

Effect of modern bridge equipment on officer attention

**Identification and consideration of the problem of the
influence of technology on human attention**

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Abstract

This study attempts to analyze the complex relationship between technological sophistication and officer concentration. Drawing on human factors and marine research, I try to understand the nuances of the dynamics at play. Through analysis of qualitative interviews and literature review, this study aims to contribute to research on the presence or absence of technology's influence on human attention in the maritime industry. Regarding human factors, one article, "Is Google Making Us Stupid?" Nicholas Carr on the topic that our attentiveness is deteriorating due to the constant use of all kinds of gadgets (laptops, computers, smartphones, etc.).

Possible solutions to this problem will be presented based on the results of the interviews and literature analysis.

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1 Introduction

The motivation for this study was the fact that with the development of technology, people have increasingly come to rely on modern technologies without even knowing about their accuracy or reliability. The same will happen in the maritime industry. Now this trend is not very noticeable, since there are now a lot of officers of the “old school” who are not so susceptible to this. However, it is only a matter of time before this problem becomes relevant as more and more young officers enter the industry. On the one hand, they have been accustomed to gadgets since childhood and do not doubt their performance and reliability (which is a misconception). On the other hand, with the tendency of the maritime business to optimize the number of people on the team, officers are burdened with a huge number of additional responsibilities, and the introduction of new technologies and greater automation of processes make their work easier. cope with the assigned tasks. I would also like to note that this study is aimed at providing research information in this area.

The objectives of this study are:

- 1) A study of the presence or absence of distraction among officers in connection with the presence of modern equipment on the bridge.
- 2) Analysis of relevant literature.
- 3) Interview of respondents and their possible solutions to this problem.
- 4) Review and analysis of the respondents' answers for a possible solution to the problem.

The relevance of this work lies in the fact that with the development of new technologies and their increasing introduction into our daily lives, people began to increasingly trust and rely on technology. However, even the most advanced systems can fail, so the officer on watch should constantly monitor the situation. Of course, there are systems for “attracting the attention” of an officer on duty, but they are too primitive and the officer can quickly get used to their “activation” and develop a reflex to turn them off.

1.1 Basic concepts about attention

Human attention. Attention is the concentration of consciousness on any phenomenon to the exclusion of other stimuli. This is the process of selectively focusing on a particular aspect of information, regardless of whether it is considered subjective or objective. Also, the concept of attention itself is divided into four more parts that we use in our daily lives: selective attention, divided attention, sustained attention, and executive attention.

The selective attention definition is the act of focusing on a particular object for some time while simultaneously ignoring distractions and irrelevant information. Selective attention is also known as controlled attention, directed attention, or executive attention. Divided attention is the ability to pay attention to two tasks at once such as cooking a meal while talking to a friend or driving a car and talking to a passenger at the same time – neither activity is stopped in order to carry out the other activity. Sustained attention refers to the ability to maintain attentional focus on relevant stimuli with repeated presentation over extended periods. Vigilance tasks are the prototypic procedure used for measuring sustained attention. And the half-second component is executive attention, the attention necessary to reconcile conflict among simultaneous attentional demands. However, for ease of understanding, I will use the term attention as the totality of all these four components. It is also worth considering the factors that directly influence a person's attention. There are controlling factors that influence attention. These are external factors that usually depend on the characteristics of the stimuli. They can be classified according to the nature of the stimulus, intensity and size of the stimulus,

contrast, change, variety, movement of the stimulus, etc. Intrinsic factors influence attention through interest, motive, etc. Attention may be attracted to loud sounds, bright lights or strong odors. Repetition is a strong factor in attracting our attention because a person can ignore stimuli if they happen once, but cannot if they happen repeatedly.

1.2 External factors influencing the officer's attention

Attention is an integral feature of every officer, especially on a night watch, when the entire ship is under the control and supervision of the officer. And how a decrease in attention to work can affect this. Lack of attention will reduce your productivity as you will undoubtedly switch between tasks more often, leading to interruptions and increased cognitive load. This leaves us feeling mentally exhausted, leading to decreased productivity and even sluggishness at work. The officer's inattention itself can be caused by a variety of external factors. For example: Lack of sleep can lead to decreased attention, slower thought processes, and decreased concentration. You will find it harder to concentrate and may become confused. Emotional states or missing family and friends may also have an impact. Another core can be called cognitive load. Task complexity and information processing demands can influence attention. Officers who have high cognitive loads, such as juggling multiple tasks at once, may have difficulty maintaining attention. Also, the time of day can affect an officer's loss of vigilance. Circadian rhythms and the body's natural sleep-wake cycles can affect alertness levels at different times of the day. Officers working night shifts may experience periods of decreased alertness. Weather conditions affect officers' attention. Weather conditions can create various problems affecting visibility, mobility and safety, and many other factors. Therefore, the officer's attentiveness is under constant strain.

1.3 Examples of current solutions to lack of attention

As I mentioned above, this problem is widespread. This is especially evident among young people who grew up with gadgets and are accustomed to trusting and relying on them. Therefore, manufacturers of various devices, especially those used in transport, must carefully develop systems and precautions, which in turn will control a person, in particular his concentration on the situation around him. For example, many automobile companies have experienced decreased attention when using modern technologies, when using Autopilot. Let's look at Tesla and how its engineers dealt with driver inattention when using Autopilot. Here are some solutions:

Driver Monitoring System (DMS). Tesla vehicles are equipped with a driver monitoring system that uses cameras to monitor the driver's attention. It tracks head and eye movements to determine whether the driver is paying attention to the road. If the system detects a lack of attention, it can issue a warning or disable Autopilot until the driver engages again (Nuno, 2021).

Visual and audible alerts: Autopilot provides visual and audible alerts to encourage the driver to keep their hands on the wheel and remain engaged. These warnings are intended to ensure that the driver is prepared to take control of the vehicle if necessary.

Progressive disengagement: If the driver ignores repeated warnings, Autopilot can disengage and stop the vehicle. This is a safety feature that prevents the driver from relying too heavily on the system without actively monitoring the road.

Extended Call Restrictions. For features like Enhanced Summoning, Tesla has put restrictions in place to ensure the vehicle can only be called under certain conditions and within the driver's line of sight.

The above mechanisms are aimed at involving a person in the process itself, so that nothing happens in the car without the driver's attention. This is done both to remove partial responsibility from the autopilot of the car and for the safety of motorists. Since no system can work without interruptions.

1.4 The influence of work experience on officers' trust in equipment

Another important factor in the impact of modern equipment on an officer's concentration is his or her age and experience at sea. On the one hand, it seems obvious that the more experience in the sea and age influence the attentiveness of the officer. On the other hand, as mentioned earlier, officers with more than 20 years of experience at sea are less likely to overly rely on modern technologies than younger officers. Because they are used to working without these innovative systems and have developed habits over time. For example, when maneuvering in an area with not very busy traffic, "old-school" officers often manually (visually, coming to the bridge wing) check the situation behind the ship. However, it is not uncommon for young officers to simply look at radar and electronic maps before a maneuver. This reliance on traditional methods by more seasoned officers can be attributed to the extensive years of practical experience they have accumulated throughout their maritime careers. Having navigated through various situations and challenges, they have honed their observational skills and developed a keen sense of situational awareness that goes beyond what modern technology can provide. Conversely, younger officers, having grown up in an era dominated by advanced technology, tend to place a higher level of trust in electronic systems. They may find it more convenient to rely on automated tools and digital interfaces, believing that these technologies offer a more precise and efficient means of navigation. However, this dependence on electronic aid can sometimes lead to a potential loss of the holistic awareness that comes from combining technology with traditional methods.

2 Purpose of the thesis

As already mentioned in the introduction, the problem of the presence of the effect of modern equipment on officer's attention becomes more relevant as ship systems improve and modernize around the world. Of course, at the current level of automation of ship systems, this problem does not seem significant, since quite a large part of all support is carried out by a person in one or another to a different degree. However, with the current rate of growth of the world economy and progress in modern technologies, this problem will become more pressing in the near future. Therefore, there

is a need to develop some rules or guidelines for officers to reduce the number of accidents due to human inattention. This study will present the results of interviews with both already working officers and students who have graduated or are just graduating from special educational institutions and their opinions on solving this problem.

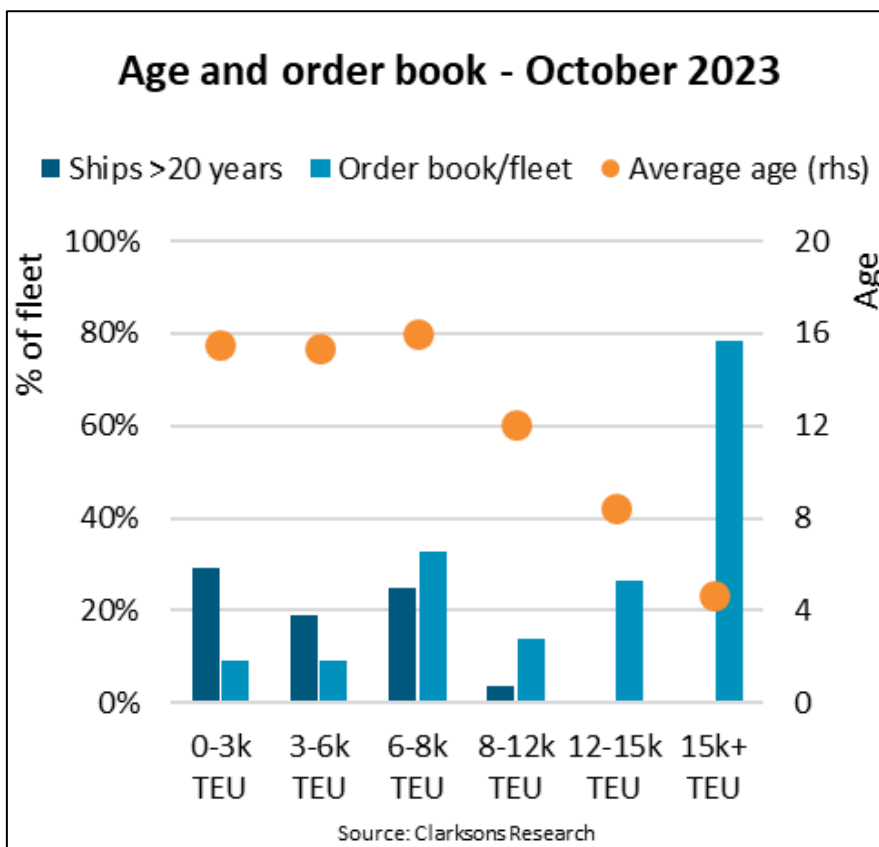
3 Research Methodology

Prior to the participation phase, additional literature review was performed to identify major themes, concepts, and gaps in current knowledge, and to identify boundaries with regional research. This literature review represents the first step in formulating interview questions, providing insight into prevailing issues, controversies, and areas requiring further research.

A descriptive literature review was conducted to establish a basic understanding of the extent to which modern bridge instrumentation may influence bridge officer alertness, with a focus on the technical focus. Although the literature review was undertaken to understand the current state of knowledge in this area, more specifically the criteria for equipment influencing mindfulness, as well as how other industries are tracking and combating this trend. To simplify the selection of useful information, number of respondents will be interviewed. A survey may be considered, especially given the increase in online surveys that are “seeing global changes in research design” (Kumar et al., 2021). Kumar et al have identified the risks of web surveys, particularly the issue of coverage bias. Let's say a researcher wants to know officers' opinions about the impact of modern technology on their alertness while on bridge watch. In this case, the quality of Internet on deep-sea vessels is “described as poor and often expensive” (The Mission to Seafarers, 2023) and will be a barrier to completing the study. Based on the above reasons, surveys will be conducted in person, directly with the respondent. Both active officers with at least 14 years of work experience, and students (who are in the last stage of their studies or who have been working for at least 2 month after graduating from university) will be interviewed. This will allow us to compare the predisposition of these two groups to be overly trusting of modern equipment. After conducting a sufficient number of interviews, an analysis of the data obtained will be carried out, more specifically, a review of the presented solutions to this problem, which were provided by the interviewees themselves, will be carried out.

4 Literature review

An officer's attention can be influenced by a huge number of factors, such as fatigue, weather, workload (the ship is unloading/loading or going to sea) and many hidden reasons. The officer's alertness is also affected by the equipment located on the bridge. To begin with, the Finnish merchant fleet has a downward trend. According to analysis (Statistics Finland) for 2021. Namely, "The next newest are tankers with an age of 15 years and ro-ro cargo ships with an age of 17 years relative to the gross tonnage. "Which correlates with the global aging of ships, in particular container ships. The article "BIMCO: Container ships reach highest average age on record of 14.2 years" (The Editorial Team, 2023) provides statistics on the age and size of container ships around the world (see the figure 1.).



The figure 1. shows the average age of the container fleet and the order book.

Following the trend of increase in the size of ships, which is confirmed by the following studies: “The new wave of container ships: Bigger? More sustainable?”(Carles Rúa, 2022) and “Ship sizes are increasing – are waterways keeping up with development?”(Finnish Transport Infrastructure Agency, 2022). Which affects the condition of the equipment on the bridge, which becomes more advanced due to increased demands from large and new ships . The functionality of the equipment on the bridge is a priority factor for the officer on duty, and it also affects his/her concentration. Which in turn results in the fact that the officer on the bridge has to devote more effort and attention to checking the instrument readings and verifying their accuracy. However, the fact is that judging by the studies listed above, a fairly large percentage of ships are very old. This means that within a certain period of time, a large number of civilian ships will be decommissioned, but since large global companies are currently focused on increasing the size of ships, the old ships will be replaced by a smaller number (relative to their current volume on 2023) of new ones. This increases the number of ships with advanced equipment on the bridge, which can cause a lack of attention. Also added to this is the fact that the generation of

old-school officers is beginning to decline due to the fact that current officers are retiring. This observation is confirmed by an analysis from the Splash247 (Bergeron, 2018) portal from 2018. It says that "After analyzing certifications issued by the Liberian Registry since 2000, here is what we found: 1)The average age of a Master has held at 47 years old. 2)The average age of a Chief Engineer has increased by two years to 49 years old. 3)Engine and Deck Ratings' average ages have increased by five and six years to 40 and 39 years old respectively. 4)Both Deck and Engine Officers of the Watch have seen their average ages decrease by one year to 34 and 36 years old, respectively. 5)In the offshore industry, averages are also increasing, with the exception of the watchkeeping engineer officers, which have seen a significant decline from an average age of 47 to 39 years old. The percentage of seafarers aged 55 and older has grown. In 2000 they represented 4% of the work force – by 2015, they were 11%." There is also a gradual decline in the number of students enrolled in educational institutions. This trend has been observed from 2020 to 2023 at 4% annually, judging by the analysis from the website (Statistics Finland). Based on the factors listed above, we can conclude that there will be a sharp generational transition, that is, a generation of officers who had work experience of 20 years or more will retire , and in their place will come a new generation of officers who are more inclined to trust the equipment and lack those “habits” that would help them raise the level of attentiveness on the bridge while on watch.

4.1 Study "Human attention in digital environments"

I would like to start with the fact that there is no word yet on this topic about the problem of deterioration in the attention of officers on the bridge while on watch due to modern equipment, since this is a fairly new topic because the technologies of the recent past were not so autonomous and portative. For this reason, officers could not rely on them as much. For example, AIS (automatic identification system), according to the work (AIS in a Historic Perspective. A History of the Identification of Ships.) "...in 2000, the Automatic Identification System (AIS) became an obligation on board of ships falling under the IMO Safety of Life at Sea (SOLAS) Convention. It took fourteen years of

discussions before the decision was taken to use AIS as the one and only identification system.»), we can also add that only by 2010 the most commercial vessels operating on the European Inland Waterways were required to fit AIS. Another example is ECDIS. According to the IMO article "...in 2009, IMO adopted further amendments to regulation V/19, to make mandatory the carriage of ECDIS. The amendments entered into force on 1 January 2011, making ECDIS mandatory for new ships built after set dates and also phasing-in the requirement for existing ships". There are also many other examples of the adoption of advanced technologies at that time, which have now become commonplace and a mandatory factor on the bridge. It turns out that all these innovations were adopted quite recently. Based on this fact, we can conclude that there is currently very little research on this topic due to the novelty of the phenomenon and its "invisibility." Since this phenomenon is only beginning to appear now, for the reasons given above. To understand the essence of the phenomenon, let's start with analysis of human attentiveness. What is its purpose, logic and what factors may negatively affect it. A lot of work has been done on this topic. However, I paid attention to a study from the University of Cambridge "Human attention in digital environments" (Roda, 2011). In my opinion, this study seemed interesting because it touches on the topic of human attention in the digital environment, which is exactly what modern officers face. This study touches on concepts such as: "Human attention and its implications for human-computer interaction", "The management of visual attention in graphic displays" and "Salience sensitive control, temporal attention and stimulus-rich reactive interfaces". I would like to look at each concept in order. The first concept says the following: "Users are often interrupted, they switch between the contexts of different devices and tasks, maintain awareness about the activity of distant collaborators and manage very large quantities of information. All this results in high cognitive load that may hinder users' overall achievements." which is very similar to the workload of an officer on the bridge, since he/she has to switch between different devices and tasks while on watch. The following is a proposed solution to this problem, which sounds like this: "Attention allocation can be used as the proxy that both reveals and guides interactions enabling us to build attention-aware systems" (Roda and Thomas 2006). These systems recognize that attentional processes play an important role in many of the problematic situations faced by users of digital environments and aim at reducing information overload, limiting..." . Such systems (BNWAS) have been used on bridges for a relatively long time

and are a mandatory feature (IMO RESOLUTION A.686(17) dated 6 November 1991). For example, a standard sound notification every 30 minutes or, as for example on the Haag ship, a motion sensor is used, that is, if no movement is observed at the control table for 12 minutes, a sound notification is triggered, but if it was not acknowledged, then the notification is triggered in the captain's room cabin. Such notification systems are still being developed, as mentioned above. However, they are quite easy to deceive or get used to them and develop a conditioned reflex. Based on this, we should look for more "smart" systems that could adapt to the situation and be more flexible.

4.1.1 "The management of visual attention in graphic displays"

The section: "The management of visual attention in graphic displays" talks about the characteristics and techniques that were used and the types of attentiveness. I want to delve into the paragraph "Attentional coercion". This section explains the operating principle of coercive displays. Which in turn can help solve the problem of information oversaturation, for example electronic maps. Since the operating systems of different ECDIS can change from year to year, changing various functions and their location (in the settings ECDIS or on a monitor screen), then problems arise with constant retraining to new systems (even from the same manufacturer). The study says the following: "Given that the visual experience of an observer depends on the coordination of attention, and given that this coordination is strongly affected by what is shown to the eyes, the possibility arises of coercive graphics: displays that coerce attention to make the observer see (or not see) a particular part of a display in a natural way (Rensink 2002b, 2007). In essence, the mechanisms that manage attention in everyday seeing are 'hijacked' to control the viewing experience of the user." That is, a similar principle can help with displaying exactly the information that an officer needs at a given moment in time. For example, an officer can preset certain conditions under which certain information corresponding to a certain situation will be displayed on the monitor. Therefore, he/she will not have to in a hurry to look for the right settings for each individual situation. This is also stated in the study: "In any event, successful coercion could result in an observer

always attending to whatever was needed by the task at hand. Apart from a general improvement of performance, such coercion might also be useful for specialized populations. For example, it might assist those users who have difficulty sending their attention to the right item at the right time" , "...potential application would be soft alerts that would not disturb existing attentional control..." .

4.1.2 "Salience sensitive control, temporal attention and stimulus-rich reactive interfaces"

This topic fits very well with my research, since the bridge officer has to perform various tasks simultaneously, not only related to working on a conventional computer, but also other tasks. As I mentioned earlier, we are well aware of the different types of influences on a person's attentiveness and concentration. However, this does not apply to absent-mindedness due to the influence of "computer technology", due to the fact that the phenomenon is relatively new. Here I would like to touch on this topic again. According to a study from Harvard University "The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review" it is said that "...the overwhelming volume of information available can lead to information overload, complicating the decision-making process and potentially causing decision paralysis (Eppler and Mengis, 2004)...". Which in turn perfectly describes the work on the bridge, especially during difficult sections of the route or busy traffic. In the study "Salience sensitive control, temporal attention and stimulus-rich reactive interfaces" this problem and its solution are touched upon. Author of the article "Human Attention in Digital Environments" Claudia Roda suggests using her system as an example in helping students learn, depending on their condition. The researcher says: "A typical example of affective computing would be an intelligent tutoring system that modulates its tuition according to the student's emotional state, e.g., curious, fascinated, puzzled, frustrated or anxious. For example, the system might regulate demands on the student according to their level of anxiety;" .Which, in turn, can be used in the software of the BNWAS (Bridge navigational watch alarm system) to better recognize the state of the officer on the bridge. This system will be more flexible in the perception of behavior and the degree of fatigue For

example, this assistant can analyze the officer's position on the bridge (at the main control panel, in the office on the bridge or on the couch) and analyze his actions based on the location. The assistant can also monitor the officer's gaze, where it is directed. For example, if the assistant observes that the officer is looking at the phone for a very long time and does not take his eyes off it or takes his eyes off it for too short a time, then the assistant can give a signal to the officer. And it will not be as "predictable" as current models. For example, pressing the alarm button every certain period of time or a motion sensor that can react to the movement of clothing or any foreign object in its "field of vision", and not to the officer.

In addition to this topic, I want to examine the research topic "Attention-aware intelligent embodied agents". In this topic, I examine what are some important aspects of physical objects that attract users, and what is the fundamental agent control technology that brings these objects to life? By physical objects, I mean virtual avatars for the assistant AI. Then the author breaks this question into two components: the first, what characteristics should this virtual avatar have to better attract and retain the user's attention. And the second question is to describe the attention control agent technology underlying the implementation agent interface.

Since, in some sense, an "AI assistant" is already present on the bridge. However, it is divided into many devices that are located on the bridge, for example: ECDIC, radar, various indicators of the state of the main engine, pumps or waterproof doors. On the other hand, in my opinion, it would be more rational to divide the AI assistants into: the one that monitors the state of the people on the bridge and the one who monitors the state of the systems, to avoid overloading the assistant AI. Next, I will consider the assistant AI in the role of BNWAS. The study says: "...the use of the word 'doctor' calls to mind associations with intelligence, knowledge and expertise and therefore engenders user confidence." In this example, referring to Fogg (2003), the names Disk Doctor and Win Doctor, associated with the Symantec Norton Utilities products, were considered.

Also, the author argues that the visual similarity of the avatar to a living person also helps to better attract a person's attention to the avatar: "the authors have found that whether the embodied agents are realistic, anthropomorphized or cartoonish, users expect a high-quality human-like connection." Hogan (1996) also argues that: "...the best

way to be believed is to have coherent or congruent verbal and nonverbal communication".

That is, returning to the AI assistant as a BNWAS, here we should focus on the "non-visual" aspects of improving attention, which is the behavior and voice of the AI assistant. The author of the study claims that when using a voice, a person memorizes the message better and is more receptive to information communicated confidentially by the avatar. Based on the study by Hogan (1996) the confidence exhibited by a person according to vocal attributes. As an example, he cites an option where the avatar is a woman, Hogan recommends lowering the frequency of her voice by one octave in order for the voice to be perceived as more professional. According to the study, women who had high-frequency voices are considered as weak and boring. With a male voice, Hogan recommends doing a similar operation by lowering his vocal frequency by half an octave in order to make it more powerful and respectable. These studies should be taken into account when developing an AI assistant system. Since, often the officer on the bridge will be rely on information transmitted by voice, because it is much faster to perceive while doing other work at the same time.

4.1.3 Basic characteristics of the AI assistant

Here we gradually approach the technical implementation of the AI assistant system. Claudia Roda (Roda, 2011) states the following: "To reduce the complexity of directing embodied agents, the set of instructions determining their behavior must be restricted to a small number of commands." However, to be sure of the efficient communication, the AI system behavior must be able to adapt to the context of the conversation. That is, you need to make a list of voice commands that the officer will give to the system. Also, a set of key phrases can be sewn into the system program by which the system will understand what exactly the officer is asking for, if he has not said verbatim the command that is recorded for this or that actions. The author herself comes to these conclusions: "Defining several levels of directives is a good solution to this problem that allows variations in the sequence of actions at different stages: (1) choosing

an intervention script; (2) using scripting language commands ; (3) implementing actions corresponding to a command". You also need to take into account the ease of handling a script language to write a test for the system. For example, the author suggests using languages based on the XML format. One of the advantages she cites is that script languages are based on This format could work well with animation, as well as a feature running in a background application, such as JavaScript code on a web page or for text or audio commands, which suits our system requirements exactly. However, in the study, the author says that the method using an embodied agent, in our case the system, may have a problem when the system interferes with the process in which the user controls the machine. The author says: "...considered as a working or learning tool, a new human-like interaction may have a negative impact...", this is especially acute when the goal is to change the user's attention focus. And also like other parts of the user interface, system interventions must be "approved" by the user and should not consider them an intrusion in a software environment they are used to. This part of the research doesn't quite apply correctly to my "proposed" AI assistant system, as it should have some freedom, particularly to be able to intervene and attract the attention of an officer if it deems it necessary to avoid an emergency. The author further states the following: "However, the risk of irritation is higher than with standardized elements that are more easily adjusted for consistency with the rest of the environment".

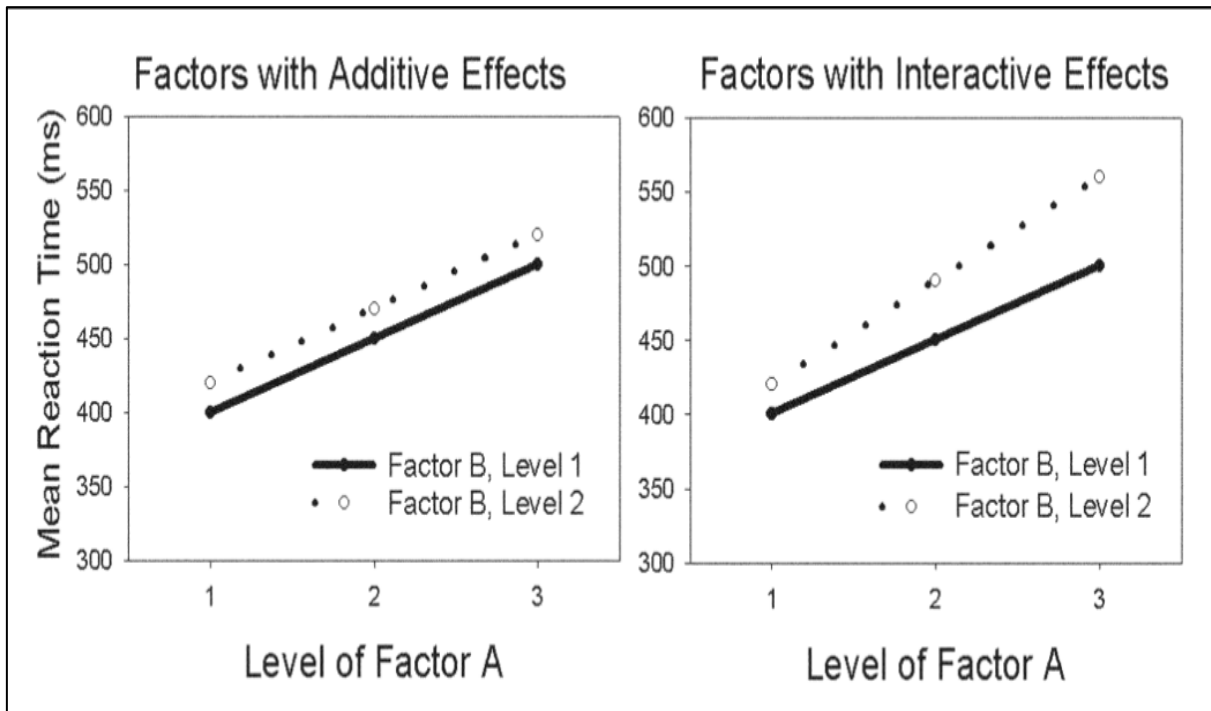
4.2 Study: “Attention: Theory and Practice”

I would like to touch directly revealing the topic of human attention in isolation from interaction with modern equipment on the bridge or in everyday life for a deeper understanding of the mechanisms that occur in the human mind. “Attention: Theory and Practice” for analysis. In the framework of this work “Information Processing and the Study of Attention”, “Selective Visual Attention”, “Attention and Inhibition”, “Multiple-Task Performance” and “Mental Workload and Situation Awareness”. I want to start in order. In the chapter "Information Processing and the Study of Attention" various tasks of attention are given, such as attention is used as a kind of amplifier that enhances the processing of information about stimuli in the studied area. Additionally, attention might impact subsequent phases of information processing. For instance, focusing on specific elements of a situation could lead you to recall other details connected with the observed information.

The study further examines the stages of processing. The authors state that: “A central idea in the human information processing approach is that the human is not just a receiver of information, but also a transmitter of information.” Or as in the understanding (Shannon & Weaver, 1949) a person can be described as an information channel. Then there is a discussion about how accurately the information will be received and how quickly and accurately the information is relayed.

Therefore, it can be quite difficult to create a calculation that will describe the effectiveness and degree of attention. However, according to research, there are many methods that can do this. I want to look at one of them - “Additive factors method”. The authors state: “The additive factors method, developed by Sternberg (1969), is a method for determining which stages are involved in a particular information processing task. That is, it can be used to infer the presence of particular stages". In this approach, several factors, also known as independent variables, are adjusted and the effect of these adjustments on task completion time is analyzed. If the effects of two factors are additive, that is, the influence of one factor does not depend on the level of the other factor, they are assumed to influence separate stages (right panel, in which the effect of changing

Factor B is relatively small at Level 1 of Factor A, larger at Level 2, and largest at Level 3).
(See figure 2.)

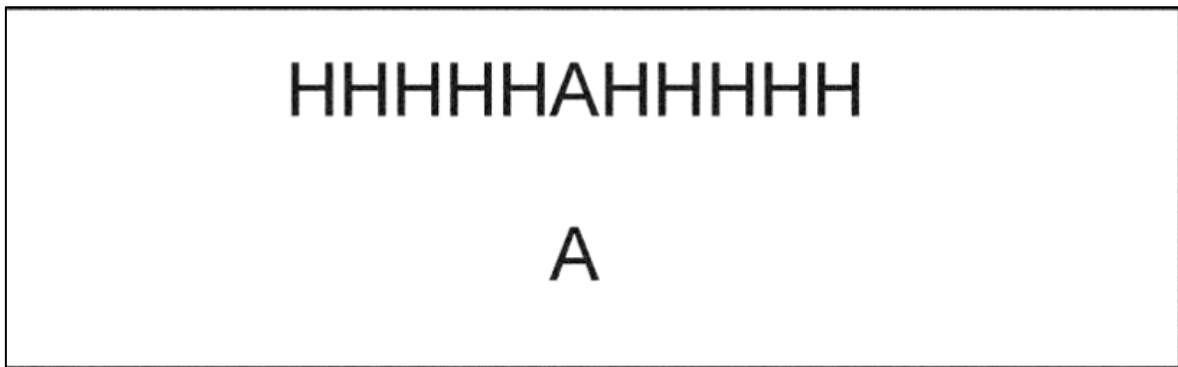


The figure 2. shows the additive and interactive effects of factor manipulations.

Therefore, if these factors interact with each other, such that the effect of one factor depends on the level of the other, then it is assumed that these two factors influence the same level of the process. Once it is known which process stage is affected by one of these factors, this becomes possible by considering interaction patterns to infer the underlying processing stages. As a clear example of this method, the authors gave the problem of a route from your home in Amsterdam to the university in Utrecht. Therefore, you need to ride a bicycle to the station, then take a train to Utrecht, and then take a bus from the station to the university. It turns out that the total time in the route will be the sum of the total time spent traveling on all types of transport (in this example, waiting time and transfers were not taken into account). And suppose that the train was delayed, therefore the total time increases by the same amount as the extended stage and all other stage durations remain unchanged.

4.2.1 “Separation of unnecessary information” and “inhibiting inappropriate actions”

After a brief excursion into the concept of measuring attention, I would like to examine one of the aspects of attention - “separation of unnecessary information” and “inhibiting inappropriate actions”. In many cases, we use our attentiveness to select appropriate information. I would like to start with the latter, namely, what is inhibiting inappropriate actions? From the study it can be understood that: "...the term inhibition may be used whenever decreases in some activity (such as pressing response keys) are seen as a result of manipulating some aspect of the task environment. Although it "may suffice to say that inhibition occurs, a deeper understanding of the nature of task performance can sometimes be gained by describing the processes by which inhibitory effects arise." I would also like to add: “Like attention, inhibition is not a unitary construct. In some cases, inhibition operates at a subconscious level as an automatic countereffect of acts of selection.” ". As an example, the authors give "inhibition of return to exogenously cued locations". This phenomenon can be observed when a target appears in a place where a cue stimulus has been shown is actually detected less readily than when the target is in a place without a signal. Another condition must be that the interval between the target and the signal is more than several hundred milliseconds. Further in the text, different types of inhibition are discussed. I propose to start looking at these types in order, starting with “neurological inhibition.” By this term, the authors understand the type of inhibition that appears as a result of interconnectivity. the network and does not require conscious effort. Also in this part of the study I would like to remember the words by John C. Eccles from his collaboration with Karl R. Popper, the book *The Self and Its Brain*: "the inhibition, as it were, chisels away at the diffuse and rather amorphous mass of excitatory action and gives a more specific form to the neuronal performance at every stage of synaptic relay." An example of such inhibition is a return of reflexes that have not been seen since infancy (in older people with Alzheimer's, the sucking and rooting responses of the nursing infant may resume). Another example is the authors The text is called: “visual search and the factors that affect how easily a target can be found among distractors”. As in the example of figure No. 3.



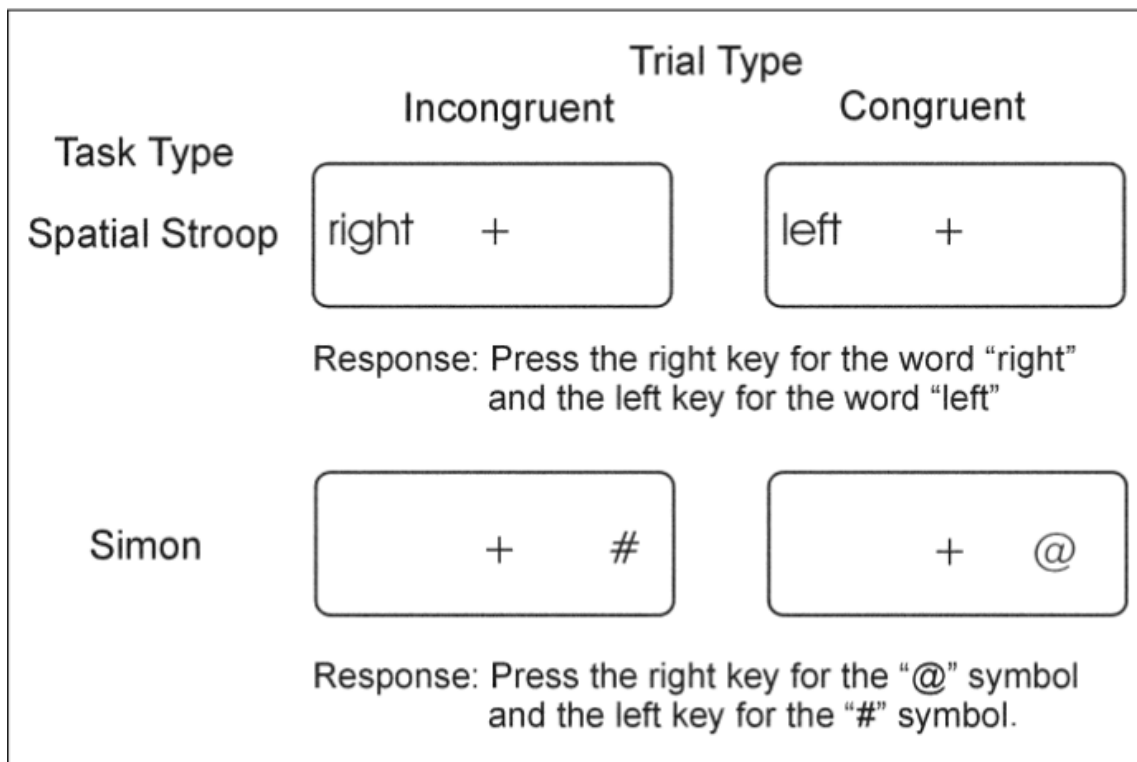
The figure 3. Shows lateral masking by flanking stimuli.

According to research, during the occurrence of inhibition that was caused as a consequence during performing some process, it can be recognized as reactive inhibition. It is also noted that this type of inhibition can appear as a side effect of a process that must subsequently be overcome. In conclusion to this analysis, the authors state the following: "Reactive inhibition builds up across one processing episode and can be observed as a slowing effect on activation processes in a subsequent processing episode." Thus, we can say that this type of inhibition is inherent in the monotonous rhythm of execution work.

4.2.2 The Stroop effect

Further in the book there is an analysis of such a concept as The Stroop Effect. Then an example is given when the subject is presented with a word printed on a sheet of paper and then asked to name the color of the ink with which the word is written, while the word itself denotes a different color. Therefore, ignoring the meaning of the word, the work will be much more time-consuming and cumbersome when the ink forms the name of a color different from the color of the word itself. The parameters of this effect can be measured using "computing the difference in response time and accuracy on congruent versus incongruent trials or as the difference between incongruent and neutral trials". Another slightly similar example of this phenomenon can be called an experiment

when the subject is asked to name where the words “right” or “left” are located and they begin to change places, that is, the word “right” is placed on the left side of the screen. Which increases the time for accepting the correct answer than if the words were arranged according to their meaning. Also in the study “Toward a translational model of Stroop interference” it is said: “An important property of Stroop interference is that it is asymmetric” (Virzi & Egeth, 1985). It is clarified that words of inappropriate color slow down color naming, but incongruent ink colors do not slow down the reading of color words. However, the situation changes when responding with keystrokes: responses to location words are slowed by physical location mismatches, and responses to location words are not slowed by words that do not match that location(Figure 4).



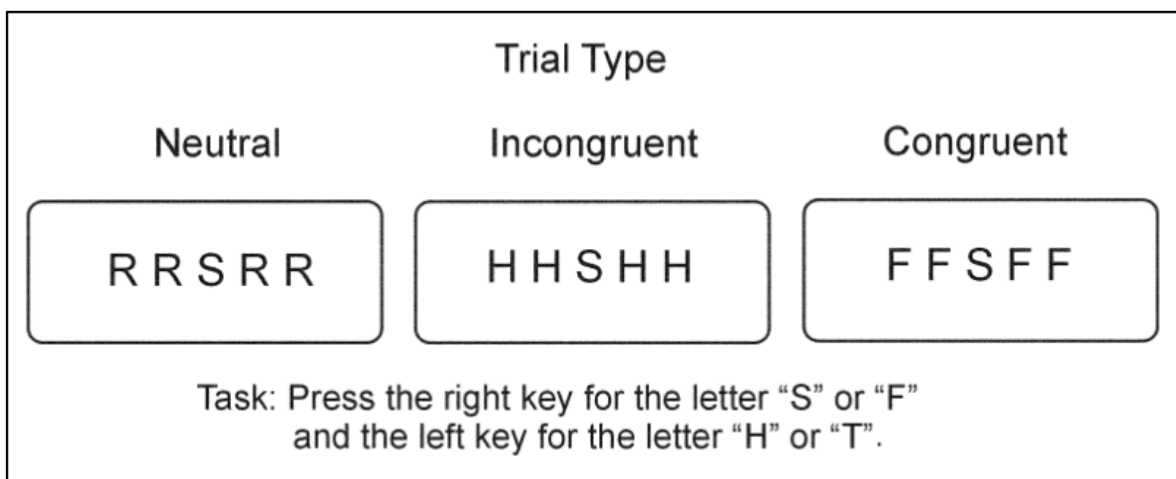
The figure 4. shows the spatial Simon and Stroop tasks.

These results generally support the idea that interference can occur when an irrelevant aspect of a stimulus is processed in the same system as the responses, or uses a similar type of encoding, and this is where disruptions can occur. Here we can conclude that automation and the cyclical nature of a person’s work still have some negative impact on him carefully when performing this work. It also becomes difficult for our consciousness to sift through all the incoming information into the brain. Especially nowadays, when a

huge amount of different information arrives every minute and our brain has to process it in a limited time.

4.2.3 The Flanker Compatibility effect

Another example showing the inability of our brain to filter out irrelevant information is the flanker compatibility effect. This paradigm was first popularized by B. A. Eriksen and C. W. Eriksen (1974). The authors of the work described the action of this effect as: "responses are relatively slow and inaccurate when the target is flanked by incongruent letters (i.e., letters assigned to a different response), intermediate when the flankers are neutral letters (i.e., letters that are never used as the target), and fastest when the flanker letters require the same response as the target". As an example, the authors give a simple problem in which the letter "S" may require moving a lever to the left, and the letter "H" may require moving the lever to the right, as shown in Figure 5.



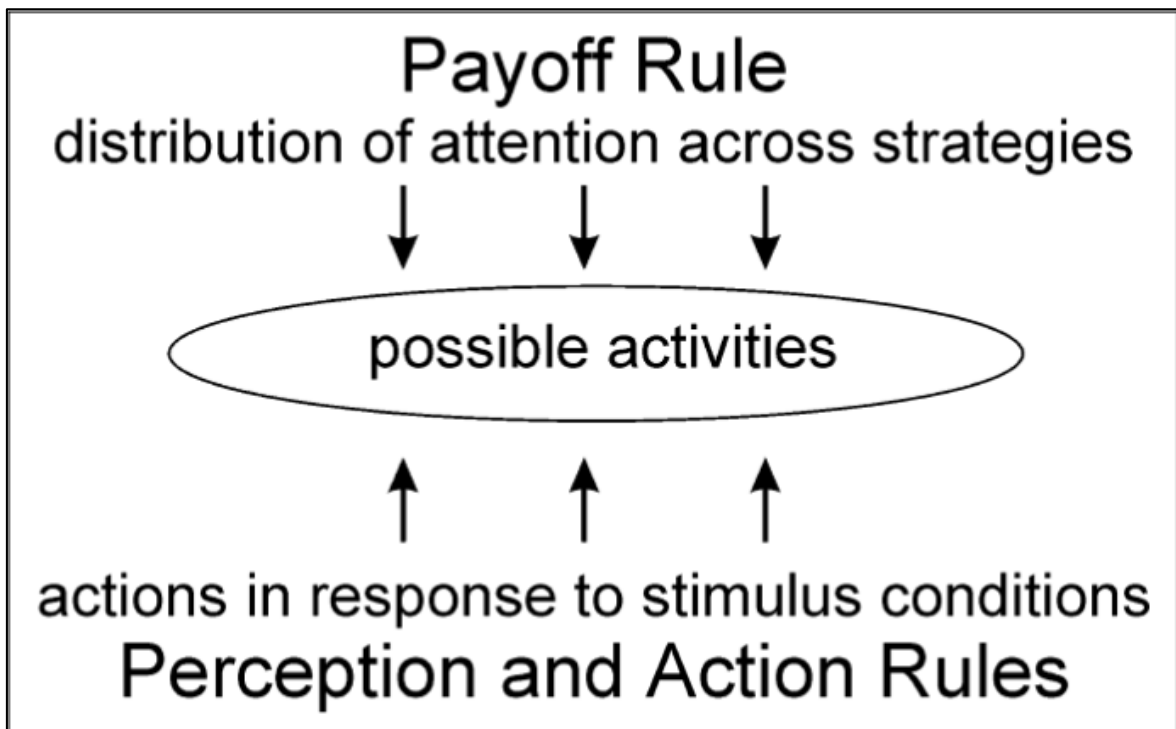
The figure 5. shows the flanker-compatibility paradigm. The task is to respond to the middle letter, while ignoring the letters on either side of it.

It turns out that when letters around a target letter suggest a different response than the correct one, it creates more interference than when the surrounding letters don't suggest any response. This happens because the conflicting response information from the surrounding letters activates response-selection or response processes. To choose the

correct response, this irrelevant activation must be suppressed or overcome. This can be designed for a task in which a person needs to perform certain work "surrounded" by other extraneous sources of information. From which one can conclude that there is a need for a system that could accommodate It contains many subsystems to provide the user, in our case the bridge officer, with the appropriate information for a specific task.

4.2.4 "Multiple-Task Performance"

Here we smoothly move into an overview of the chapter "Multiple-Task Performance". Many of us periodically start working on many things at the same time, we no longer notice it so much due to the volume of daily work. It would also be true to say that for many of us the need for our attention manifests itself in these moments. However, we must take into account that the resources of our attention are limited; therefore, it is necessary to correctly distribute attention only to the necessary actions to complete the assigned tasks. And it is necessary to find the minimum attention necessary for each action performed. In the work, the authors give an example of a case when a person rotates his head and eyes to evaluate the situation around you and draw any conclusions. If a person is too concentrated on these two tasks, for example while walking, he or she may stumble. An example of paying sufficient attention to any action is a situation when a person is jogging in the forest and on his way he or she sees a tree, for the runner it is not it matters what type of tree this particular tree in front of it belongs to. The work "A cognitive game-theoretic analysis of attention strategies, ability, and incentives" by Erev and Gopher (1999) can be called one of the options of optimizing performance by changing attentional strategies. The authors of this paper state that: "the cognitive strategies are available to the performer and the incentives (payoff rule) for applying these strategies", thereby proposing that attention control is subject to two constraints. Their approach is based on the idea that behavior determined by a cognitive strategy with two key components: the top-down part of executive control, which selects what information to focus on (using a payoff rule; see diagram 6), and the bottom-up part of perception and action which reacts to selected information.



A diagram 6. showing Erev and Gopher's (1999) game-theoretic model of attention and control. The payoff rule decides how much importance will be given to each strategy for paying attention to stimulus information. Perception-action rules determine how this information will be used.

The roles of both bottom-up processing and executive control are well demonstrated in the experiment "Training head movement in visual scanning: An embedded approach to the development of piloting skills with helmet-mounted displays." (1997) by Seagull, F. J. and Gopher, D. In this experiment, scientists made tasks for helicopter pilots, based on the belief that a certain level of divided attention is optimal. In the experiment, the helicopter pilots in Seagull and Gopher's study had to learn to move their heads to collect data in order to be able to fly safely while wearing a helmet with a camera. The pilots' strategic executive control decided how much and what kind information they collect. They could restrict their head movements to focus on a specific area (such as a possible emergency), or turn their heads to get a wider view (such as when planning for the future). As a result, Seagull and Gopher were able to train pilots to adopt efficient strategies by having them perform a secondary task requiring head movements concurrently with the piloting task.

4.2.5 Task-set switching

Continuing the theme with multitasking, it is also worth considering such a phenomenon as task-set switching. This phenomenon implies a quick transition from one action to another. The authors give an example of a player waiting at bat in baseball. After First, he should concentrate his attention on hitting the ball with a bat, after which he needs to instantly switch his attention to running to first base. Scientists call such a rapid change in the vector of attention - advance reconfiguration. Here I also want to consider this effect on the part of the officer on bridge. Since he/she has to deal with different tasks. For example, when a ship enters a reporting zone, the officer needs to record this, then report it to the traffic control station and report all the necessary information. It depends on the experience of the officer how quickly and how clearly he/she can convey information. However, even despite the experience, switching costs increase in reaction time and error rates on the task after the switch. But, the experiment "Costs of a predictable switch between simple cognitive tasks" (1995), conducted by Rogers, R. D. and Monsell, S. showed that when people knew that there was going to be a task switch and had sufficient time to prepare for it task-switching costs were substantially reduced. Here I again want to return to the situation on the bridge during the officer's report of the necessary information to the station. It turns out that if the officer looked through the route in advance and found in advance the position at which he needed to make a call, he would be more confident and better cope with this task. Of course, as mentioned above, having extensive experience can help in solving this problem when the officer did not see the reporting point in advance and he/she has to change the vector of attention during the action. This awareness is partly possible thanks to modern technologies such as ECDIS. Using it, you can monitor reporting areas in real time. This timely awareness entails excessive confidence in the officer that the equipment will indicate when a call needs to be made. The officer becomes "overprepared" for the upcoming operation and does not need to constantly check the position of the ship, which leads to a decrease in the officer's attention on the bridge.

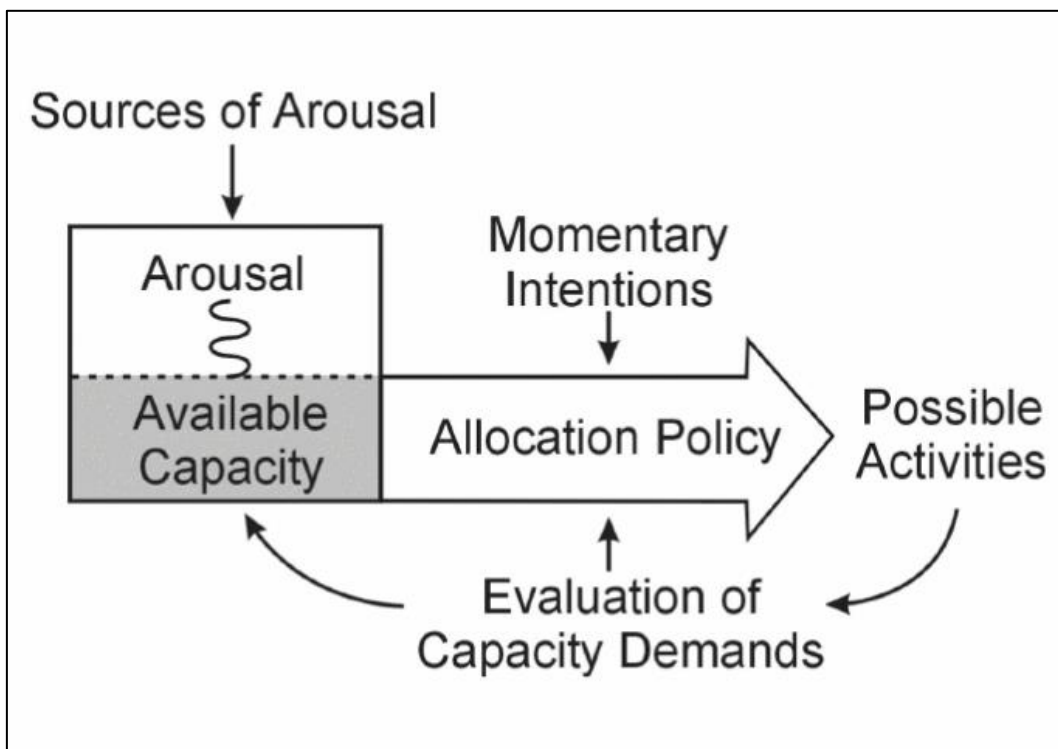
It is also worth mentioning the following trend in gaining experience. Many of us have noticed that when we repeat a task many times, we are able to do it automatically, without spending much attention on its implementation. This is confirmed by the words of William James from his work "The Principles of Psychology" (1890): "habit diminishes the conscious attention with which our acts are performed". In other words, an action becomes automatic when much less attention is spent on its execution or, in principle, there is no control over the action performed. Also, the authors of the work "Attention: Theory and Practice" state that as actions become more skilled, there are two aspects to the withdrawal of attention: reduced capacity demands, meaning skilled operations don't interfere with or get interfered by other ongoing operations, and independence from voluntary control, meaning once automatic operations start, they finish on their own.

Also, if we continue to consider the topic of multitasking, under the prism of "automation of the work process," we can conclude that two tasks can be performed together only to the extent that sufficient attentional resources are available. Taking into account that human attention is viewed as a limited-capacity resource. It turns out that if one of two tasks becomes automatic and doesn't require any attention, it should be possible to do both tasks at the same time without much difficulty, even if they initially required a lot of the same mental resources. One of the many examples of this phenomenon I would like to cite from the work "On the division of attention: A disproof of the single channel hypothesis" (1972) by Allport, D. A., Antonis, B. and Reynolds, P. Where they noticed, that the skilled pianists showed almost no decrease in their ability to sight-read music (which should be very automatic for them) when they were also asked to repeat words presented to them through headphones. However, in the shipping industry there are examples where multi-tasking has led to emergency situations. Even with additional training and education, officers still face the negative side of multi-tasking. In the study "Simultaneous tasks as a contributory factor to maritime accidents: A socio-cultural approach" states that ship operators may not realize that seafarers often have to do multiple tasks at the same time at sea, which can lead to deviations from the prescribed tasks. Task deviation happens when the order in which a seafarer performs tasks at sea is different from the order specified in the procedure provided by the ship operator.

4.2.6 "Mental Workload and Situational Awareness"

Another very important part of this research regarding the area in which I see my research is "Mental Workload and Situational Awareness". As I have mentioned many times before, amazing technological advancements have changed both the types of jobs that need to be done and the way work is completed. One big trend has been a decrease in the physical demands of work. For example, even a secretary's job has changed, with paper files being replaced by computer files, reducing the amount of walking, carrying, and handling of materials. Instead of using a typewriter, most secretaries now use advanced word processing programs on a computer for even simple tasks. Now let's now look at what mental workload is. According to Gopher, D. and Donchin, E. "Workload: An examination of the concept" (1986) mental workload reflects: "the difference between the capacities of the information-processing system that are required for task performance to satisfy expectations and the capacity available at any given time." In "Attention: Theory and Practice" this definition is explained in the following way. This definition suggests that the mental workload felt by one person may differ from that felt by another, as workload depends on how well the task requirements match a person's abilities, and people have different abilities. Gopher and Donchin also suggest that the workload imposed by a task or combination of tasks will depend on the specific abilities needed for the task. To define mental workload as the difference between available and required capacities, we need to clarify what those capacities are. Some important terms used to describe mental workload include effort, arousal, and resources. Effort refers to conscious exertion, while arousal refers to physiological readiness for activity. Resources can be thought of as hypothetical processing reserves or capacities for sensory, motor, or information processing. Further in the work, the words of Wickens (1991) are cited: "one of a small set of scarce commodities within the human information processing system, which is associated with a distinct physiological structure, and with physiological arousal changes as increased demands are placed on it". Workload usually happens when effort or processing resources are needed. But not all tasks will cause mental workload that can be measured. If the task's demands are within the performer's abilities, there won't be any signs of mental workload. Mental workload is felt when enough stress is put on

different capacities. Some things that might cause mental workload include energy limits (like doing hard work when tired), structural limits, limited resources, the need for controlled versus automatic processing, and top-down control of perception. The next paragraph talks about the relation between the concept of arousal and mental workload. The authors of the work state that: "...the case for arousal, performance seems to benefit from a minimal amount of imposed mental workload. Low levels of workload can lead to boredom and a lack of alertness that influence performance negatively". What can we observe during process automation, as I have already given an example with the Finneco 3 ship and its ballast system, which can be controlled and monitored directly from the bridge (the ship is tilted to the right or to the left while washing decks). Which removes a large amount of work from the officer, for example, if we are talking about monitoring the filling of ballast tanks. The following are the words of Kahneman (1973), which talks about the idea of an allocation policy for distributing attention resources means that there's a kind of 'comparator' that evaluates the current resources and the performer's active intentions and activities. The need for attention allocation ability is most clear in complex or dangerous situations (see figure 7).



The figure 7. shows Kahneman's (1973) unitary-resource model of attention.

An example of this would be driving and talking on the phone at the same time. When the road is known to you or does not require vigilant attention, then you can safely combine the action of driving with the action of talking. However, when weather conditions or other external factors make it difficult to control the vehicle, then You can no longer easily speak or even finish a conversation to fully focus your attention on the situation on the road. In many situations, productivity needs to be “protected” from the distractions of the outside world, and this can only be achieved by maintaining task-oriented goals as top priority. Also, the study suggests that the need to control and “protect” task completion can be a major factor in feelings of workload or fatigue. Here I want to move a little away from this research and refer to another paper, “Automation and mental workload: Why it is important to get the balance right” (Mark Young, 2022). In the case of automation, this problem is solved, since the machine begins to monitor the situation and thereby relieves stress from the person, which entails an “increase” in underload. This study says: "Underload can occur in an operator who is facing excessively low – but not entirely zero – mental demands, such as when supervising an automated system... So reducing workload is not necessarily a good thing, if we are expecting the person to remain attentive and alert." Which in turn confirms what was said above in the work "Attention: Theory and Practice". Now let's get back to this work again. Further in the study, a possible manifestation of stress or high workload such as “strategy adjustment” is given. It is also mentioned that if the task is too hard, people will try to use a simpler method to do it if they have the option. In this case, we We can observe the phenomenon of "attentional narrowing", which manifests itself in the fact that in situations of high stress people often focus their attention on a limited set of displays or sources of information, which may be inappropriate. Even people who simply expect to encounter a stressful situation tend to focus only on central signals and ignore peripheral stimuli when performing a detection task. The authors then give an example with airplane pilots. If any indicator fails, the pilot will focus his attention directly on this faulty indicator, ignoring all other instruments important for flight control.

4.2.7 "Cognitive Factors in Situation Awareness"

Here I would like to move on to the topic of situation awareness. The chapter "Cognitive Factors in Situation Awareness" examines the factors that are involved in situation awareness. This study states that what we focus our attention on determines what information in our environment becomes part of our understanding of the situation. The significance of information, as well as a person's goals and priorities for attention, will influence how we perceive and act. Inattention to easily accessible information (for example, when we focus too narrowly) is the most common cause of loss of awareness of the situation. It turns out that if awareness of the situation involves tracking events and objects around us, then memory can play an important role in maintaining it. The following is an example from the work "Situation awareness during driving: Explicit and implicit knowledge in dynamic spatial memory" (1997) by Gugerty, L. J. In it, Gugerty conducted tests in a car simulator. The researcher added dangerous situations to the driving task and observed how people reacted to these dangers. One task required drivers to react to vehicles that crossed their path and could cause a collision if the driver did not take the correct actions. Another situation involved the driver's blind spot. Drivers had to monitor traffic and check to see if a car was in their blind spot before they could safely move right or left to avoid the dangerous vehicle. Explicit memory was tested by asking participants to place cars in the correct order on the road. The strong relationship between explicit memory and performance suggests that only information that people actively notice and are aware of influences their situational awareness. This research shows that people don't typically drive on autopilot: they need to pay attention and remember important information. Here the question arises about the awareness of the officer on the bridge, if the machine collects and analyzes information for a person. It turns out that if an officer is on watch, for example, due to great trust in the machine, he will monitor the situation around him less, for example, he will be more distracted by the phone (from -for reduced load, including). At this point, he/she loses awareness of the situation, since he/she does not have to keep so much information in his head.

4.2.8 “Situation Awareness and Mental Workload”

Also, awareness may suffer when workload is so high or when workload is so low that operators lose vigilance, as was already clarified earlier. However, the chapter “Situation Awareness and Mental Workload” states that mental workload and situation awareness are basically separate constructs. Judging by the study, changes in design meant to improve situation awareness don't always reduce mental workload, and the opposite is also true. The authors of the work state the following: "In a review of 15 studies in which both situation awareness and mental workload were measured before and after the implementation of a new interface...". Substantiating their conclusions, they refer to the work "The Relationship between Mental Workload and Situation Awareness" (2000) by Vidulich M. A. In this study, Vidulich found that in 80% of the studies, situation awareness was improved, but mental workload was reduced in only 47% of them.

4.2.9 “Measurement of Situation Awareness”

This raises the question of how to deal with poor situational awareness. For example, the chapter “Measurement of Situation Awareness” discusses how to measure situational awareness on the SAGAT system. SAGAT is a system built on a thorough analysis of task goals and smaller goals that help achieve each major goal. During pauses in the simulation, questions are asked about these goals and subgoals." The operation of this system is demonstrated on the air traffic controller, when the operator needs to avoid near misses and collisions and landing aircraft safely (these are his main goals). And the subgoals include collecting information about each aircraft. SAGAT questions may then ask about this additional information, such as the speed of the aircraft. Thus, the officer can check himself by asking the most key questions, for example: 1) how many ships are around, what is their course (whether there is a threat of collision), etc. By

answering a "quiz" like this and testing his or her answers using available equipment, an officer can assess how aware he or she is of the surrounding situation.

4.2.10 “Improving Situation Awareness”

Next, I would like to consider a rather interesting topic in this study from the point of view of my work, namely “Improving Situation Awareness”. This chapter suggests that some of the same factors that improve routine performance can have a negative impact on situation awareness. One example of such factors that improve routine performance but reduce situational awareness is the effect of automation, namely reduced workload. and situation awareness, as a consequence and attention, based on the work “How in the world did we ever get into that mode? Mode error and awareness in supervisory control” (1995) from Sarter, N. B. and Woods, D. D. Which exactly defeats the purpose my research.

However, the next section suggests that automation may also have positive aspects. Airplane pilots are again cited as an example. In aircraft with two pilots (for example, a captain and first officer, who take turns flying), incidents associated with loss of awareness of situations are more likely to occur when the captain is flying than when the first officer is in control. And that the fact that the captain is more likely to become disoriented while flying the aircraft seems to contradict the conclusion that control of the system generally leads to higher awareness of the situation. When a pilot has to fly the plane, they have to use resources that could have been used for gathering and sharing information for the task of flying instead. And it goes on to say that the first officer should take control of the plane in problem situations, and the captain should be in the place of the co-pilot. It has long been prescribed in the rules of navigation that during maneuvering or emergency maneuvering the ship must be controlled by the sailor on watch and the officer must give him instructions (that is, the control mode is transferred

from the machine (autopilot) to the person). Also This section does not provide an example of solving this problem using automation . There is also an example of the opposite, that when actions are repeated monotonously, they become automatic. The authors cite arguments from the study “Actions not as planned: The price of automatization” (1979) from Reason, J. . Where does it say that slips of action occur because many of our actions are performed automatically, without conscious thought or control. In short, mistakes in actions happen because of the way our actions are programmed and automated, which again indicates that oversimplification of the work process can affect a person's attentiveness.

4.3 Conclusion on literature review

With this I would like to conclude the literature review. In conclusion, I would like to say that, of course, without all the currently presented control systems, systems for converging on the operation of the ship’s instruments, it would be impossible to achieve the results that we have today. Consequently, the officer would have much less productivity and excessive processing, which as we have already seen from the review I conducted, it also affects the deterioration of attentiveness. Also, the percentage of incidents that occurred due to human fault still leads among other reasons.

However, with such a rapid “evolution” of equipment capabilities, it is also necessary to take appropriate regulations, measures, etc. In order to be prepared or at least aware of similar challenges in the future. To reduce the number of incidents associated with this problem.

5 Interview's questions

Below is a list of questions asked:

1) Could you compare your early days as officer how it was / now? (Is navigation more safe today or not? ; Why? Why not?)

2) Do you feel that your training and experience helps you better cope with the impact of modern technology on your mindfulness?

3) Do you feel that the excessive amount of information provided by modern systems may have a negative impact on your ability to effectively monitor the situation on the bridge?

4) Could describe an officer that you trust when on watch. (How do they work? What is typical? What makes you trust them?)

5) How often have you noticed signs of overwork while on watch? Can you remember the moments when modern equipment contributed to a more effective "fight" against overwork or when, on the contrary, it worsened it?

The list of questions was compiled based on the literature presented above, the assistance (providing possible questions on the topic of your research) of AI (Mistral Ai,

2024) and based on the experience gained. This section describes the methodology used to conduct the interviews in order to ensure connections between the questions and existing literature, while minimizing the possibility of researcher bias.

A review of the literature revealed a lack of specific research on this issue. These findings served as the basis for formulating interview questions that would examine the presence or absence of this issue today. The interview questions were modified and customized to suit the specific context and objectives of this work. The questions were important to answer the research questions of this study.

To prevent bias in the study, the researcher was careful and mindful of any potential bias based on reading material on the topic. The researcher maintained a reflexive approach throughout the study, which allowed him to modify and adapt the interview questions as new ideas emerged from the data. This flexibility ensured that the study could respond to unexpected findings and changing goals.

Interviews were conducted with seven who were selected based on their work experience and position.

Participant consent was given and recorded during the interview. A semi-structured interview format was chosen to ensure that pre-planned questions were answered for analysis, as well as the opportunity to discuss new ideas.

5.1 Interview

The first respondent has about 13 years of experience at sea, 7 of which he worked as an officer. At the beginning of the survey, the respondent noted that, indeed, modern technologies simplify the work of an officer on duty. He gave an example of updating maps. While still in the OS position, he observed how his navigation officer was faced with the difficulty of updating nautical charts. The officer had to update the maps while on watch or in his free time, which had a negative impact on safety. However, with the advent of ECDIS the situation has changed dramatically. Now you just need to press a few buttons, and the system itself will update everything you need.

Regarding work experience and training, the respondent said that his training, and most importantly work experience, helps him deal with excessive trust in equipment through years at sea (relying on his knowledge and using equipment on the bridge not as a second “officer”, but as a tool). Also, he noted that as long as the officer can assess the situation and be familiar with all the equipment on the bridge, then he or she can calmly make appropriate decisions effectively. The interviewer then continued the topic of the officer's skills. He said that in his opinion, an officer whom he trusts should check the situation around him at intervals appropriate to the situation; the busier the traffic, the shorter the “review of the situation” interval. Also, the interviewer noted that the officer should rely on several sources of information (ECDIS, radar and visual overview of the situation (depending on weather conditions)). The officer should not trust too much in any system and during the watch should double-check the information using different devices.

At the end, the respondent summarized that, as mentioned earlier in the example of updating maps, modern equipment greatly simplifies the officer's work. However, if such equipment becomes unusable, appropriate specialists are needed to replace it and this can bring some difficulties. He also noted that the more complex and functional (increasing the number of various sensors, etc.) modern equipment becomes, the higher the chance of it breaking.

The second respondent has 15 years of sea service, of which 5 years as an officer. The interviewer noted that navigation has become safer due to the development of equipment that both reduces the officer's workload and provides an additional "level of security" of the situation around the ship beyond the officer.

The officer agreed that his experience helps him with the impact of modern equipment on his alertness, having started his career before the widespread adoption of ECDIS, GPSD and more advanced systems. The interviewer saw officers, when he was still a sailor, using paper nautical charts and doing almost all the calculations by hand. Also, when he became an officer, he was helped by officers who had experience working without modern equipment, as a result of which they did not rely so much on equipment. This in turn was conveyed to the interviewer. The respondent added that he does not consider the amount of information provided by modern equipment to be excessive and negatively affect his awareness of the situation, he also noted that if the officer has good training and awareness of the equipment, then he or she will not be bothered by the amount of information.

Regarding how an officer should be aware of the situation around him, the interviewer said that the officer should collect information from all available sources and not become fixated on anyone.

At the end of the interview, the respondent expressed a similar position about modern equipment and its "fight" officer fatigue. As an example, he cited a situation where an urgent need to make a new route. The officer compared working with paper maps with plotting a route in ECDIS. Also, the interviewer concluded that modern equipment greatly simplifies the work of officers.

The third interview involved a respondent with 18 years of experience at sea and 15 years as an officer. The officer also noted that now, navigation has undergone positive changes in the area of safety. It has become more automated, in particular, many tasks fell on the equipment, thereby making the work easier for the officer.

The interviewer said that while studying at a higher education institution, he did not practice handling ECDIS, for the reason that ECDIS at that time had not yet entered the

category of mandatory equipment and was just beginning to develop. Despite this, the respondent in the process of work became familiar with the latest equipment at that time, which did not pose any problems for him. However, the officer noted that at the moment the equipment, in particular ECDIS, has gone quite far in its capabilities and scope of functions, in comparison with what it was even 5 years ago, and if he were given the task of laying out a new route, then the interviewer had problems there would be some difficulties with this (at the time of the interview the respondent was working as a chief officer). Also, regarding training, the respondent replied that such training has a positive effect on the capabilities of future officers; as an example, he cited his own experience of the lack of that very training.

Regarding how the officer reported observing the situation around him, the respondent expressed similar thoughts as the two previous interviewers. That the officer on watch should not rely too much on the equipment and maintain proper control of the situation around the ship according to the surrounding situation.

At the end of the interview, the respondent said that modern equipment improves and significantly simplifies the officer's work; examples included updating maps, updating admiralty publications and laying out new routes on ECDIS.

The fourth respondent had 12 years of experience at sea, 5 of which as a 2nd officer. During the interview, the respondent revealed some information about himself. He had experience working as a junior sailor on small and fairly old ships (one ship was 34 years old) in the Philippines. He also worked 2 years as a OS and 5 years as a 2nd officer in the Finnlines company. In this company, he worked on Ro-Ro ships.

The officer said that navigation with modern equipment is much easier and safer than even 7 years ago. He especially noted the difference between old and small-tonnage ships when he worked in the Philippines and working on modern ships in Finland. Where, the convenience and safety of work on the latter was partly due to the availability of good equipment. The officer explained that since he had worked on the Finntide for the last 4 years, he was quite familiar with the system, so he had not experienced any problems with its use. As for the abundance of information, the officer also said that at first it

caused problems. However, over time and gaining sufficient experience working with the system on the bridge, this problem went away (since he configured the system for himself).

The respondent named all the same features as the three previous officers. Therefore, I do not see any point in dwelling on this again.

An example when modern equipment helped him cope with fatigue was during loading, when the officer had to carry out a de-ballasting operation. He could carry out all operations from the cargo office and did not need to manually start the pumps. He also remembered updating the maps, like other officers. However, he could not remember the last time he had been bothered or relaxed by modern equipment, as he had developed the habit of manually determining his location and surroundings. This was a skill he had developed while working in the Philippines. During night watches with an officer, he had trained him.

The fifth respondent had minimal work experience (2 months as a 2nd officer and 3 months as a OS) and only graduated from university a year ago (in 2023). At the beginning of the survey, it is clear that the respondent cannot answer the first question due to the lack of sufficient experience.

However, in the process of answering the second question, the respondent noted that with the improvement of skills in handling equipment on the bridge, the officer's attentiveness began to "slightly" decrease. The respondent attributes this fact to the fact that over time he became accustomed to and accustomed to the equipment, learned new ways of how to control the ship, find the location and recognize threats. Which ultimately led to a reduction in stress on the bridge and an increase in confidence in both his own skills and the capabilities and trouble-free operation of the equipment on the bridge. He also went into a little more detail about the "trouble-free operation" of the equipment when he shared his experience of undergoing practical training (mostly on modern ships (Ro-Ro and passenger ships). On those ships, the equipment was quite modern, which sometimes, according to him, inspired excessive confidence in its reliability and accuracy.

The officer answered the third question in the affirmative. However, he also added that this amount of information can be confusing in the absence of the proper level of training.

The respondent also had no problems answering the penultimate question. He said that he wants to see in the officer to whom he hands over the watch the features of an "old school" officer. The respondent explained that the officer should first of all be an officer on watch, and not a person who simply obediently carries out the machine's commands. And it is his responsibility to keep the situation under control and to be in control of it at all times, and not the machine's.

The officer also answered the fifth question in the affirmative. He said that in the absence of much experience in fishing, some tasks are more difficult for him than for experienced officers, as a result of which he experienced signs of fatigue very often. And here modern equipment helped to cope with some of the workload, which in turn helped to combat fatigue. As an example, the respondent cited cases when he needed to build a new route. He looked through ready-made routes and used them as a template.

I would like to clarify that after this, two more officers who had recently graduated from the university were interviewed, but their answers were similar in content. And I decided to show only one interview with the "junior" officers.

5.2 Review of the respondents' decisions.

As we can see from interviews with respondents, certain trends and features can be observed that were discussed above in my research. Namely, the influence of work experience on an officer's attention and his or her attitude toward equipment. It turns out that the "old school" really considers equipment to be just equipment and they rely on their experience and skills more than on the capabilities of modern equipment. Also, the topic of simplifying the officer's work and reducing the burden on him or her was touched upon. In addition, companies can see a clear course towards increasingly automated processes and system autonomy. Which in turn, as discussed in the chapter

"Mental Workload and Situational Awareness," can lead to a negative impact on the officer's alertness by reducing the load on him or her.

The solution to this problem, according to the officers surveyed, is training. More precisely, both practical and theoretical classes, in order to better demonstrate to future officers the capabilities and, most importantly, the limitations of this or that navigation equipment. For example, it is necessary to increase the number of classes on simulators, as well as add to the program moments when this or that equipment "accidentally" fails, so that from the early stages of training young officers do not rely on it as a "second officer" on the bridge.

6 Conclusion

In conclusion to this work, I would like to summarize that due to the rapid development of modern technologies, the instruments on the bridge will become more and more advanced and independent. Consequently, there will be an increase in over-reliance on the latest equipment among officers. In turn, this can cause a decrease in alertness while on watch, leading to emergency situations.

To avoid this, you should make a list of recommendations to the officer so that he/she can "check" himself and, if anything happens, take appropriate action. It is also necessary to improve the existing BNWAS, based on the research presented in this study.

It is worth noting that the author of this thesis does not oppose the introduction of the latest developments in the navigation system (and not only) of the ship and, on the contrary, supports such initiatives. However, it emphasizes that the officer should maintain the required level of concentration and attentiveness while on watch and not rely on the "computer officer" too much but use the provided equipment primarily as a tool.

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Appendix I

Interview's questions:

- 1) Could you compare your early days as officer how it was / now? (Is navigation more safe today or not? ; Why? Why not?)
- 2) Do you feel that your training and experience helps you better cope with the impact of modern technology on your mindfulness?
- 3) Do you feel that the excessive amount of information provided by modern systems may have a negative impact on your ability to effectively monitor the situation on the bridge?
- 4) Could describe an officer that you trust when on watch. (How do they work? What is typical? What makes you trust them?)
- 5) How often have you noticed signs of overwork while on watch? Can you remember the moments when modern equipment contributed to a more effective "fight" against overwork or when, on the contrary, it worsened it?