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How should a ship´s Operational Management System be designed?

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ABSTRACT

The ISM Code's *functional approach* aims to ensure that management systems are tailored to meet the specific needs of each ship and shipping company. However, our literature review reveals that the Code may lead to a documentation-centric approach, disconnected from the operational reality of the ship (Størkersen, 2020). This documentation describes a parallel reality that is commonly referred to as *audit loops*[3].

It should be noted that these harmful issues should not be attributed to the Code itself. Some inspectors, auditors, and shipping companies view the Code as a mere source of prescriptive rules, overlooking its functional intent. This may be due to the fact that the functional approach of the Code can only be fully understood from a thorough knowledge of what an operational management system is and how it works.

In this article, we will examine the root causes of the aforementioned negative effects of the Code and provide recommendations on how to mitigate them.

1. Introduction.

The management system of a business organisation encompasses both the human and material structures that store and apply the knowledge of the organisation, functioning as a support for decision-making processes[4].

The activities of a management system are classified into two levels: strategic and operational. The strategic level focuses on business direction and leveraging competitive advantages (Gestión por procesos: innovación y mejora, 2003), while the operational management system controls and improves the organisation as defined by the strategic management.

For instance, the strategic management of a shipping company will determine the type of ship, the financing options, the country of registry, the policies to be followed and the objectives to be pursued; while the operational management system of the shipping company controls (operates) the ships and makes decisions for continuous improvement.

The shipping company's operational management system must comply with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code).

The Code is not a set of prescriptive rules detailing what each organisation must comply with. On the contrary, the organisation can implement the management system according to its criteria, provided that it meets certain capabilities known as *functional requirements*. Governments must then verify the performance of those systems.

1.1. Prescriptive approach vs. functional approach.

Regulation 4 of Chapter IV of the SOLAS Convention defines the *functional requirements* (capabilities) of a ship's radio station:

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[3]"Audit loops are perhaps the most perfect achievement of bureaucratic accountability: a system of checks and verifications that has become consistent only with itself, and that has less and less to do with the way risk might be building up outside the administrative self-referential knowledge bubble." (Størkersen, 2020)

[4]Statement made at a conference at the University of Cantabria. (Pérez de la Calle, 2013)

1. *Every ship, while at sea, shall be capable:*

.1 except as provided in regulations 8.1.1 and 10.1.4.3, of transmitting ship-to-shore distress alerts by at least two separate and independent means, each using a different radiocommunication service;

.2 of receiving shore-to-ship distress alerts;

.3 of transmitting and receiving ship-to ship distress alerts;

.4 (...)

Later, Part C of the aforementioned Chapter IV of the SOLAS Convention offers a detailed breakdown of the radio equipment required to comply with the standard and meet the functional requirements. This Part C effectively converts Chapter IV into a *prescriptive* regulation. Under these conditions, auditors, inspectors, and shipping companies can easily assess compliance with the standard.

Similarly, the ISM Code outlines the *functional requirements* of the management system. However, as shown in paragraphs 4 and 5 of the Preamble, the Code is designed to be *functional*, i.e., there are no details about how the management system should be implemented.

The ISM Code also includes some prescriptive requirements, such as the appointment of a Designated Person(s) Ashore (DPA), or the need to document the master's responsibilities and authority. In practice, due to unawareness, these requirements may become the focus of compliance with the Code.

Ultimately, either the functional nature of the Code is misunderstood, or we have yet to explore how the capabilities of a management system can be assessed.

2. What is an operational management system and how does it work?.

2.1. Functional requirements applicable to all operational management systems.

The operational management system must *control* the organisation's key processes, with this control being *improved on an ongoing basis* (Ministerio de Fomento, 2005A), (Ministerio de Fomento, 2005B), (Harrington, 1993) and (Galloway, 2002).

2.2. What does it mean to control?.

To control is to keep the processes within certain pre-set parameters. The goal is to accommodate process variability, ensuring that performance remains within an acceptable range, regardless of the circumstances or the individuals in charge.

The type of processes that can be controlled are the *operational processes*[5]. Operational processes are those for which a procedure can be designed to describe how they should be performed.

Therefore, operational processes are completely determined by identified and characterised events or causal conditions, which implies that operational processes are risk-free[6]. Nevertheless, it is widely acknowledged that even the most mechanical and repetitive processes entail some degree of uncertainty, despite the efforts to develop a sound procedure. Therefore, it shall be concluded that truly *operational processes* do not exist.

However, the goal of any operational management system is to minimize the uncertainty of certain processes, which are reduced to the application of certain rules that are previously established in their procedures.

Thus, the functional requirement for any operational management system is to develop and apply procedures that keep key processes under control in the vast majority of cases. These are the *operational procedures*.

Operational procedures ensure that the activities are performed in an orderly manner and without improvisations, regardless of the individuals in charge, and that they achieve the previously set objectives (Castillo Calle, 2014).

Operational procedures outline the responsibilities, the levels of authority, the options for conducting the process, the required training and the acceptable performance parameters (Harrington, 1993).

2.3. How is an operational management system designed?.

2.3.1. Delimit the scope.

The processes most directly involved in generating the product or service must be identified and controlled. Process control may not always be feasible but, fortunately, the key processes of the transport activity can be controlled (Ministerio de Fomento, 2005B).

The processes to be controlled are distributed in activity areas. It is recommended that each one of them has its own process map. The organisations will develop these process maps according to their own specific criteria.

A merchant vessel is the functional unit of a shipping company. The key activity areas that ensure the proper functioning of a vessel include navigation control, cargo loading and unloading, and the repair, maintenance, and improvement of equipment.

The design of a vessel's management system starts by developing the process map for the activity areas mentioned above. The following Figure 1 illustrates a generic process map for navigation control that can be adapted to various vessels.

The map represents the navigation as processes iteration. In turn, the implementation of operational procedures ensures the navigation is conducted in an appropriate manner, regardless of the circumstances or the individuals in charge, i.e., the implementation of operational procedures *controls the navigation.*

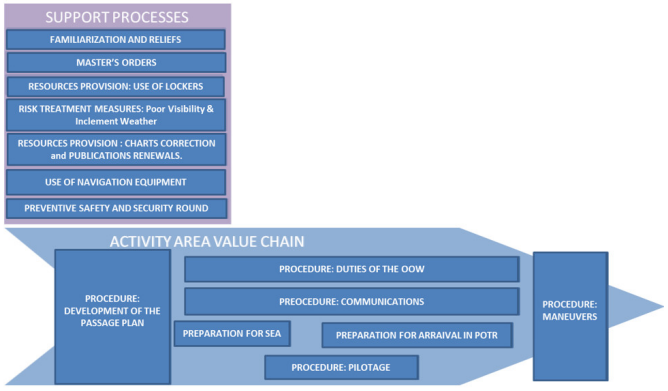
2.3.2. How are operational procedures designed?.

Shipping companies will aim to establish easily auditable standardised procedures. They will also be inclined to purchase

[5]The Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO Rule-Making Process (Organización Marítima Internacional, 2018) define human error assuming the existence of an acceptable or suitable course of action defined prior to the execution of the process. This approach supports the concept of operational process as used in this article.

[6]https://www.juntadeandalucia.es/sites/default/files/2022-03/ManualEvaluacionRiesgos.JA-CTE.pdf. Accessed: July 2023.

Figure 1: Process map for navigation control. Adapted from "Bridge Procedures Guide" by the International Chamber of Shipping (International Chamber of Shipping, 2022).



Source: Authors.

premade safety management systems (Størkersen, 2020). Unfortunately, in areas with high variability this may result in documentation that does not accurately reflect how tasks are regularly performed.

Operational procedures' design should be based on existing knowledge and expertise linked to frequent and significant risk exposure where, ultimately, each operational team is responsible for its own safety (Morel et al., 2008).

Those in charge of operational processes acquire expertise and know-how that must be incorporated into the procedures. The analysis of their knowledge and experiences –and the subsequent continuous improvement of operational procedures– is accomplished through a component of the management system that has yet to be discussed: the improvement cycles.

2.3.3. Improvement cycles.

An operational management system consists of operational procedures and improvement cycles[7]. The latter of which will be described below.

Let us take the process map for navigation control (Figure 1) as our starting point. After arrival at the port of destination, the vessel's Safety Committee [8] convenes to review the performance of this processes during the voyage.

For this purpose, the Safety Committee will consult the records from the last voyage and then formulate improvement actions. These actions may include disciplinary measures, training (retraining), awareness-raising or improvements to operational procedures.

We have described an improvement cycle that reviews navigation control. Its inclusion in the process map [9] results in the creation of two new activity areas: 1) Management Review (MR) and 2) Monitoring, Measurement, and Analysis (MA).

The Safety Committee meetings fall under the first of these two areas. These processes ensure the application of operational procedures, correct deviations, and design and enforce actions to improve them through both corrective and preventive actions.

To complete improvement cycle in the process map, it is necessary to add the second activity area mentioned above. The processes in this area collect information from the operational activities being improved.

In many cases, operational processes' performance is evaluated by MR processes with different authority levels; for example, records describing last navigations, loads or maintenance activities may be assessed on board by the head of a department or the Safety Committee, then reviewed by the ship's Captain and finally submitted to the shipping company. The key element of the success of these improvement cycles is to keep the higher authority levels informed (Chang, 1996).

Figure 2 is the process map for improvement cycles of navigation control. The position of MR processes indicates their authority level. Those at a higher level can demand action from those below, and the lower levels must keep the higher levels informed.

As a rule, the processes in the MR area with the highest authority are those that can enforce the improvement actions that affect documented knowledge. Those responsible for these processes sign the different versions of the documented procedures or technical instructions (TIs).

Improvement cycles ensure that operational procedures become increasingly thorough and that they accurately reflect actual practices. They also address risk management [10].

In the light of the above, it can be concluded that the improvement cycles contribute to compliance with the ISM Code. The work of the improvement cycles generates operational procedures that truly control the ship operations and its risks levels.

2.4. Documented information.

Despite the importance of documented information, it should not become an obsession. As a general rule, it is not necessary

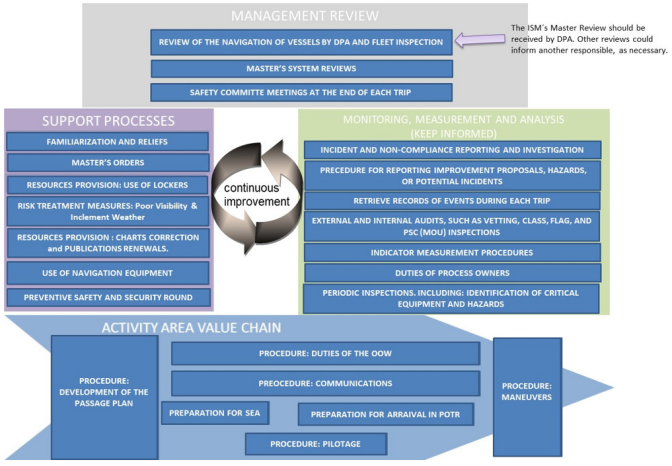
[7]This statement is supported by a comprehensive analysis of the ISO standards for management systems. All these standards share a common high-level structure across all management systems and approaches. This article tailors this structure to the vessel's areas of activity. It is recommended to consult the certifiable standards to gain a comprehensive understanding of the range of ISO standards for management systems. See EN/ISO 9001: 2015 Quality management systems. Requirements. EN/ISO 14001:2015 Environmental management systems. Requirements with guidance for use. EN/ISO 45001:2023 Occupational health and safety management systems. Requirements with guidance for use. Also see UNE 66177:2005, especially interesting in this regard.

[8]Organ cited in the Maritime Labour Convention, 2006. https://www.mitma.gob.es/areas-de-actividad/marina-mercante/normativa/convenio-sobre-el-trabajo-maritimo-2006. Accessed: June 2023.

[9]ISO Management systems standards use this formula to create processes maps that outline improvement cycles. Management review includes both planning and monitoring. Monitoring ensures that what is supposed to be done is, in fact, being done.

[10]Improvement cycles perform risk assessments and design treatment measures that are incorporated into operational procedures. In the risk management approach, also known as "'risk control", the function of the operational procedure is to reduce the risk level of the process to a predefined acceptable value known as the residual risk. This residual risk can be mitigated through continuous improvement of the operational procedures, which is achieved through improvement cycles. ISO 31000:2018 provides recommendations regarding the implementation of this approach.

Figure 2: Process map for navigation control and improvement. Adapted from "Bridge procedures guide" by the International Chamber of Shipping (International Chamber of Shipping, 2022), and the ISO standards for management systems.



Source: Authors.

to document processes or tasks that are well understood and not susceptible to improvement [11].

Documented information helps maintain control over processes because...

- It provides guidance on how the tasks should be performed.
- It eases the familiarisation.

It is also essential for achieving continuous improvement because...

- Documentation requires a thorough analysis of verbal descriptions to ensure their coherence and identify possible inconsistencies. This may lead to a better understanding of the activity.
- Morel (Morel et al., 2008) states that operational procedures are developed based on experience. The improvement cycles document this experience, preventing it from being lost when personnel change.

Once the significance of the documentation has been acknowledged, we can address in more detail the document pyramid on which management systems are based.

Within the document pyramid, we must highlight the importance of technical or work instructions (TIs). These TIs contain information related to certain tasks or equipment that is too long or technical to be included in the main body of a documented

[11] Many authors consider that a process or task is not improved if it has not been documented. Otherwise, following a change of personnel, the improvement is considered lost (Galloway, 2002), (Harrington, 1993)

Figure 3: Documentation pyramid (with the contents of the manual marked in red).

Source: Authors.

procedure[12]. In addition, TIs are the ideal location for the information amended through continuous improvement, especially when the Administration must validate the management system manual[13].

Admittedly, the experienced staff would not need to refer to neither the detailed information contained in the TIs nor the body of the operational procedure. However, it would be misguided to stipulate what should be documented solely according to the needs of experienced staff. It is important to extensively document an operational process to ease the familiarisation period for new or less experienced personnel.

The essential role of *checklists* should also be mentioned. Both Galloway (Galloway, 2002) and the management system of the Universidad Complutense de Madrid (UCM, 2013) consider checklists as reminders of operational procedures.

This raises another key question: Is the existence of a checklist proof enough that there is a procedure in place that eases familiarisation and establishes *control*? Or is it necessary to expand and clarify each point on the checklist with detailed documents, such as TIs?

The answer will depend on the complexity of the process. The workers shall communicate if –when they accepted their current position– they had access to enough knowledge to successfully perform their tasks or if they experienced a period of uncertainty, doubt, and overwhelm.

2.4.1. Documented operational procedures vs. documented non-operational procedures.

There are two types of processes: operational and non - operational. An operational process is executed by implementing the rules of its procedure. Conversely, non-operational processes **cannot have** a procedure describing how to perform it, even though management system manuals do include procedures for them.

This apparent contradiction can be explained by the fact that non-operational procedures merely record certain requirements that the organisation must comply with or chooses to adopt.

[12] See Prevention Technical Note number 560: Preventive Management System: Procedure for Drawing Up Work Instructions. https://www.insst.es/ntp-notas-tecnicas-de-prevencion. Accessed: September 2021.

[13] The Technical Instruction (TI) is a controlled document that is not included in the manual validated by the Administration. The manual only refers the TI Code, ensuring that any changes made to the TI will not entail a re-validation of the manual.

For example, Spanish companies with more than fifty employees are required to have a documented procedure for Health and Safety Committee meetings. This procedure simply sets the composition of the Committee, how to convene it, the frequency of meetings, the format of the minutes... There is nothing in the procedure meant to provide guidance to the Committee on identifying the health and safety issues or how to address them. In other words, this procedure is not a resource for the Committee's decision-making process, as most decisions are not based on pre-established rules.

The Health and Safety Committee meetings are not an operational process. The task of identifying new hazards or potential incidents and developing measures to mitigate the risks they pose cannot be addressed simply by implementing pre-established rules.

The Health and Safety Committee meeting is a process that falls under the MR area of the improvement cycles. None of the processes within this area are operational in nature. Similarly, certain processes within the MA area, such as periodic inspections or the investigation of incidents and non-conformities, are not operational processes either.

The management system manual should distinguish between operational procedures and these other procedures we are now addressing, as they require completely different design criteria.

2.4.2. Recommendations for operational management systems manuals carried onboard.

Every manual begins by stating the policy and objectives that guide continuous improvement. Then, they include the system's description.

Since the operational management system consists of both operational procedures and improvement cycles, it is recommended to include process maps in the manual that clearly represent the improvement cycles and the operational processes that are improved, in addition to the usual list of documented procedures.

Organizational structures are created by hierarchizing organs and titles according to their level of authority –specifically, who has the right to demand action from others–. There are organisational structures that hierarchize the organs and titles that responsible for implementing operational procedures, while others do so for those in charge of improvement cycles.

The manual should refer to the TIs in which the operational knowledge is stored. It should also provide a breakdown of how records are generated, retained, and retrieved, particularly those relevant for improvement cycles.

We have outlined the contents of an operational management system manual carried onboard. However, the drafting of its final version may prioritise different interests. For instance, the manual may be intended to guide the crew's daily operations or to facilitate external inspections and audits.

A crew-focused manual should be structured in such a way that guides crew members from general to specific information, providing an orderly access to all the documented knowledge. The process map should be used as the documentary index for these manuals. Ultimately, these manuals ease familiarisation, control, and improvement of processes, since the knowledge is properly grouped according to each process, i.e. according to the activity to be addressed.

However, most on-board manuals are designed to demonstrate compliance with the ISM Code to third parties. In extreme cases, the table of contents of the manual mirrors that of the Code sections. This approach simplifies the work of inspectors and auditors; however, it may hinder the ship's crew access to documented knowledge in an orderly manner.

A manual written according to the sections of the ISM Code is not practical for the familiarisation of new crew members. Moreover, it could even result in a manual disconnected from the ship's operational reality, a flaw mentioned by Størkersen (Størkersen, 2020) and that we have already discussed.

We are not dealing with a manual designed to explain the system. We are dealing with a document that follows the guidelines of a regulatory body to describe how certain prescriptions have been integrated into the organisation. Take, for example, the Occupational Risk Prevention Plan required by the Spanish Law on Occupational Risk Prevention. This Plan is a document that describes how the preventive activities are integrated into the organisation, but it is not consulted during the execution of the preventive activities.

It is also worth noting that designing separate procedures for the ISM Code and the ISPS Code (International Ship and Port Facility Security Code) is a widespread practice. However, there is no fundamental difference between the maintenance of fire extinguisher and that of security cameras. It is likely that, when assigning these tasks on board, it would often be desirable to have the same person perform them at the same time. Therefore, they should be included in the same process and procedure. Ultimately, the operational reality of the ship does not align the documented procedures.

Conclusions.

This article aims to describe how an operational management system works. In addition, it highlights certain issues that may prevent the ship management systems and their documentation from meeting expectations. Considering the above, the following conclusions can be drawn:

FIRST

Compliance with the ISM Code is achieved through improvement cycles that create procedures to maintain control over operational processes.

Therefore, the Government's verification of the ship's compliance with the ISM Code should focus on...

- Verifying that the operational procedures for the vessel's operations are in place, and
- Ensuring that the improvement cycles are active.

SECOND

Shipboard management system manuals are designed to demonstrate compliance with the ISM Code to third parties. In many instances, the table of contents of the manual mirrors the

sections of the Code. While this manual design approach simplifies the work of inspectors and auditors, it can make it challenging for crew members to access documented knowledge in an orderly manner.

Other manuals, in which the documentary index is the process map, must be designed to replace or complement the existing manuals.

THIRD

Documented procedures should be linked to the processes in the process map, and the process map developed based on how activities are performed on each vessel. Therefore, the list of documented procedures should not be created solely to meet legal requirements.

FOURTH

The full text of the Technical instructions (TIs) should not be included in the manual validated by the ship's flag state. This makes the frequent improvement of the documentation for operational procedures easier for the management system.

A vessel that is several years old should have added many rules to its TIs to assist with decision making. Many of these rules should have been developed on the vessel itself and describe how tasks should be performed in a practical manner.

FIFTH

More often than not, it is obvious that improvement cycles do not work on vessels, except in response to incidents or non-compliances. This may be due to several reasons, such as lack of knowledge about Management Science[14], excessive workload related or not to the system itself, lack of support from top management, an implementation focused on merely generating records, etc.

However, every ISO Standard related to management systems establishes that requirements are achieved through active improvement cycles. A series of small, continuous changes yield great long-term benefits.

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[14]Management Science investigates how business organisations can improve their ability to enact rational and meaningful decisions.