THE ROLE OF STATE-OF-THE ART TECHNOLOGIES FOR DEVELOPING A MODERN ORGANIZATIONAL CULTURE IN MARITIME SAFETY AND SECURITY MATTERS

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Abstract. Ship crews have a specific organizational culture which is formed mainly in the process of education and training. The safety and security aspects of this culture have a key stone role for the career development of the future maritime officers, a fact which is confirmed by the current policy of the IMO. Assuming, on the one hand, that modern maritime personnel education and training relies strongly on virtual environment, and on the other – that maritime safety and security environment (MSSE) remains highly dynamic, hard to predict and is dominated by the inherent subjectivism of the human factor, the question of "Is it possible for high technologies to contribute to the establishment of an organizational culture adequate to the specificity of the MSSE" is of particular interest. On the background of the recent dimensions of the MSSE, the study discuses the "pros and cons" of maritime education and training in a virtual environment and formulates approaches for using state-of-the art technologies for developing a modern organizational culture in maritime safety and security matters.

"Nothing is more practical than good theory"

Professor A. Shutko

I. INTRODUCTION

Performing their duties in a specific environment, ship crews have a specific organizational culture which is formed mainly in the process of education and training. The safety and security aspects of this culture have a key role for the career development of the future maritime officers, a fact which is confirmed by the current policy of the IMO. Assuming, on the one hand, that modern maritime personnel education and training relies strongly on virtual environment, and on the other – that maritime safety and security (MSS) environment remains highly dynamic, hard to predict and is dominated by the inherent subjectivism of the human factor, the questions of "Is it possible for high technologies to contribute to the establishment of an organizational culture adequate to the specificity of the MSSE" and "Which aspects of the crew's organizational culture are subject to formation through simulations" are of particular interest.

Before discussing the "pros and cons" of maritime education and training in a virtual environment and formulating approaches for using state-of-the art technologies for developing a modern organizational culture in MSS matters, it is necessary to present the particularity of the ship crews' organizational culture.

This approach, in turn, is to be based on proper definition of the term "organizational culture".

II. DEFINING THE TERM "ORGANIZATIONAL CULTURE"

It should be noted that a diversity of definitions for "organizational culture" exists currently. The major part of the definitions is focused predominantly on the psychological aspects of the collective functioning

of the organizations. Classically, this type of definitions associates the organizational culture with collective knowledge and presents it as an "organizational opinion", an aggregation of commonly adopted beliefs which are reflected in traditions, habits and even - in more tangible forms: existing "legends", symbology, and some items of the traditional organizational equipment and products. The more significant the interpretation in the organizational functioning, the more tangible the organizational culture's attributes [3, p. 39].

Despite the correctness of such an approach, of more important interest for the study is the "systematic" aspects of the term "organizational culture".

In this context, the definition given by Edgar Schein provides a suitable basis for studying the particularity of the ship crews' organizational culture: "*a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems*" [4].

It is appropriate to make some additional explanations.

Classically, the organizational culture is considered to be a "derivative" of the structure of a system. It means that the specific trends of the structure are reflected by the peculiarity of the organizational culture. Taking into account that the structure is a "dialectic trinity" of the structural aspects: the composition, the connectivity, and the relations, the organizational culture is influenced by the three structural aspects. In this context, two conclusions, a theoretical one and a practical one, are of importance for the study:

The theoretical conclusion is that the organizational culture is formed spontaneously and relatively independently of the system designer's will.

The practical conclusion is that the peculiarity of the organizational culture is to be considered to be a result of the specific trends of the structural aspects and logically – in any case of a particular organization the organizational culture is to be studied on their background.

As far as the practical conclusions concern the next part of this paper, let us turn our attention to the spontaneous formation of the organizational culture. One question is of particular interest: "Does the organizational culture emerge relatively independently (and some time – in defiance) of the system designer's will, what is the purpose of the organizational culture?".

The "bearers" of the organizational culture are the system's components. In fact, the organizational culture reflects their motive to withstand (or to overcome) the inner system dynamics and the possible unpredictability of the interaction. In this context, the organizational culture serves the purpose of achievement and maintenance of inner system stability and it is a result of the typical for any system "aspiration for negentropy (negative/counter entropy)".

The most appropriate way of system stability achievement relies on:

- institutionalizing the connections and relations;
- prioritization of the alternative connections;
- standardization of the relations among the system's components.

Taking into account that the "bearers" of the organizational culture are the system's components, the practical dimension of these three directions of system stability achievement is the understanding that organizational culture is a "general protocol" for interactions among organization's components in the process of the organization's purpose orientated functioning.

Assuming such an understanding, we can go further and state: although a single system's component is the "guardian" of the adopted organizational culture, its real "beneficent" is the collective (or – the organization) as a whole. Being relatively subordinated to the functional aspect of the system, the structure generates the organizational culture as a specific tool, serving the purpose of managing the

possible fluctuations in the system functioning. In other words – consciously or not, the organizational culture supports the process of system adaptation but not each of its aspects. Something more – in many cases adherence, to outdated traditions and routinism could impede the organization from adapting to the dynamics of the environment.

It is of particular interest, which the supported by the organizational culture adaptation aspects are.

Firstly, the emergent nature of the organizational culture suggests that it needs time to "sift out" alternative protocols of interaction and to establish traditions. This fact prompts the following conclusions:

- the organizational culture is an attribute of "mature" organizations;
- the environment of functioning in a relatively static (smoothly changeable[1]) and/or to its dynamics – of changes possesses cognizable cycles;
- the goal (goals) or the process of system functioning possesses repeatable trends or activities.

Summarizing the conclusions, we have to recognize that the organizational culture brings for optimization and the idea of adaptation is to preserve the routine performance of an organization in cases of "replacement" of components.

The next aspect of adaptation supported by the organizational culture is related to the potential emergency of "improper" behavior of a system component. The problem in the case is what behavior is considered to be "improper". Basically, any deviation from the routine (when such a routine is applicable) is classified as being irregular. In similar situations, the organizational culture supports adaptation to internal processes of instability by the way of not tolerating deviations and suggesting mechanisms for their compensation.

Without claiming completeness in studying the correspondence between the organizational culture and the process of adaptation, one more aspect is to be mentioned: the preserving nature of the organizational culture. Being a kind of "a general agreement signed by the system's components that proves the status of dynamic inner organization equilibrium", preservation of interests of individuals (components) is inseparable part of any organizational culture. In this context, the organizational culture supports adaptation by achieving conformity between the individual and the collective interests (motives, behavior, etc.).

The last two discussed aspects of correspondence between the organizational culture and adaptation are of significant importance for the study. In fact, these aspects bring for "an inherited" contradiction in any organizational culture – the contradiction between, on the one hand, lack of tolerance to any deviation of the routine behavior, and on the other hand – the guaranteed level of individual component freedom. Taking into account that the organization contacts the environment through its components, balancing these two contradictory aspects of the organizational culture makes the component to perform their personal adaptation to the environment in conformity with the collective interests. To a high degree of certainty we can state that the organizational culture brings for the maintenance of a dynamic equilibrium between inner stability and the flexibility necessary to adapt to the dynamics of the environment.

Obviously, the organizational culture strongly influences the functioning of the organization and especially – the process of its adaptation. The consciousness of this fact makes the organizational culture subject to deliberate formation, maintenance and improvement.

Before answering the question what the particularity of the ship's crew culture is, let us summarize the results of studying the theoretical aspects of the organizational culture in the following conclusions:

The organizational culture in its peculiarity reflects the specific trends of the three structural aspects: the composition, the connectivity, and the relations.

[1] Smoothly changeable environment means that the dynamics of changes follows a cognizable rule (set of rules).

In spite of its spontaneous emergence and relatively high degree of subjectivism in the process of formation, the organizational culture yields to deliberate formation, maintenance and improvement. The idea in this process is to achieve better collective performance

Aiming to achieve internal stability, the organizational culture is directly related and consequently – dependant on the following organizational aspects:

- professionalism of the personnel;
- cohesiveness of the team;
- established relations among components and especially – subordination, and distribution of responsibilities;
- established routine strategies of organizational functioning.

One of the aspects of organizational synergism is based on the organizational culture: ability to achieve adaptation of the whole system to the dynamics of the environment as a result of component's processes of adaptation.

III. STUDYING THE PECULIARITIES OF SHIP CREWS

When speaking the ship crews, the first peculiarity emerges in the very beginning of the discussion – the maritime environment. Not intending to go deeper in this temping topic, let us say that this trend of the maritime profession is so important that it dominates almost any other characteristic.

Keeping in mind the paramount role of the maritime environment, let us focus our attention on the structural aspects: the composition, the connectivity, and the relations.

Starting with the crew's composition, the following conclusions are valid:

- the crew is composed by a great variety of members possessing high degree of narrow professional skils;
- the crew as an organization is limited in its ability to "replace" components due to the limited "reserve" of human resources;
- the abilities to substitute a crew member is restricted in number and in time;
- performance of a great variety of great variety of different ship typical functions insists on different structural realizations based on a constant composition.

In summary, the components (crew members) are to be highly prepared not only for their position, but also – for the positions that they are to perform as substitutes. Obviously, the well known idea for standardization of the maritime personnel education and training is absolutely valid in this case.

There is one more trend of the crew composition – the rotation of crew members. As it is mentioned above, the organizational culture needs time to be established. Obviously, we can't afford the luxury to loose time in assembling the crew after any replacement of a crew member. Two requirements are expedient:

1. The new member is to be highly professionally and psychologically prepared for his position.
2. The crew has to be made not to suffer the substitution.

The first requirement concerns the overall process of education and training including their regular maintenance when the person is not on board.

The second recommendation has an additional psychological aspect. A good idea is to establish a standard behavioral model for every position. Being to a high degree standard and unbiased, the education and training in virtual environment can contribute for the purpose.

The fact that nowadays most of the crews are international, additionally advocates for the idea of establishment of standard behavioral models. The real challenge is the question if it is possible the professional education and training to modify and superstruct the basic cultural trends (nationality, ethnicity, etc.).

The peculiarities of the organizational culture concerning the relations among a crew are multidirectional.

The most typical relations among the components are:

- highly developed hierarchy;
- clear distribution of the responsibilities;
- cohesiveness.

Although a variety of methodologies for education and training are focussed on the development of these qualities, one more challenge for the education and training in virtual environment is to be noted. It is the inherited contradiction between the degree of subordination and the cohesiveness. In fact, this contradiction is similar and closely related to the contradiction already mentioned – the lack of tolerance to any deviation of the routine behavior and the guaranteed level of individual component freedom. The differences are that in the case of subordination and cohesiveness, relations are formally established and are very often marked by strong personal nuances.

Let us conclude that there is one more argument for establishment of standard behavioral models.

The question of how the organizational culture reflects the connectivity is another multidimensional problematic field. One of its aspects is of particular interest. Being an organization that is to perform duties in potentially extreme conditions, in addition to the cohesiveness, friendship, accountability, etc., this type of functioning of the centralized structures strongly relies on the following ideas:

- maintenance of a firm chain of command;
- availability of duplicating connections for informational exchange;
- existence of bypassing connections for informational exchange.

In terms of the informational exchange, the real challenge in the case is the elaboration of a proper protocol for using the connections and adherence to the protocol[2].

Obviously, these problems can be solved by education and training, but it should be noted that they have already mentioned behavioural aspect.

In conclusion, let us summarize and say that there the peculiarities of ship crews formulate three specific areas in maritime education and training (E&T):

- Professional training.
- Team building.
- Establishment of behavioural models.

Before discussing the pros and cons of using modelling and simulations in these areas, let us provide our understanding about the question of how the organizational culture and maritime safety and security are interrelated.

IV. BRIDGING THE ORGANIZATIONAL CULTURE AND MARITIME SAFETY AND SECURITY

Taking into account that any study should not be a "closed" system and it is appropriate, on the one hand, to consider existing knowledge, and on the other – to lay a basis for future research in the area, it is a good idea to address two papers, published in the Proceeding of the 8th and the 9th Annual General Assembly of IAMU.

While discussing the methodological issues of preparing and conducting computer-assisted exercises on maritime safety and security matters and drawing a parallel between, on the one hand, the short-term, long-term and the evolutionary aspects of system adaptiveness, and on the other – the maritime safety and

[2] The problem in the case is that the bypassing connections establish shorter way for informational exchange. In spite of being useful in cases in emergency, the "time-saving" bypassing connections very often do not support the established chain of command.

security E&T[3], we use the brilliant metaphor provided by Professor Donna J. Nincic for explaining the difference between the safety and the security concepts: "*safety is doors open to allow free access for escape or rescue in a dangerous or unsafe situation. Security, on the other hand, is doors closed to prevent access to those who might wish to do us harm*" [2, p.147]. On this base, "*the security can be considered protection from active malicious agents*" and "*safety, on the other hand, can be considered protection from accident, maritime casualties...*" [2, p.147]. As it is formulated earlier in the paper, the organizational culture supports adaptation by achievement conformity between the individual and the collective interests (motives, behavior, etc.) and, in fact, the organizational culture brings for the maintenance of a dynamic equilibrium between inner stability and the flexibility necessary to adapt to the dynamics of the environment. Combining, on the one hand, the difference between safety and security concepts, and on the other – "the inherited" contradiction in any organizational culture (between lack of tolerance to any deviation of the routine behavior and the guaranteed level of individual component freedom), we can say that the safety supports the interests of the components, but the security supports the interests of the system as a whole. In fact, one of the aspects of the organizational culture is that, on the background of the safety end freedom of components, the security of the whole system emerges. In other words, the organizational culture "transforms" the individual safety of components into overall system security.

V. DEVELOPING ORGANIZATIONAL CULTURE IN MSS MATTERS THROUGH MODELING AND SIMULATIONS

Using the new technologies, modeling and simulations play a significant role in contemporary education. Because of its advantages, the education in virtual reality has to respond to bigger demands to simulating complexes, trainers and simulation models that have to be reproduced. Simulation is an instrument which helps us to understand the dynamics and the behaviour of systems. A simulation uses a model which is designed for this purpose. Some important characteristics of a model are purpose, relationship between model and original and reduction of complexity.

Models are substitutes of an original for defined, understanding and acting model-using subjects (intelligent systems) within defined time frames and by restrictions on given mental or real actions. The most determining principle of the purpose is that models are developed and applied in order to fulfil given goals or motivations.

Either a model is seen as a representation of its original, or is seen to be a prototype for a future construction. Thus there is a certain relationship between a model and its original in reality or between the future construction and its model in reality. The generation of models is a directed process in time and the model-original relationship can be subdivided into two aspects – representation of the original or prototype for a future construction

Using modeling and simulation in educational sphere has lots of advantages. They may be subdivided in two groups: advantages for the organization and educational advantages.

Advantages for the organization:

- better performance in live exercises and real incidents;
- train any time, anywhere without using operational resources;
- use existing training and exercise curricula, scenarios and play books;
- safe (no need for safety officers) and non-polluting;
- low training costs.

[3] For more information see: Mednikarov B, Dereliev P. and K. Kalinov. *Methodological issues of preparing and conducting computer-assisted exercises on maritime security matters.* Proceeding of the 9th Annual General Assembly of IAMU, San Francisco Maritime Academy, San Francisco, October 19 – 22 2008. ISBN 978-0-615-25465-4, pp. 289 – 302.

Educational advantages:

- powerful learning environment with the opportunity to experiment;
- creation of exactly the scenario circumstances needed;
- capture video clips and screen shots to use in courseware;
- training staff will have a full control over the exercise and after action review;
- observation and scoring should be structured and objective.

Integration of M&S in educational field allows going beyond the theoretical recognition of processes and phenomena and going ahead to obtaining of practical skills.

Despite the advantages, the use of simulators possesses some disadvantages.

The first is that simulation deals with manipulation of great number changeable characteristics of determined model of existing system. There are factors with uncertain relations with the whole system. This fact makes them impossible to include in the model.

The next can be determined as follows: It is difficult to create an intuition in educated and emotional sense that using simulations is aimed to determinate relations among different changeable model's characteristics.

Simulation research, [1] like any other research method, also suffers from problems and limitations. The value of simulation findings rests on the validity of the simulation model, which frequently must be constructed with little guidance from previous work and is prone to problems of misspecification. Simulation work can be technically demanding and susceptible to errors in computer programming. The data generated by simulations do not represent real observations, and the techniques for their analysis are limited. Also, it is risky to attempt to generalize simulation findings to areas of the parameter space not examined in the simulation.

In order to decrease the negative factors of simulators it is necessary to improve their performance to achieve realistic reproduction of simulation models and environment conditions.

A part of questions related to the use of modeling and simulation for increasing the level of organizational culture of ship crews are related to creation or building of behavioral simulating models that include personal characteristics and practical habits demanding adequate operational requirements by simulators.

The purpose of using modeling and simulation in this area is the creation of homogeneous environment of maritime personnel with logical and predictable level of competency able to integrate in crews with different stage of organizational culture.

From organizational culture definition follows that organizational culture has two main parts. The first is crew's adaptation to environment and the second is internal crews' integration.

When we talk about adaptation onboard we can subdivide it in three groups: professional adaptation, organizational adaptation and adaptation of crew members in extreme situation.

The methods available for improving adaptation include using agents, control theory, game-theoretic methods, or more ordinary model-related operations-research algorithms. The methods may be deterministic, stochastic, or a hybrid of the two. They have to be compared in order to be chosen the best method or combination of methods.

The adaptation relates on sub models that represent decision-making by officers; sub models that adjust simulated strategy and tactics in relation with objectives, situation, and projections; or sub models that represent, the behavior of individuals in different conditions.

The professional adaptation is related to building professional skills and work habits. It has close relation with degree of correlation between real and virtual environment and fullness of simulation model used in

process of education and training. In this way, the more characteristics of environment are reproduced, the more knowledge and skills will be accumulated in the trainees.

In relation with the last we can think about integration of simulators and damage control exercise trainers.

If we create such a virtual ship it will be a prerequisite for the realization of the second component of organizational culture – integrity of the crew members for solving common tasks.

In relation with organizational culture aspect related to integration in organization additional explanations have to be made.

Applying system analysis to ship crews, we will notice that this is a complex system divided in different levels. As an example, we can distinguish officers and seamen, senior and junior, bridge team and engine room team etc. On war ship, things get even more complicated. The reason is the bigger number of crew members and appearance of new organizational groups. In this sense, we have to investigate internal integration not only in horizontal and vertical direction but also among the different levels.

Every one of the interacting subjects can form personal values, behavioral style and in this way it is possible to create a counterculture in contradiction with the existing and approved values and approaches.

In this case, a sub model can be created for every group or models representing two or more subjects.

The next aspect of the use of new technologies, modeling and simulations is related to multicultural environment. When we analyze organizational culture, we understand that one of the most important parts of organizational culture is the cultural features of crews' members. In today's merchant marine, most ships have international crews. This fact is a prerequisite for the formation of organizational culture with complex structure, internal system relations and processes.

The models representing this environment have to be flexible and they can provide descriptions of both physical and human phenomena, including situational awareness and environment conditions.

In this case M&S can be used for creating and testing organizational culture models. By way of changing the different model characteristics, we can make a conclusion about the behavior of the particular crew in different situations. This fact can be used in investigation of processes of crew's adaptation in critical situations.

Both internal integration and crew's adaptation can be improved by way of increasing the time spent in simulators.

Most questions related to increasing level of organizational culture can be solved by applying organizational measures. In order to mitigate one of the biggest disadvantages of simulators related to understanding that this is a game and whatever we do has no harmful consequences for us, personnel and ship are to set a requirement for obligatory examinations in simulators. In this case the goal of the trainees will be excellent performance to pass an examination and step ahead to successful realization in real world.

The next aspect of using state of the art technologies is related to the use of educating technologies in virtual environment.

The educating model in Bulgaria is a model based on class-lesson system. This model has lots of well known disadvantages. They are group education – it is impossible for a teacher to follow all his students, active teacher and passive students-it means that teachers teach, students listen, bad students-teacher correspondence, etc. In this model the goals of students are absent. [3, p.12].

Using present educational forms such as lectures does not correspond to our expectations. Educating technologies place the results in front of student instead of the teacher. In the base of such a model are international conventions and national educational requirements. This model puts the students in the active position. They have to do a determined job that will result in the formation of educational goals. It means that lessons, lectures and consultations will be a means of reaching results, not a goal.

The educating model allows education to be represented as sequence of procedures which will be planned for every person.

VI. CONCLUSION

Computer simulation [1] can be a powerful way to do science. Simulation makes it possible to study problems that are not easily addressed, or may be impossible to address, with other scientific approaches. Because organizations are complex systems and many of their characteristics and behaviors are often inaccessible to researchers, especially over time, simulation can be a particularly useful research tool for management theorists.

Simulation analysis offers a variety of benefits. It can be useful in developing theory and in guiding empirical work. It can provide insight into the operation of complex systems and can explore their behaviors. It can examine the consequences of theoretical arguments and assumptions, generate alternative explanations and hypotheses, and test the validity of explanations. By relying on formal modeling, simulation is in the base of scientific progress.

The new technologies allow simulators to be built in way that demand following of specific organizational culture.

Increasing the time spent by cadets in simulators will contribute to the formation of organizational culture adequate to the dynamics of life at sea.

References

[1] Harrison J., Lin Z., and G. Caroll. Simulation modeling in organizational and management research. Academy of management Review, Vol.32, 2007, № 4, pp. 1229 – 1245.

[2] Nincic1, D. "Maritime Security Education and Training: Establishing a Learning Community and Framework for Program Goals and Outcome". World Maritime Excellence. Odessa, 2007.

[3] Petrova, A., Strategic management. Piter. Sankt Peterburg, 2005.

[4] Schein, E. Organizational Culture and Leadership, 3rd Ed., Jossey-Bass ISBN 0-7879-7597-4.