KPI_{Excellent}$ is the KPI_{value} which give KPI_{rating} =100

$KPI_{LowLimit}$ is the KPI_{value} which give KPI_{rating} =0

* To see the reporting and calculation periods, please refer to the www.shipping-kpi.com

** To calculate *Drydocking Planning Performance* you need to determine if the time and/or cost deviation falls in the 0% to -10% range, if so the cost and/or time deviation is set to 0 respectively, else it follow the formulas given.

Need more info ?	
For further information about the standard please refer to the web site	www.shipping-kpi.com
For information related to use and participation please contact InterManager	**Kuba Szymanski - InterManager** *Secretary General* kuba.szymanski(at)intermanager.org
For information related to the standard (definitions, formulas, calculation etc.) please contact	**Harald Sleire - MARINTEK** *Research Manager* Haraldsl(at)marintek.sintef.no

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Appendix C

Overview of PIs, KPIs and SPIs

Below are all SPIs, KPIs and PIs of the Shipping KPI Standard listed. The coding of the SPIs (2.x), KPIs (3.x) and the PIs (4.x) are, for an easy cross reference, taken from the Shipping KPI Standard (cp. (MARINTEK 2010)). Additionally the author has indicated on the right side of a respective measurement tool were it has been used within this thesis.

2. Shipping Performance Indexes

2.1 Environmental Performance .... TMSA 1, 1A, 10, 10A/ DPI

2.2 Health and Safety management and Performance .... TMSA 1, 1A, 8, 9/ DPI

2.3 HR Management Performance .... TMSA 1A /DPI

2.4 Navigational Safety Performance .... TMSA 1,1A, 8, 9

2.5 Operational Performance .... TMSA 1A /DPI

2.6 Security Performance .... TMSA 1A /DPI

2.7 Technical Performance .... TMSA 1A /DPI

3 Key Performance Indicators

3.1 Ballast water management violations

3.2 Budget performance

3.3 Cadets per vessel

4.26 Number of dismissed crew

4.27 Number of environmental related deficiencies

4.28 Number of explosion incidents . . . . Zero Tolerance KPI

4.29 Number of failures of critical equipment and systems . . . . TMSA 4A

4.30 Number of fatalities due to injuries . . . . TMSA 9/ Zero Tolerance KPI

4.31 Number of fatalities due to sickness . . . . TMSA 9/ Zero Tolerance KPI

4.32 Number of fire incidents . . . . Zero Tolerance KPI

4.33 Number of groundings

4.34 Number of health and safety related deficiencies

4.35 Number of HR related deficiencies

4.36 Number of logged warnings

4.37 Number of lost workday cases

4.38 Number of navigational related deficiencies

4.39 Number of officer days onboard all vessels under technical management (DOC) . . . . TMSA 3

4.40 Number of officer experience points . . . . TMSA 3

4.41 Number of officer terminations from whatever cause

4.42 Number of officer trainee man days . . . . TMSA 3A

4.43 Number of officers onboard

4.44 Number of operational related deficiencies

4.45 Number of passengers injured

4.46 Number of permanent partial disabilities

4.47 Number of permanent total disabilities (PTD)

4.48 Number of PSC deficiencies

4.49 Number of PSC inspections

4.50 Number of PSC inspections resulting in a detention

4.51 Number of PSC inspections resulting in zero deficiencies

Appendix D

Merging Result Table Overview

Below the graphs from Chapter 6 are depicted one below the other in order to enable a easy comparability of the different Elements and consequently also a easy reference of the TMSA Element' results. For explanations see Chapter 6.

Element 1 Management, leadership and accountability

Stage		TMSA requires? KPI	Benchmarking	Shipping KPIs	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2		NO	NO	N/A	NO	
Stage 3	.1	YES	NO	3.28	NO	
	.3	NO	NO	N/A	2.1/ 2.2/ 2.4/ 3.5/ 3.21/ 3.30	Additionally used.
Stage 4	.2	YES	NO	2.1/2.2/2.4	3.5/ 3.21/ 3.30	

Element 1A Management, leadership and accountability

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2		NO	NO	N/A	NO	
Stage 3		NO	NO	N/A	NO	
Stage 4	.1	No	YES	2.1/ 2.2/ 2.3/ 2.4/ 2.5/ 2.6/ 2.7	NO	Shipping KPI project used for benchmarking
	.2	NO	NO	TBD	N/A	Shipping KPI project used for support

Element 2 Recruitment and management of shore-based personnel

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2	.4	YES	NO	NO	3.22	KPI used as framework
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Element 3 Recruitment and management of vessel personnel

Stage	TMSA requires?				
	KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1 .4	NO	NO	N/A	4.20	PI additionally used
Stage 2	NO	NO	N/A	NO	
Stage 3	NO	NO	N/A	NO	
Stage 4 .3	NO	NO	N/A	4.39/4.40	

Element 3A Recruitment and management of vessel personnel

Stage	TMSA requires?				
	KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1 .2	NO	NO	N/A	4.20	Supportive use
Stage 2 .1	NO	NO	N/A	4.42	Supportive use
Stage 3 .2	YES	NO	3.22	N/A	difference just in the threshold
Stage 4 .2	YES	NO	3.22	N/A	

Element 4 Reliability and maintenance Standards

Stage	TMSA requires?				
	KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1 .3	N/A	N/A	N/A	4.23	
Stage 2	NO	NO	N/A	NO	
Stage 3	NO	NO	N/A	NO	
Stage 4	NO	NO	N/A	NO	

Element 4A Reliability and maintenance Standards

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2	.1	NO	NO	N/A	4.29	additionally used
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Element 4B Reliability and maintenance Standards

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	YES	NO	N/A	NO	Shipping KPI not of use
Stage 2	.1	YES	NO	N/A	NO	
Stage 3	.1	YES	NO	N/A	NO	
Stage 4	.1	YES	NO	N/A	NO	

Element 8 Incidents Investigation and Analysis

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	NO	NO	N/A	3.4/ 3.7/ 3.13/ 3.20	
Stage 2		NO	NO	N/A	No	
Stage 3	.1	NO	NO	N/A	3.4/ 3.7/ 3.13/ 3.20	KPIs used as additional reporting tools
Stage Stage	.2	NO	NO	N/A	2.2/ 2.4	SPIs used additionally in statistics and bulletins/ circulars
Stage 4		NO	NO	N/A	NO	

Element 9 Safety Management - Shore-Based Monitoring

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2		NO	NO	N/A	NO	
Stage 3		NO	NO	N/A	NO	
Stage 4	.2	NO	NO	N/A	2.2/ 2.4/ 3.13/ 4.30/ 4.31	additionally used

Element 10 Environmental Management

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.1	NO	NO	N/A	3.28	Used additional
Stage 2	.1	NO	NO	N/A	3.5/ 3.21/ 3.30/ 4.15/ (3.28)	Used to depict set targets
Stage 3	.2	NO	NO	N/A	3.5/ 3.21/ 3.30/ 4.15/ (3.28)	Used to depict set targets
Stage 4	.2	NO	NO	N/A	2.1	Used to support long-term plan
Stage 4	.3	NO	YES	2.1	NO	

Element 10A Environmental Management

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.3	NO	NO	N/A	2.1/	Used to ensure compliance with policy
Stage 2		NO	NO	N/A	NO	
Stage 3		NO	NO	N/A	NO	
Stage 4		NO	NO	N/A	NO	

Element 12 Measurement, Analysis and Improvement

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1		NO	NO	N/A	NO	
Stage 2	.2	NO	NO	N/A	3.27/ 3.33	Internal use
Stage 3	.1	NO	NO	N/A	3.27/ 3.33	Mandatory comparison
Stage 4		NO	NO	N/A	NO	

Potential Element 13 - Energy Efficiency and Fuel Management

Stage		TMSA requires? KPI	Benchmarking	Shipping KPI	Additonal/ altered KPIs	Remarks
Stage 1	.3	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 2	.1	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 2	.3	NO	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 3	.1	YES	NO	N/A	3.5/ 3.21/ 3.30	additionally used
Stage 4	.2	NO	YES	N/A	3.5/ 3.21/ 3.30	

Table D.1: Merging Result Overview Table

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