

## The VTS System in Maritime Transport

Alireza Naseri<sup>1</sup>, RaminVafaei Pour Sorkhabi<sup>2,\*</sup>, Omid Giyasi Tabrizi<sup>3</sup>

<sup>1</sup> Department of Civil Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran

<sup>2</sup> Department of Civil Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran

<sup>3</sup> BS student of Civil Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran

Corresponding Author's: RaminVafaei pour sorkhabi

**Abstract:** this regard, questions about the real situation of the collected, recorded, processed and analyzed information to support decision making in the field of maritime safety and environmental protection, are asked. These questions should be understood in an effort to "conceptualization" of the world that cannot be objective and as long as there is not sufficient transparency in realizing similar concepts and not appropriate assistance (including technical cooperation, political, administrative, etc.), complete potential of marine vessel traffic control information systems, will not be released. In this regard, the data analysis is necessary to ensure value judgments in data collection and interpretation and providing an effective basis for decision-making fully understood. Recently, VTS capabilities significantly have changed and have become a multi-functional tool. This is due to the technological advances and social expectations. This paper has conducted to investigate the factors influencing personnel performance in activities that are carried out in marine vessel traffic control center and in this regard provides an interactive model. Also, providing of an effective way to deal with factors affecting the performance of personnel who are dealing with the issue of marine vessel traffic control is other objective of the paper.

[Alireza Naseri, RaminVafaei Pour Sorkhabi, Omid Giyasi Tabrizi. **The VTS System in Maritime Transport**. *Life Sci J* 2013;10(6s):597-603] (ISSN:1097-8135). <http://www.lifesciencesite.com>. 94

**Keywords:** VTS function, attitude, values, beliefs, interactive model, functional model, the human element, interactive conceptual method.

### 1. Introduction

Interaction between man and machine is a concept that if we don't pay attention to it can cause problems on the efficiency and effectiveness of the activities carried out by a machine.

The political, legal, and technological complexities on the one hand and on the other hand, the differences in perceptions, attitudes, beliefs and human values have significant impact on the effectiveness of decision-making in marine vessel traffic system (VTS). Development of legislation in recent years in the fields of safety, marine environmental protection, maritime security, etc in national and international scales, considerably have added the volume of business navigation process and number of peoples who work in marine vessel traffic control centers and in this regard, we can see increased rules based on safety in the international community, especially the IMO that, essentially, they address the human factors that are involved in the affairs. Therefore, in group works, due to a lack of the same understanding of the raised issues, there are some uncertainties, which in turn are substantial. In this regard, questions about the real situation of the collected, recorded, processed and analyzed information to support decision making in the field of maritime safety and environmental protection, are asked. These questions should be understood in an effort to "conceptualization" of the world that cannot

be objective and as long as there is not sufficient transparency in realizing similar concepts and not appropriate assistance (including technical cooperation, political, administrative, etc.), complete potential of marine vessel traffic control information systems, will not be released. In this regard, the data analysis is necessary to ensure value judgments in data collection and interpretation and providing an effective basis for decision-making fully understood. Recently, VTS capabilities significantly have changed and have become a multi-functional tool. This is due to the technological advances and social expectations. This paper has conducted to investigate the factors influencing personnel performance in activities that are carried out in marine vessel traffic control center and in this regard provides an interactive model.

Also, providing of an effective way to deal with factors affecting the performance of personnel who are dealing with the issue of marine vessel traffic control is other objective of the paper.

### 2. New functions of marine vessel traffic control (VTS)

Although in the early years of marine vessel traffic control, safety of vessel traffic and efficiency of navigation was its main objective, but the importance of the marine environment has been started from 1980s and today importance and paying attention to the marine environment has high sensitivity.

Recently, the issue of terrorism has added a new dimension to the discussion of the proper administration of shipping. There is no doubt that marine vessel traffic control, in accordance with International Security on Ports & ships (ISPS) Code, plays a role in promoting security in its covered range of control. In these cases, including, the role of safety duties, navigation performance, marine environmental protection and maritime security which significantly increases the data needed on the ships as well as the operator workload in VTS centers and confront them with difficult tasks which should respond the information that is now coming in many ways. This is reminder of a story about a rural man that he was going to market with his quadruped to sell his product. On the way to the market he saw that the animal had hardly walked under heavy load. As the sun came up and the weather get warmer and warmer, the man felt that his quadruped could not walk and it is difficult to go on. Also there was a steep slope in front of them to the market. The man who was careful about his quadruped, decided to take some of the load from the quadruped back and lay on his own back. After taking the load, he was ride on the quadruped and kept on walking.

This simple story tells us that the upgrade could be useful in giving aid but if it was not properly planned, other affairs can be prevented.

Providing information, including information from the equipment on the ship or from land based VTS centers, can be appropriate to fill the ship navigation officer's gaps in information to perform his duties that have some limitations. Today, reducing the number of crew members to reduce costs, commercial pressures and competition between providers of maritime transport service has led to the reduction of traveling time. On the other hand, strictly setting rules and adjustments based on the requirements of the conventions and benefits of the ship personnel is causing some kind of conflict. Questions that should be asked in the process of preparing the VTS information include:

- 1) What type of information is needed?
- 2) How should the information be collected?
- 3) When and in what form information should be available?
- 4) How should be data processing, analysis, prioritization and management?

These questions have been seriously plagued people who do navigation health activities.

This is not surprising, since it lies in the nature of human efforts to be better confronted with the world about it. This means we continually seek to improve our understanding of the world with collecting information to improve our knowledge from the world which we live in.

To understand this, we do conceptual study on the human knowledge in the process of maritime safety which is described as follows:

Here the question is that: how do we understand we know? In other words, how we know that our actual knowledge is to what extent? In this case, is there something like the "net" data or observations "purpose"? So far, science has been unable to give a clear answer to these questions. If we put two scientists together, they will be discussed forever on components of "data" and this is because of the lack of "net data" or "pure data". Perhaps it is better to pay attention a little deeper into the science of sociology that interprets the surrounding world. But we can never take a step back from our perception and interpretation from the world. Attempting to do so is such that we get out of the human condition, while it is impossible.

Sociology scientists say that we must accept the society and moral dimensions of knowledge. They believe that knowledge is always a product of experience and people being lucky and unlucky that would be visible based on human values system such as beliefs, emotions, etc.

In other words, we are dealing with the knowledge that forms the concept of everything existing in our minds (What that sociologist scientists call "involuntary movement").

We need to understand and feel the world around us, so that we may be able to interact with the subject.

Usually, different people come together in working environment that each of them has their own personalities, beliefs and values. Some of these beliefs and values are the same for all in the area where the work is done but some others are just personal and unique.

Beliefs and values of the people determine their attitude and influence on their perception. These shape the most important part of the personality of each individual. In order to we have a proper and efficient working environment for VTS personnel; we must identify and understand the factors that affect the behavior of individuals and note that various people that have come together in an environment, every one of them have their own personality and experiences that determines their behavior in the environment (such as marine traffic control center).

Here the question is that what factors affect on comprehension (understanding) of human? To answer this question, first we investigate principal components influencing human behavior.

### 2.1. Perception

Perception is the internal process through which the human selects (choices), evaluates and organizes his senses stimulating factors to understand their world (understand). Humans constantly are bombing

by external stimuli while only a small fraction of these stimuli are perceived or used. What people are understanding and interpretation of this is done through the following:

- 1) Culture, previous experiences, attitudes and modes that these are called understanding (perceiving) properties.
- 2) The conditional concept of the goal that should be perceived. These are called status properties.
- 3) Symptoms that are sent from the target are combined with status properties and are interpreted based on individual needs and experiences. Many people may look at the same thing and see something totally different. What is causing these different perceptions?

To answer the above questions, the main factors that have led to a different understanding of a subject by different people and are discussed here are:

- 1) Selective perception: the tendency to select the information that supports our vision.
- 2) Perceptual defense: the tendency to protect ourselves from bad things (to avoid).
- 3) Effect of the first encounter. The trend that we desire what we have seen at first.
- 4) Effect of novelty: Tendency or desire that we are affected by what we have seen recently.
- 5) Halo effect: The trend that a dominant feature is extended to all.
- 6) Effect of Gestalt or holistic: The tendency to combine data and provides an overall pattern.
- 7) Projection effect: The trend that gives characteristics to people based on our sense (prehensile).
- 8) Implicit personality theory: The trend that behavior of others be interpreted based on the people view.
- 9) The effects of stereotyping: The trend that is extended to the group of people, regardless of their differences. Because humans are generally lazy in terms of cognitive and the stereotyping is the shortcut to reach the desired goals and sometimes stereotyping can be helpful for us because some guidance on expectations. For example, stereotyping about age can help us about expecting a baby at a specific age. But we must be careful, because there are always expectations. So thinking stereotypes often leads to unrealistic discrimination and differentiation between individuals. We must learn how to use stereotypes and move beyond stereotypes in order to more realistic perceiving of people.
- 10) Self-fulfilling prophecy: We understand the issues based on expectations before they

occur, (Understanding and interpretation of what they will do). The following example makes this clear:

“An experiment has performed in which the subject is explained very well. Two classes A and B were assigned to teaching by a teacher.

The talent of the students in both classes was similar. The teacher was told that pupils of class A are smarter than class B. The teacher knew (understand) that students in class A are really smarter than class B. Therefore, he/she worked with them in a different way. At the end of the year the scores of students in class A were higher than class B. As a result, the teacher perception from class A and his expectations led to more effort in Class A and finally, the scores of students in the class A were better than other class.

### 2.2. Attribution

Attribution is a process in which we try to interpret and explain the events that happen in our lives. Attribution is everyday people theories. Observations and events are related to each other. First time, researcher called Fritz Heider noted that the behavioral attributions to internal and external factors are linked.

- a) Attribution to internal factors: Attribution to personality, spirit, intelligence, health status, attitudes, or even a genetic tendency, is called attribution to internal factors.
- b) Attribution to external factors: Attribution of behavior or causes to the environment out of the person is called attribution to external factors. Behavior is judged by three signs. These signs include:
  - 1) Distinction: Are there different behavior for a particular situation?
  - 2) Stability: is it stable during treatment?
  - 3) Consensus: whether the act is done by other people?

All these means is that positivism is unexpected. There is not any great theory or one-dimensional science to encompass all affairs but instead we face the multiple concepts of a fact. These subjects are very important for activities related to marine traffic control being well understood and activities and behavior of those associated with navigation safety processes being correctly assessed.

The subjects that include VTS activities, particularly, efforts and attempts to retrieve the "right kind" of the information related to the safety, efficiency, protection of the marine environment and navigation safety, appropriate emergency response, etc.

In this regard first we should be aware of the strong relationship between knowledge and power. As

everyone has their own interpretation of the world, perceptions, inevitably, will be occasional in conflict (or are). However, this does not mean that these differences can not have a solution.

Secondly, due to the different viewpoints, it is necessary to get acceptable solutions (valid) that explain the nature of these differences. Hopefully we can convince others of our point of view or at least force them understanding about where the subject has originated. This subject highlights the matter of "Value Theory" that is pointed out as following:

### 2.3. Value theory in performing the activities

As previously mentioned, we can not abandon our values and beliefs even if they were not important. Because it means that we are separated from ourselves (humanity), which is an impossible task. Our values are important. The question here is that: how much these values are important for us? These questions when we take our own opinions or decisions and when we are challenging with others are more notable and it may be that those who have strong values and beliefs can convince (persuade) us. Thus, a value viewpoint is not just a personal taste. Taste is concerned with what work is appropriate for person. Like running in the park instead of practicing in gym club, sleeping on a firm mattress sleeping on a soft bed, drinking coffee instead of drinking tea, etc. The taste is so subjective that it really can not be argued. Conversely, it is possible to we have a rational discussion about the specific value viewpoint of the world around us. For example, is the traffic of vessels in a particular situation considered safe or not safe? Or in general; is the vessel traffic safety provided?

To answer this question we must first be able to determine the criteria (that has led to recognize safe or unsafe conditions) used in our decision. Detailed results of the study show that navigator officers are not necessarily following consistency with the available information. Instead, they have apparent willingness to accept some ambiguity and effectively follow dealing with ambiguity through negotiation. Nevertheless, observation of potential demoralization of mariners is not difficult, as they often are bewildered finding a way to work in information technology.

Sociologist scientists provide interesting insights on the implications of knowledge based on the community information in public morality.

One of the sociologists suggests that the emphasis of current society to science, specialized knowledge and technology, has undermined people's sense of identity.

Other researches show that people who regularly check their mobile messages or surfing the internet are affected by behavior disorder (non-voluntary). People who entertain themselves in this way can not convince

themselves to press the power button and these people acquire lower skills, and can not access the high level skills and may eventually reach a point where they can no longer adapt the situation.

### 3. Factors affecting the performance of individuals

Here it is appropriate to discuss the factors affecting the performance of individuals and determine relation of factors with regard to the behavior of individuals.

#### 3.1. External factors

External factors refer to factors that are applied from outside of the working environment and affects on employees. Supervisors and managers are not able to control these factors. Employees must adapt themselves to external changes. Such as heat and cold, inclement weather conditions, etc.

#### 3.2. Internal factors

Internal factors are related to the area where the employees work. These factors divide in three categories of: software, hardware and humanware (or brainware).

- 1- The software factors include information of directions, maps, etc.
- 2- The hardware factors include environment that people are working there (ergonomics), equipment, technology, etc that are given to employees for doing tasks.
- 3- Humanware or brainware includes factors such as technical and professional abilities of employees, the power to do work, knowledge, experience, training, education, personality, aptitude, motivation, emotional-mental needs, attitudes and attitudes and behavior of bosses.

As we know, the main operating factors of technology and equipments are peoples as the operator, supervisor and manager in VTS. There are two aspects in the implementation of works: practical aspect and usefulness. The one that humans can adapt themselves with working, is the practical aspect. They may do their job, but they may have not motivation to work and is likely to do work and be happy doing it. In this regard, successful employees should be encouraged and also make opportunity for other people to develop their motivation. To motivate and keep peoples in jobs such as marine traffic control, separate studies should be conducted.

### 4. Conception in communications and its role in the performance of personnel in the VTS

Good communications in sea-based activities (such as VTS) and having skill in verbal communication are very important in effective performance. Good flow of information is considered

such as blood in body in every system that a work is performing there. In other words, all the parts are fed. Good communications for desirable performance in the work environment is considered the most valuable activity in the management of maritime affairs. When communicating with others, message passes from the conceptual refinement and then communication is established. Due to these refinements, there is a tear at each stage of the communication process, like saying "I know you think you understood what I said, but I'm not sure what you heard is what I meant" shows these refinements. Language is one of the factors affecting communications and conceptual refining. Given the facts above and the importance of effective communication in navigation, and safety of ship communication with the shore and vice versa, ship to ship, and necessitates the accuracy, simplicity and unambiguousness of messages on the ship.

However, messages should be free from any errors or misunderstanding in the transmission of concept from the sender to the receiver. This necessitates the use of a standard language. Generally, any communication has three elements.

If any of the above three factors can not be able to play its role, the relationship will be incomplete and a part of the message will not be sent.

Several obstacles can be between the transmitter and receiver of the message. One of them is the lack of proper perception of the message by the receiver. In other words, the message that transfers through conversation and other ways should be understandable to the recipient and language plays a key role in this regard. To resolve this problem, achieving a common language in the field of marine communications, that the message communicates mainly verbally and through VHF radio, is inevitable.

### 5. Application of automation technology in VTS

Today, technology increasingly provides the possibility of using automation in the VTS centers. Manufacturers of automation emphasizing that it reduces workload, increases savings and improves maritime safety. While automation may play a role in reducing accidents but it does not necessarily reduce the VTS operator error.

There are three aspects of automation functions:

- 1- The automation that it's the main part is based on software. Such automation functions only depend on the programmers and designers. In other words, automation performance depends on the true recognition of effective automation components by the planner.
- 2- People who use the automation they must know its potential use and, more importantly, be aware of the limitations of the automation.

Awareness of the limitations of automation is very important in the users' final decision.

- 3- Users should consider automation as a tool to aid and not assume it a manager. They should not allow automation to make decision.

Approach to the use of automation should consider users as the basic elements that have thought, decision, analysis, interpretation, etc. Finally, in automation design, human capabilities should be considered fully and prevent human limitations such as uncertain monitoring and falling into the trap of making decisions. VTS users trust the equipment in the VTS center that provides the traffic image in the area covered by VTS, while the equipments trust information received from the radar data, AIS (Automatic Identification System) and other means of receiving information to determine a target in the area to track and monitor with accurate received information.

VTS equipment manufacturers have conducted experiments with a variety of displays. As a result, they have provided the use of several displays having complex interfaces.

Today SOLAS Convention has determined standards for radar stationed on the ships in the world although there is no standard on the VTS radars. VTS operators believe that it is necessary that the use of hardware equipments should be easy, simple and convenient (User Friendly). Also the use of softwares should be considered to be easy, simple and convenient for operation.

Applying human factors engineering in the construction and arrangement of equipments, reducing risk, reducing training requirements, reducing equipment maintenance costs, providing information for the operators to perform their tasks effectively, ensuring correct and safe operation, operator training, equipment maintenance and increasing operator intrinsic satisfaction (human factor), all this is carried out by considering the followings:

- 1- User requirements
- 2- Display placement
- 3- Human-computer interface
- 4- Legibility
- 5- Background color
- 6- Information display
- 7- Multi-media system
- 8- Feedback

In equipment design, manufacturers are trying to adapt and meet the needs of system users. This occurs by investigation of the matters that must be carried out and by considering employees abilities as final users. Fortunately or unfortunately (depending on the angle from which it is seen), all men have not equal

capability and their capabilities vary considerably from person to person, so how manufacturers attempt they could not always provide satisfaction to all. In fact, what that makes the interaction between the operator and the equipment is software, or better say software program (such as the relationship between the operator and the equipment in VTS center). Technology has provided the possibility of using automation to the marine industry and limitations are also created. The technology is so effective and provocative that can not be taken from the VTS operators. There is possibility of system failure (equipment) in VTS, as there is the possibility for human error. Humans have flexibility, consistency, creativity and adaptability to automation and the humans have the ability to react to changes and unforeseen circumstances. Automation in VTS world is defined as a system or device that has taken over a part or all of the tasks that were previously performed by the operator. For example, a computer software program automatically provides the ability to track ship traffic while all of the previous track or plotting, were done manually.

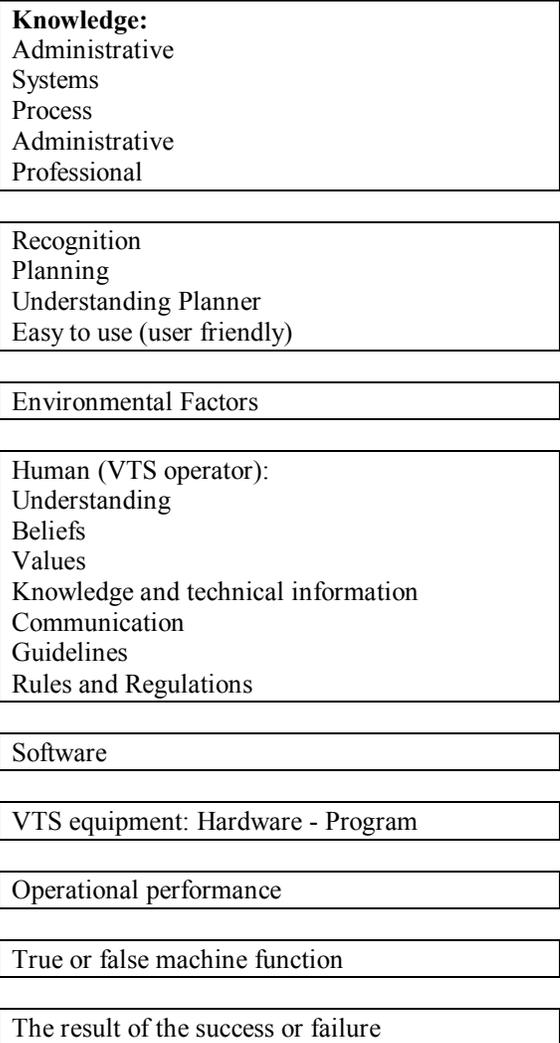
The automatic tracking has its own limitations and is not a perfect tool for this purpose. For example, it is necessary for VTS officer to ensure constantly monitoring and track conditions of vessels. Basically it is VTS officer that uses the automation information and uses it to analyze the situation. Automation is generally well designed and it will work to the extent that the program is correct. If the inputs be false, the results also will be incorrect.

**6. Conceptual model of the interaction of man and machine in VTS function process**

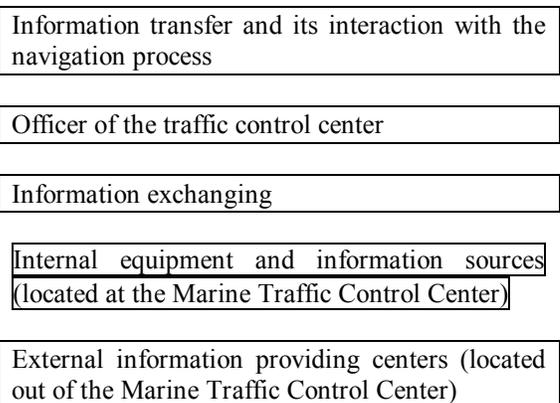
Figure 2 shows conceptual model of the interaction of man and machine in the VTS activities. This model offers factors influencing on human and factors influencing on the system (equipment).

From human aspects, many components and variables are affecting the employees and ultimately performance of the personnel that recognizing each of them can be effective in removing the obstacles. From aspects of the machine (system) factors, hardware and software are affecting factors that in terms of hardware, increasing the performance of the system in environmental conditions and software program that make system intelligent that in this regard, proper planning is important. By the planning that will be considered in software, defines the relationship between humans and system and covers the factors that are most relevant to the understanding of human abilities and equipment.

**Fig. 2. Conceptual model of the interaction of man and machine in VTS**



**Figure 3 - Functional model of human-machine interaction in VTS**



## 7. Conclusion

The main purpose of a VTS in any maritime region is creation of satisfaction and balance between safety and efficiency of navigation. Human links this ring (VTS operators continually, make adjustments and improvements without safety negligence, to achieve the desired performance).

Knowledge of the factors influencing human performance and identifying its components will help planners, managers and administrators to better manage the VTS authorities in maritime traffic control systems (VTS). Considering the issues that can be reduced or eliminated with proper planning may be very important in improving employees in VTS.

Human resources are the key to doing all activities in the VTS centers. It is highly desirable to provide information as required but if it was too much information, not only it will not improve the efficiency and effectiveness of VTS but it will provide slowness and inefficiency. Further studies are conducted on human errors that arise due to a deficiency or absence of the following:

- 1- Effect of sleeping on staff performance
- 2- Food and its quality on staff performance
- 3- Mental fitness for work, mismatch between the recognition and the practice of mental and behavioral disturbances.

- 4- Vision Error in performing duties.
- 5- Effect of resting on personnel performance
- 6- Software, hardware, peripheral and software environment and liveware effects on the performance of VTS personnel.

## References

1. Friedman, M. (1996). *Type A Behavior: Its Diagnosis and Treatment*. New York: Plenum Press (Kluwer Academic Press).
2. Jenkins, C.D., Zyzanski, S.J., & Rosenman, R.H. (1971). Progress toward validation of computer-scored test for the type A coronary-prone behavior pattern.
3. Man-Machine Integration, for Better or for Worse, by Aline Ae Bievre VTS 2004 Hong Kong.
4. Human Factors in Vessel traffic Services (VTS) by Captain Terry Hughes, VTS 2004 symposium.
5. *Rezaeian. A. 1372. Organizational Behavior Management, Publications School of Management, Tehran University* (in Persian).
6. Mirsepasi, N. 1385. *Strategic Management of Human Resources and work Relations*, Mir Publication, Tehran (in Persian).
7. Journal of Ravesh. No: 110. November 1386.

4/11/2013