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Using the BIMCO Shipping KPI Database to identify costs and benefits of e-navigation solutions

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Abstract. In the RCN-funded research project SESAME Solution II, funded by the Norwegian Research Council under the MarOff programme, a key aspect is to develop a cost benefit assessment framework. This framework will be used to assess the solutions related to e-navigation and automatic reporting, to be developed by the project.

Some benefits are only visible on a larger or aggregated scale. This is particularly true for benefits which concern the reduction of unwanted incidents (e.g. accidents, deficiencies and detentions). Instead of focusing on case by case, historical trending on industrial or segment level provides a better picture of the actual benefit of certain solutions and measures. For this we need access to trustworthy sources. In the SESAME Solution II project, we have gained access to BIMCO's Shipping KPI Standard database. BIMCO is the world's largest international shipping association, with around 2100 members. Membership includes shipowners, operators, managers, brokers and agents. This database contains performance data related to ship management from 2011 with thousands of ships reporting KPIs (Key Performance Indicators on a quarterly basis. The database also allows for selections on the basis of ship type, trade, etc.

This paper explores the challenges and opportunities related to such use of statistics and aggregations when assessing the potential benefits (and costs) related to e-navigation and automatic reporting. Such challenges include the mapping of KPIs to the implementation of specific solutions/measures. As an example, aggregated KPIs may show the effect of certain IMO regulations such as the IMO DCS (Data Collection System: Monitoring, validating and reporting fuel consumption and CO2-emissions from international shipping). Other challenges include proving correlation as well as an overview of external factors which may skew the conclusions.

The suggested approach will prove adaptable to similar sources of data such as THETIS, APCIS and others.

1. Introduction

Shipping faces a long list of reporting requirements, related to regulatory- and commercial requirements. These add up to the total administrative workload on board. A link between human error and administrative workload has been long established [1] and seafarers argue that the added administrative workload in some cases, prevent the safety gain originally intended by the said regulations [2]. An instrument providing an assessment of the associated benefits and disadvantages related to new and existing reporting requirements and other initiatives related to increased safety, efficiency and reduced administrative workload on board, would prove a valuable asset for the entire shipping industry. This ensures a continuous improvement loop where new and existing requirements and initiatives are validated through real life monitoring of their effects, both intended and unintended.

BIMCO, through its Shipping KPI Standard [3] manages a database with currently over 6400 merchant ships (containers, dry and wet bulk, tankers, reefers, etc.) reporting quality and performance related data on a quarterly basis. These data are used for internal improvement through performance and quality monitoring as well as external benchmarking to industry averages. Only companies reporting through Shipping KPI are given access to these data. A company's own data is 100% private and industry averages are only accessible if a sufficient number of companies and ships are available for creating an industry average, securing that no single company, fleet or ship can be identified. However, BIMCO has allowed for researchers and academics to access the industry level data through its Non-Disclosure Agreement (NDA). In the Research Council of Norway (RCN) funded project SESAME Solution II [4], we have obtained such access as part of the project's need to develop a cost benefit assessment framework. This framework will be used to assess the solutions related to e-navigation and automatic reporting, to be developed by the project. The SESAME Solution II project seeks to further develop and productify a complete e-navigation system, using human-centred design principles, that reduces the administrative workload both onboard vessels and ashore. This is supported through work packages on Automated electronic ship reporting, Expanded just-in-time arrival, Cloud-based e-navigation services, development of a harmonized display of navigational information, and a cost-benefit analysis that can verify cases.

This paper explores the challenges and opportunities related to use of statistics and aggregation when assessing the potential benefits (and costs) related to e-navigation in general and automatic reporting specifically. Such challenges include the mapping of KPI results to the implementation of specific solutions/measures.

2. Applying a cost benefit assessment methodology to the assessment of the effects of an increase or reduction of administrative workload

A cost benefit assessment compares costs and benefits related to an investment such as investment in new technology, resources or ships. The result is used as input to the decision maker(s). Costs include hard cash, but disadvantages such as time for administration are vital to capture. Costs are divided into CapEx and OpEx and elements such as depreciation will in some cases be highly relevant. For some analyses in shipping, the term VoyEx is used: Figures that can be allocated to a specific voyage from port to port. In other cases, it may not. Benefits include hard cash (both income and savings) but advantages such as time savings, improved reputation, risk reduction, etc. may play an important role.

For simplicity we will use the term "Cost benefit assessment" in this paper, recognising that what we are covering are advantages and disadvantages in general and not only monetary aspects. There will always be an element of uncertainty. In most cases, the investment costs are more easily estimated than overall disadvantages and benefits, but there are no absolute certainties. The quality of the input affects the quality of the result but there will in most cases be a compromise between quality of input and availability of input.

2.1. The challenge of an uneven distribution of advantages and disadvantages

The basic idea in any cost benefit assessment is to compare the advantages of a measure to the disadvantages the measure represents. This is however a major simplification for several reasons, e.g.:

The cost absorber (bearing the costs of the measure, whether installation costs or running costs) may not be the one receiving the benefits. The decision maker (deciding whether a certain measure should be implemented or adapted) may in some cases represent a third party, outside the beneficiary or the cost absorber (e.g. in cases of regulatory requirements). Both costs and benefits may be distributed between several parties, only one of which is the decision maker. The below figure presents the overall framework chosen for cost benefit assessments in SESAME Solution II, taking into account the abovementioned complexity.

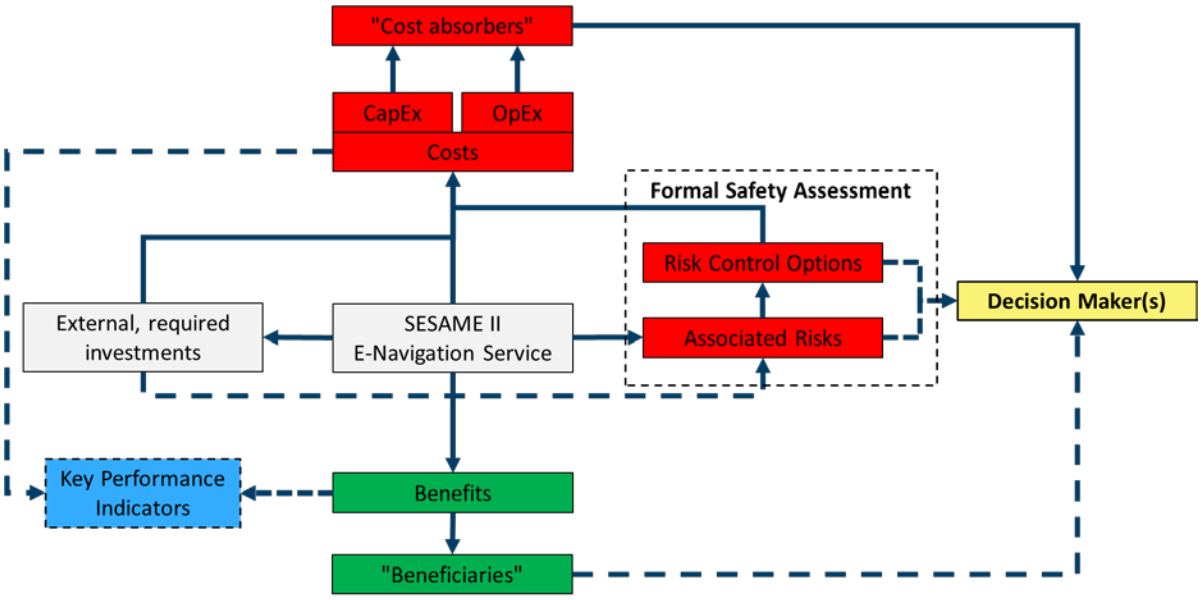

Figure 1 Cost benefit assessment framework in SESAME Solution II, Source: SINTEF

As we in this paper presents a subset of the overall SESAME Solutions II CBA framework, our focus is on the link between Costs, Benefits and the Key Performance Indicators, represented by the BIMCO Shipping KPI Standard.

3. BIMCO Shipping KPI Standard and its usability in the SESAME Solution II CBA-framework

Requirements and initiatives towards the shipping industry can be roughly divided in two: 1) Commercial requirements such as imposed by charterers, ship management companies, P&I Clubs and port agencies and 2) requirements from international regulatory instruments and conventions such as SOLAS (International Convention for the Safety of Life At Sea) [5], MARPOL (International Convention for the Prevention of Pollution from Ships) [6] and STCW (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers) [7]. It is no doubt that these play a vital role in promoting efficient, safe and environmentally sustainable operations but the potential for reducing the associated administrative workload as well as ensuring that these instrument and conventions are up to date, should be explored. This is also done by bodies such as IMO e.g. through its "Have your say" initiative [2].

The BIMCO Shipping KPI Standard contains quality and performance data on an international industry scale. IMO, through its Ad Hoc Steering Group for Reducing Administrative Requirements (SG-RAR) points to the impression that compared to the voluminous paper work imposed by charterers, ship management companies, P&I Clubs and port agencies, the administrative workload emanating from IMO instruments were “the very minimum” by comparison [2]. When using industry averages this pose a challenge as such data cannot be directly linked to commercial requirements. These requirements differ from trade to trade, from vessel type to vessel type, and in some cases from port to port. The same is true for requirements emerging from regional bodies such as US Coast Guard

and EU. Although carrying a higher potential for savings in terms of administrative workload, these requirements cannot be directly assessed through the BIMCO Shipping KPI Standard. Surely, individual companies using the BIMCO Shipping KPI Standard and other performance monitoring systems may use its own data where the link to commercial and regional requirements may be established. These data however, do not represent the same power as data from the overall industry. The framework presented in this paper will therefore consider internationally imposed requirements and initiatives only.

Another key aspect of the BIMCO Shipping KPI Standard is its focus on quality and performance. There are no Key Performance Indicators (KPIs) related to administrative workload directly. This implies that the KPIs are only proxies of the administrative workload. However, reduced or increased administrative workload cannot be considered a practical consequence unless linked to the actual effects this increase or reduction actually has on the quality, safety or performance of the operation. In this paper we therefore argue that, through the established link between human error and administrative workload, the data from the BIMCO Shipping KPI database are suitable for assessing the actual benefits and disadvantages of internationally imposed requirements.

In SESAME Solution II, the cost benefit assessment concerns the solutions related to e-navigation and automatic reporting to be developed by the project. Consequently, advantages and disadvantages related to e-navigation and automatic reporting are what is needed as input. An initial mapping of the relevance of Shipping KPI data to the SESAME Solution II Cost Benefit Assessment Framework is seen in Figure 2.

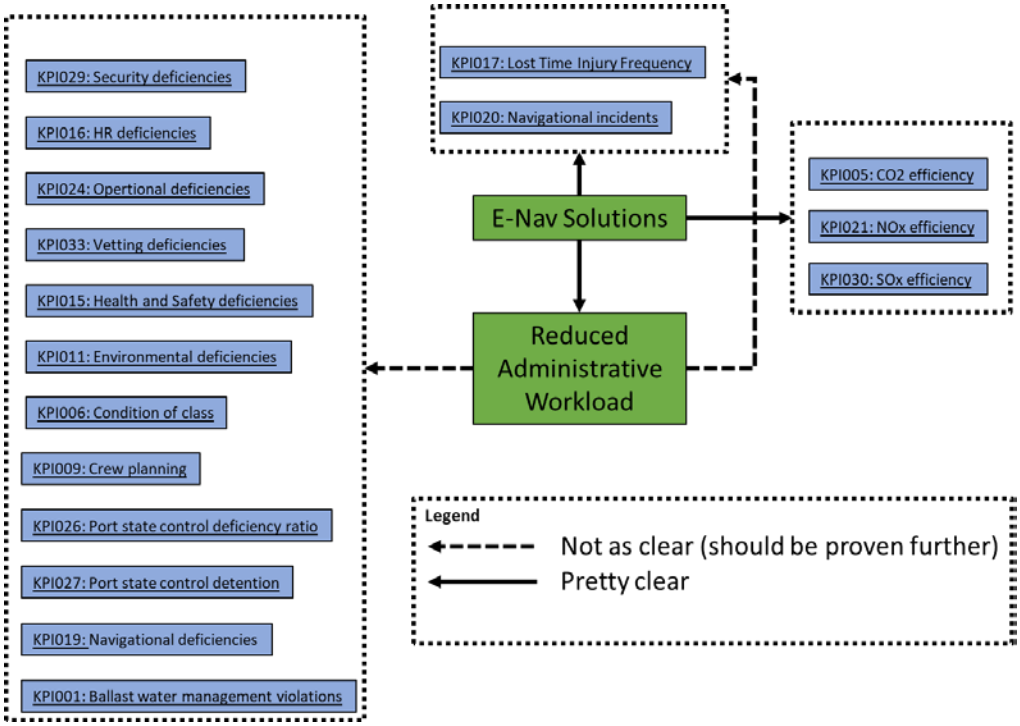

Figure 2 The BIMCO Shipping KPI Standard and its suitability in the SESAME Solution II CBA-framework, Source: SINTEF

There are two main categories of Shipping KPIs which are relevant to assess in terms of proving the effects of increased or reduced administrative burden. The first category entails actual incidents (navigational incidents and human injuries). The second and biggest category entails deficiencies, and violation of prevailing rules and regulations. The third and final category entails energy efficiency.

3.1. KPIs related to navigational incidents and human injuries

Two KPIs are relevant to look at in terms of serving as proxies for reduced or increased administrative workload, namely Lost Time Injury Frequency and Navigational incidents. These KPIs basically express the total number of unwanted incidents. A reduction or increase of incidents, expressed through a continuous trend over a given time period, is an indication that more time and resources have been made available for situational awareness and for navigational operations.

3.2. KPIs related to deficiencies and violations of prevailing rules and regulations

There are ten KPIs related to deficiencies identified through external inspections such as Port State Control Inspections, Class inspections and vettings. Besides vetting inspections (vetting deficiencies) the KPIs cover all inspections from a regulatory perspective. Whether or not the identified deficiencies are related to navigation, Health, Safety and the Environment (HSE), operations or Human Relations (HR), is in our framework, irrelevant.

The remaining KPIs are related to violations of prevailing rules and regulations. Crew planning expresses the number of STCW violations, while Ballast Water Management expresses the number of violations of the Ballast Water Management Convention.

All KPIs related to the number of deficiencies or violations of prevailing rules and regulations are indicative of a reduced or increased administrative workload though the notion that more or less time and resources have been spent on internationally imposed regulations and initiatives.

3.3. KPIs related to energy efficiency

The third category of KPIs are all related to energy efficiency. They cover the emitted mass of CO2/NOx and SOx over the total transport work (ton/miles) performed. The emitted mass of CO2/NOx/SOx is calculated on basis of the fuel (type and quantity) burned. Thus, for our purpose, any of these KPIs will do in terms of taking into account energy efficiency as a result new e-navigation solution. The challenge with these KPIs is that the rely heavy on the transport work. The transport work is a product of commercial decisions outside the scope of the ship's actual voyage. Energy efficiency related to e-navigation, is a result of better weather routing and passage planning. In addition, the implementation of Energy Efficiency Technologies (EETs) will affect the energy efficiency. Further analysis must be made before one can argue that the KPIs related to energy efficiency can be claimed to be a direct result of new e-navigation solutions. As for the reduction or increase in administrative workload, these KPIs play little to no part.

4. SESAME Solution II CBA-framework in practise

The work in SESAME Solution II has not yet come to a point where the actual solutions to be developed can be assessed. We have however made an initial mapping of the BIMCO Shipping KPIs to the planned work/solutions to be developed in SESAME Solution II.

There are four packages that are relevant to the BIMCO Shipping KPIs:

1. **Automated electronic ship reporting:** By introducing more automated reporting it is likely that the ship officers on the bridge release more time for navigation purposes, which again is likely to reduce incidents because of more attention given to navigation.
2. **Expanded Just-in-time arrival:** Better planning between the ship entrance to a port where the time-slot and the availability of port services is coordinated, and the traffic into port is optimized is likely to reduce noxious emissions because of power reduction on a vessel and reduced waiting times. It will also be possible to regulate the traffic such that dangerous situations can be avoided by better vessel schedule planning, in harmony with the total traffic picture.

3. **Cloud-based e-navigation services:** These services seek to improve operations both on board and on shore through enabling the exchange of data between vessels and between vessels and shore stations, such as VTS centers. Route exchange, route optimization, pilot route, marine safety information and chart updates are all services that are intended to improve efficiency and increase safety of navigation.
4. **Develop a Harmonized Display of Navigational Information received via Communications Equipment, supporting the IMO effort:** To further develop navigational standards and to present the navigational information, such as that received by Navtex, in an intuitive way will improve situational awareness on board. One central topic in the project is use of the S-100 framework.

Figure 3 depicts how the BIMCO Shipping KPIs will be used in the different work packages. Please note that not all BIMCO Shipping KPIs will be equally relevant. The actual suitability of each KPI can only be determined (or indeed estimated) once we have a much deeper knowledge of the solutions to be developed in the SESAME Solution II project.

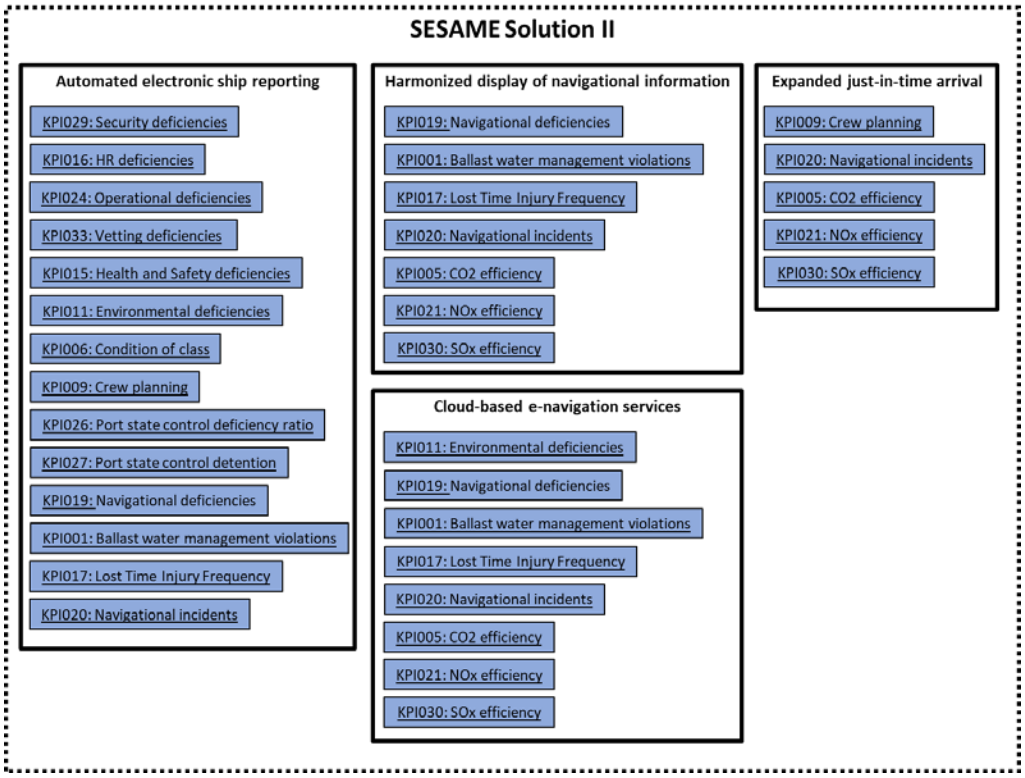

Figure 3 Initial mapping BIMCO Shipping KPIs to SESAME Solution II work packages, Source: SINTEF

5. Concluding remarks

The use of statistics and aggregations on an industrial scale in assessment of potential benefits (and costs) related to e-navigation and automatic reporting, may indeed prove useful. The framework presented in this paper will be an important prerequisite for such assessments. Further analyses should be made to trigger use in a larger context including assessment of any industry initiatives, hereunder international rules and regulations as well as industry improvement initiatives. The concept of mapping certain solutions/measures to aggregated KPI values is also transferable to internal improvement. In the case of BIMCO's Shipping KPI Database, ship managers may map their own KPI

values to internal improvement initiatives, thereby gaining access to actual performance data resulting from the improvement initiative. Especially in terms of historical trending, such results may prove useful indeed for both identifying the need for improvement and the essential assessment of the improvement initiatives themselves.

A purely quantitative validation of the SESAME Solution II solutions poses a number of challenges. Some of these can be solved by statistical methods such as the use of trending and averages rather than snapshots of specific ship performance at a specific quarter. Nevertheless, one must pay close attention to external elements potentially affecting the KPI values. Correlation analyses in general can be a dangerous game, especially without close knowledge of the context in which the analyses are made. Statistical correlation does not prove actual causation in itself and measures must be taken to ensure proper interpretation and exploitation of the CBA-results.

Timing is also a factor. The BIMCO Shipping KPIs are by definition lagging indicators, meaning that they express actual performance. To that extent, they cannot be used for estimation of the effects of the SESAME Solution II solutions but rather as later proof when the solutions have been implemented and in use over a certain time period. Depending on the nature of the actual causation, the correlation between the solutions and the ships' performances (expressed by the BIMCO Shipping KPIs) will be visible immediately or only over time.

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