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## **A STUDY OF SAFETY CULTURE IN PASSENGER SHIPPING**

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**Abstract:** In a maritime project, safety culture and safety management in Swedish passenger shipping are studied. The overall aim is to obtain increased understanding of dimensions in maritime safety culture, its effect on safety management and its relation to the International Safety Management Code. This paper presents results from two safety culture studies conducted on two types of vessels. The results showed differences between officers and crew in how safety culture dimensions were reported.

**Key words:** maritime safety, safety culture, safety management

### **1. INTRODUCTION**

The International Safety Management Code (ISM Code) has been developed in order to provide an international standard for safe operation of ships (1). The overall aim of a Swedish maritime project is to study safety culture, safety management, cultural management and port state control in the shipping domain in relation to the ISM Code.

The project is a collaboration by senior and junior researchers from four universities and contains the following sub-projects: 1) Safety and work organization in merchant shipping (Växjö university), 2) Cultural management and safety management in cargo shipping (Luleå university of technology), 3) Safety culture and safety management in passenger shipping (Lund university), and 4) International comparative study of maritime safety regulatory framework provided by the ISM Code and the status of its operation and implementation in the shipping industry (World maritime university and Lund university).

This paper focuses on the third sub-project that aims at studying safety culture and safety management in Swedish national and international shipping industry that includes passenger transport. The main hypothesis is that the safety culture determines in part how well the ISM Code is implemented on board vessels and more importantly, is acted upon, yielding the practical and positive drive toward improved safety in the shipping domain as it is intended to do.

Comparative studies of shipping companies and vessels engaged in the project are being conducted in order to better understand the prominence and influence of the different dimensions constituting a safety culture in the maritime area.

A method developed for measuring safety culture is used in these studies and applied at different levels within the organization on board vessels and in shipping companies. The method is intended to collect valid data that characterize the safety culture such that the results can support changes towards more efficient safety management.

The aim of this paper is to give some results from safety culture studies conducted on one high speed craft (HSC) and one passenger/cargo ferry (ROPAX) operating almost the same route in the Baltic sea and to discuss differences and similarities in these results.

The two vessels constitute different concepts in passenger shipping. The HSC focuses on carrying large amounts of passengers, and the size of the crew varies with the number of passengers. This creates a flexible safety organization. The ROPAX vessel is a more traditional vessel carrying both passengers and cargo (trucks) having a fixed crew in size and safety organization.

The research questions posed are 1) whether safety culture differs in the two study locations (two types of vessel), 2) whether safety culture differs across different levels in the respective work organization on board.

## **2. THEORY**

### **2. 1. SYSTEM PERSPECTIVE FOR CONTROLLING SAFETY**

The safety culture model used in the two studies is based on a system perspective for controlling safety. In a system perspective one is aware that a socio-technical system is divided into levels (politicians, regulators, managers, safety officers, work planners and workers) and that these levels need to have well functioning co-ordinations for safety (2). It describes the importance of strong connections between the levels in the form of goal directedness with feedback, learning and action both within and across levels. Learning becomes a basic principle in the dynamic socio-technical system.

### **2. 2. DIMENSIONS IN A SAFETY CULTURE**

When studying safety culture, a working definition consisting of nine dimensions is used. The definition is described in this section. Learning in an organization is connected with a proactive approach to safety, which concerns having updated knowledge about how the work and safety are functioning. Thus a 1) Learning culture is created where one learns from gathered information and is willing to introduce changes when needed. Learning in an organization comprises creating a 2) Reporting culture where individuals are willing to report incidents and anomalies e.g. faulty work equipment. This is closely connected to a 3) Just culture where a well-balanced blame approach enhances the willingness to give such reports. (A no-blame culture is not realistic.) A Just culture also has to do with defining safe behaviour. 4) Flexibility in an organization concerns the ability to transform

the work organization in order to be prepared for changing demands, e.g. in periods of high workload. It also comprises respect for individuals' skills and experiences. These four dimensions are based on Reason's perspective of a safety culture (3). The other dimensions in the working definition are 5) Communication in daily work, which comprises e.g. a need for and clarity in information, and communication between people and between work groups. 6) Safety-related behaviors comprise e.g. discussions about and encouragement of increased safety. 7) Attitudes towards safety (from both management and staff) concern e.g. commitment to safety. 8) The perceived Working situation concerns cooperation, support and appreciation, and the influence of the design of work. The last dimension is 9) Risk perception, which concerns for example the perceived risk of harming others or oneself, and the experience of having an influence on safety in one's work. The last five dimensions have been used in earlier safety culture research studies and can be found for example in Guldenmund's review article (4).

The safety culture expresses itself in observable outputs as safety management practices (5). Variables such as motivation, knowledge, training and application of resources are therefore also relevant and are incorporated in the above given dimensions. In an early study of safety culture/safety climate performed by Zohar (6) it was found that in activities or enterprises where safety and safety issues were given high priority there existed a strong commitment to safety among top and middle management. Safety training was emphasized and there existed frequent contact between workers and management creating good communication. There were low staff turnover and frequent safety inspections.

### **3. METHODS AND MATERIAL**

#### **3. 1. METHODS**

A methodology developed for measuring safety culture was used in the studies (7). The methodology included five techniques: 1) observations on board the vessels; 2) open interviews with crew members in order to get experience about which risk and safety situations exist in the work on board and to take part in the crew members' experiences of the daily work; 3) a standardized questionnaire comprising the nine safety culture dimensions mentioned above. The questionnaire consisted of 97 questions of which a majority are answered using a five-degree scale (i.e. 'very much, much, a little, barely, not at all', or 'very often, often, sometimes, seldom, never'). A few questions in the questionnaire related both to vessel safety and work injuries. The answers to these questions were therefore divided into two alternatives. The questionnaire was to be filled in anonymously by all crew members; 4) a standardized interview with crew members from different work levels in the deck, engine and catering departments; and 5) collection of facts and statistics about the vessel and its operations.

The purpose of this combined methodology was to gain a multifaceted picture of a safety culture within an activity. The five different methods are intended to confirm, validate and complement each other.

### 3. 2. MATERIAL

This paper presents some results from safety culture studies conducted on one HSC vessel and one ROPAX vessel carrying passengers. The vessels belong to the same shipping company and operate on almost the same route in the Baltic Sea. On board the HSC 33 men and 19 women from a total of four crews took part in the study. On board the ROPAX 46 men and 11 women from a total of two crews took part in the study. The distribution of officers and crew on the two vessels is given in Table 1. In some of the analyses given in the results chapter, the HSC's deck and engine departments were combined into one operations department. The questionnaire survey received response rates of 93 % (HSC) and 80 % (ROPAX). The low drop out rate thus gives a good opportunity to get a representative view of the safety culture in the different organizations.

**Table 1.** The distribution of officers and crew on board the HSC (four crews) and the ROPAX (two crews).

Vessel	Total		Deck		Engine		Catering	
	Officers	Crew	Officers	Crew	Officers	Crew	Officers	Crew
HSC	16	36	8	10	6	5	2	21
ROPAX	17	40	8	15	5	6	4	19

### 3. 3. STATISTICS

For both vessels a number of analyses were conducted in order to see how the groupings of officers and crew reported the different safety culture dimensions. For each individual crew member mean scores were calculated for the nine dimensions using the questions belonging to the respective dimension. Differences in mean safety culture scores between subgroups among the crew were thereafter tested using the t-test (2-tailed).

### 4. RESULTS

Comparisons between officers and crew were made for each respective vessel as a whole and for the three departments on each vessel in order to see whether there existed differences in how safety culture dimensions were reported.

On board the HSC the officers (as compared to the crew) reported significantly more positive (higher mean) scores on four of the nine safety culture dimensions. As compared to the crew, officers reported a more positive view of their Working situation ( $p=.021$ ), more Flexibility ( $p<.001$ ), better Reporting ( $p=.015$ ) and a more positive view of the Risk perception ( $p=.008$ ).

On board the ROPAX, the officers (as compared to the crew) reported significantly more positive (higher mean) scores on eight of the nine safety culture dimensions (Working situation ( $p<.001$ ), Flexibility ( $p=.001$ ), Communication in daily work ( $p=.032$ ), Reporting ( $p=.007$ ), Learning ( $p=.033$ ), Safety related behaviors ( $p=.013$ ), Attitude to safety ( $p=.022$ ) and Risk perception ( $p=.032$ )).

On board the HSC, deck officers (as compared to the crew) reported significantly better Flexibility ( $p < .001$ ). The same result was found on board the ROPAX ( $p = .008$ ). On board the ROPAX the deck officers also reported a more positive view of their Working situation ( $p = .042$ ).

In the HSC engine department the officers, as compared to the crew, reported significantly better Flexibility ( $p = .024$ ). On board the ROPAX no significant differences were found on safety culture dimensions between engine officers and crew.

Using the organizational design on board a HSC, the deck and engine departments were combined into an operations department and analyses were made to get a more complete picture using this combination. Again, officers (compared to the crew) showed better Flexibility ( $p < .001$ ) and better Reporting ( $p = .027$ ).

For both vessels, no significant differences in reported safety culture dimensions were found between officers and crew in the catering departments.

## **5. DISCUSSION**

The results indicate that safety culture differs across different levels in the work organization on board. Comparisons between the total groups of officers and crew at the respective vessel showed that differences existed in how the groups perceived the safety culture. The differences were most pronounced on the ROPAX vessel where the officers had a more positive view on eight of the nine safety culture dimensions. On the HSC the officers had a more positive view on four of the dimensions, i.e. Working situation, Flexibility, Reporting and Risk perception. The many differences on the ROPAX can perhaps partly be explained by its being a more traditional vessel in the sense of it having a more traditional work organization (e.g. fixed in size, fixed structure of the safety organization) and traditional vessel design.

The lesser differences on board the HSC might be explained by it having a smaller crew size, and the crew members therefore being more dependent on each other for the daily work to function well and also in handling emergency situations.

### **5.1. FLEXIBILITY**

One safety culture dimension where differences clearly appeared was Flexibility. On the HSC it emerged in the total group and in all departments except catering. On the ROPAX it emerged in the total group and in the deck department.

As mentioned earlier, Flexibility comprises respect for individuals' skills and experiences on all levels. This could be expressed in such a way that the person with the best insight into a problem, but not necessarily the person with highest rank, can handle and solve the problem when it arises. This is a way of creating an organization that is safer and better prepared for crises.

An explanation for the differences on board the HSC was that more individuals among the crew than among the officers (both in total and in the deck and engine departments) experienced that the personnel's knowledge and experiences were not fully appreciated. In the total group and most visibly in the deck department, it also emerged that the officers (more often than the crew) were asked about how to solve problems that arose on board. This difference did not emerge in the engine department.

The dimension Flexibility was also visible in the deck organization on the ROPAX vessel. The results from the study showed that the crew, compared to officers, thought it was less accepted to make suggestions for change on something that concerned somebody else's area of responsibility. They were less often asked about how to solve a problem on board and they less often experienced that they were encouraged to put forward ideas and suggestions for improvements concerning the work on board.

These differences between officers and crew on the dimension Flexibility might well be due to inherent differences in their work situations. Perceived better flexibility among officers could be natural, considering the characteristics of their work. Whether crew feelings of less flexibility influence safety needs to be studied further.

The physical design of the HSC has had spin-off effects that influenced flexibility. On board a HSC the deck- and engine departments are combined into an operations department. One expression of this is that the engine department has its control panel on the bridge beside the deck control panel. This is in some way revolutionary in the shipping world. The construction of the vessel has led to the overcoming of boundaries between the deck and engine departments. The channels of communication are shortened, the cooperation between the two departments is improved and, as one chief said, it has led to a more open atmosphere. Each department is more dependent on the other in a new way.

A HSC is equipped with a "flexible" crew, i.e. the crew size is adjusted according to the number of passengers. This means that the size of the safety organisation is also adjusted and "flexible". During the visits on board the HSC it was suggested by several crew members from all departments that they believed that this had positive effects on the safety work on this type of vessel, compared to a more traditional vessel. The number of safety exercises was greater and the flexibility in the safety organisation demanded more knowledge on the part of the individual crew member and more cooperation among crew members. The individual crew member must actively think about which safety routines are going to be applied each particular time. This fact they believed prevented routine manners and gave rise to increased commitment in safety work.

On all types of vessels the safety organization is built around the work organization. This fact has a built-in negative effect concerning the dimension Flexibility. For example, a crew member who was a trained nurse in his/her earlier profession will probably not be used in this capacity when a medical emergency arises on board.

## **5. 2. RISK PERCEPTION**

The dimension Risk perception concerns the individual's perception of risk and safety on board. As total groups, the officers on both vessels reported a more positive view of the Risk perception than the crew. One explanation for this result on board both vessels was partly that officers to a greater extent than the crew experienced having an influence on the safety concerning the work on board. This was especially pronounced in the deck department on both vessels. Officers were generally also more positive than the crew concerning the risk for getting injured in work, which perhaps has a natural explanation. This was especially clear in the deck and engine departments on the ROPAX. Still, they believed the risk to be moderate. On the whole, both officers and crew at all departments on both vessels thought the work on board was carried out in a safe way concerning both vessel safety and work injuries. A more negative result, though, was found concerning work injuries among the catering crew. Officers, especially in the deck departments, experienced that the ship was conveyed with good safety margins. On board the HSC officers were somewhat more pessimistic than the crew concerning the existing risk that their work could lead to others being injured. This difference was especially pronounced in the engine department on the HSC. On board the ROPAX the differences between officers and crew concerning this question was not so great.

## **5. 3. REPORTING**

On board the two vessels, a system existed for reporting incidents and anomalies. These reports were sent to the safety coordinator ashore and in severe cases to the National Maritime Administration. Other than this, there existed no organised exchange of information between vessels within the company concerning, for example, gained experiences of incidents and quality of equipment. This kind of exchange of information existed in a more informal way when seamen changed vessels within the same shipping company.

During interviews it emerged that the psychosocial working environment on board to a large extent determined the commitment to safety. It was the crew members and the leaders who set the standard and quality of the safety work on board. They believed the crew's knowledge, attitudes and behaviours in relation to safety determined the safety culture on board.

## **5. 4. METHOD FOR MEASURING SAFETY CULTURE**

A method developed for measuring safety culture is used in these studies. The method is intended to collect valid data that characterize the safety culture in such a manner that the results can support changes towards more efficient safety management. The basic goal is to provide a method that, in cooperation with shipping companies and vessel crews, supports continuous improvements of safety and safety culture and increases participation among the personnel. A long-term goal is the integration of the method into the shipping company's and vessel's safety management system (which are derived from the ISM code) and audit systems.



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