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Hierarchical Control Planning Based on the Film 'Avatar: The Way of Water' to Minimize Work Accidents Among Fishermen

Dinda Okta Dwiyanti Ridwan Gucci[1], Muhammad Adi Sukma Nalendra[2], Prisilia Cahaya Putri Sarena[3], and Yohaneis Saleh[4]

[1,3]Industrial Engineering Study Progam, Faculty of Industrial Technology, Institut Teknologi Batam, The Vitka City Complex Jl. Gajah Mada, Batam, 29425, Indonesia
[2,4]Visual Comunication Design Study Progam, Faculty of Information Technology, Institut Teknologi Batam, The Vitka City Complex Jl. Gajah Mada, Batam, 29425, Indonesia

Abstract. Cultivating health and occupational safety among fishermen can involve various strategies, such as reviewing movies for insights. These films serve as reflections of the relevance to the cultural aspects of fishermen's health and safety, contributing to the Health and Occupational Safety Triangle or Hierarchy Control. Hierarchy Control, a sequential risk reduction process, encompasses elimination, substitution, design, administration, and personal protective equipment (PPE). The study aims to reduce or eliminate work accidents for fishermen, utilizing planning hierarchy control with an approach involving Macro Ergonomics, Semiotics, and the Fogg Behavior Model. Findings identify a minimal health and safety culture during service, leading to the design of three hierarchy controls: Standard Operating Procedures (SOPs) for machines and equipment (administrative control), ship closures for noise reduction (engineering controls), and the implementation of Personal Protective Equipment. However, elimination and substitution remain challenging to implement in daily service activities.

Keyword: Fogg Behavior Model, Health and Safety Work, Hierarchy Control, Macro Ergonomics, Semiotics

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1. Introduction

Indonesia is a maritime country, with 70% of its territory consisting of water and the remaining 30% comprising more than 17,000 islands, boasting over 99,000 km of coastlines. The extensive maritime expanse positions Indonesia as a nation with significant potential in the fields of maritime activities and fisheries. The fisheries industry and the livelihoods of fishermen represent a focal point for national growth. Fishermen are individuals seeking a livelihood by maximizing the potential of fishing in these abundant waters[1]. The growth of any sector warrants careful

*Corresponding author at: [Institut Teknologi Batam, The Vitka City Complex Jl. Gajah Mada, Batam, 29425, Indonesia]
E-mail address: [dinda@iteba.ac.id]

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attention to various factors that influence it, and the field of health and occupational safety is no exception.

Health and Occupational Safety encompass efforts aimed at safeguarding workers from harm in the workplace. To ensure the well-being of workers, regular maintenance must be conducted, and production activities should be executed in a safe and efficient manner [2]. The number of work-related accidents has tripled compared to the previous year. In 2020, there were 221,740 reported cases, which increased to 234,370 in 2021. The most recent data available, covering the period up to November 2022 (with the total data for 2022 withdrawn in early January 2023), indicates a further rise to 265,334 work-related accidents [1] .

In contrast, work-related accidents among fishermen encompass various incidents. Light accidents, such as slipping during work (97.7%), falling from the boat (26.7%), running out of material leading to burns (73.3%), scratches during work (100%), collisions with other ships (6.7%), water leaks in the boat's hull (56.7%), running out of food supplies (56.7%), and getting entangled in fishing nets (33.3%), are prevalent. Currently, fishermen also face more severe accidents, including drifting away (53.3%), experiencing boat shipwrecks (43.3%), engine failure in the middle of the sea (90%), burns (13.3%), explosions affecting 3.3%, and encountering typhoon winds (90%). Additionally, heavy accidents, like broken bones, occur at a rate of 10% [1].

Various case data reveal a lack of attention to safety among fishermen during their work at sea. Therefore, a solution is needed to address this issue. Implementing countermeasures for work-related accidents among fishermen can be achieved through straightforward initiatives embraced within the fishing community. Cultivating health and occupational safety among fishermen can involve various strategies, one of which includes drawing insights from movie reviews [3]. Almost everyone loves movies, and recently, there is a film that features scenes providing insights into Health and Occupational Safety for fishermen—namely, the movie "Avatar: The Way of Water." This film has received numerous awards, including the inaugural 2023 Oscars in the Best Visual Effects category [4]. The victory and award achieved by "Avatar 2" at the 95th Academy Awards mark a significant milestone. Directed by James Cameron, the film surpassed other incoming blockbuster films in its nominations. It is anticipated that studying this film would be interesting, as it may serve as a reflection on its relevance to the cultural aspects of fishermen's lives and their health and occupational safety at work.

This can provide control in the so-called Health and Occupational Safety Triangle Control or Hierarchy Control. Hierarchy Control is a sequential process (done progressively until the level of risk or danger is reduced to a safe point). Among the elements of hierarchy control are elimination, substitution, design, administration, and the use of personal protective equipment (PPE). To address this issue, an effective approach involves utilizing planning hierarchy control with a comprehensive framework, incorporating Macro Ergonomics, Semiotics, and the Fogg Behavior Model.

2. Material and Research Method

2.1. Macro Ergonomics

Macro Ergonomics is a sociotechnical systems approach that operates in a top-down manner to analyze, design, or enhance work systems and organizational structures. It focuses on harmonizing planning across all elements of the system to ensure overall efficiency and effectiveness [5]. The conceptual definition of Macro Ergonomics is a top-down approach applied in a socio-technical manner to plan work systems comprehensively. It encompasses the entire interaction among humans, their jobs, machines, and software interfaces. The sociotechnical theory emphasizes the interplay between technical requirements of the job and the social demands placed on the individuals performing the job. The key elements utilized in Macro Ergonomics include humans, the environment, organization, technology, and work [6].

2.2. Semiotics

Semiotics, as explored by Piliang [7], delves into the study of signs and signifiers, aiming to understand their interconnected elements within a system governed by specific rules or agreements. Signs, which represent something beyond themselves, resist separation akin to the two fields on a sheet of paper. Saussure's definition emphasizes the unity of a 'sign,' with the field marker (signifier) defining 'forms' or 'expressions,' and the field signified (signified) explaining the 'concept' or 'meaning.' In Semiotics, this significance extends to all social practices involving language, including social media campaigns. Interpreting visual campaigns as signs unveils meanings with two layers: the first being the obvious, existing, and innocent Denotative meaning, and the second, the Connotative meaning, linked to situational conditions and social events [8].

2.3. Fogg Behavioral Model

The Fogg Behavior Model is a theory of behavior developed by BJ Fogg. He proposes that the theory of behavior change consists of three elements, namely [9]: (a) Motivation; (b) Ability; (c) Trigger.

3. Data Analyze and Discussion

The following are the results of the research implementation that have been achieved, namely:

3.1. Data Collection

The following is the data collected to complete this research, namely as follows:

Table 1 Data Collection

No	Data	Category
1	Sign system images	
2	PPE images	
3	Pictures of tools	
4	Vehicle images	
5	Outfit and apparel images	Semiotics
6	Drawings of movie scenes	
7	Environmental images	
8	Pictures of animals and plants	
9	Architectural drawings of culture	

No	Data	Category
10	Personal protective equipment	Man
11	Images of outfits and apparel	
12	Health and occupational safety policy images	Organization
13	Awards	
14	Pictures of movie scenes	
15	Machine images	Technology
16	Equipment images	
17	Equipment SOPs	
18	Technology-based system information	
19	Vehicle images	
20	Environmental images around	Environment
21	Architectural drawings of culture	
22	Schedules and working hours	Work

The following are the vessels used by fishermen, which can be seen in Figure 1. This research focuses on designing a hierarchy of occupational health and safety controls in fishing, so it does not discuss size, equipment, and techniques in fishing. The Standard Operating Procedure (SOP) is made comprehensively so that it can be used by all organizations or individual fishermen.

Figure 1 Boats Used by Fishermen

Based on the film "Avatar: The Way of Water," it provides insights into the critical importance of occupational safety and health in ocean environments. This film has the potential to inspire fishermen to modify their fishing behavior, with a particular emphasis on enhancing safety during fishing activities. To achieve optimal results and eliminate potential hazards in fishing, a perspective considering the 5 elements of macro ergonomics is crucial. Macro ergonomics, being an encompassing approach, can maximize ergonomic considerations across a broad scope. In addition to macro ergonomics, this research incorporates a semiotic approach to identify and analyze safety signs at sea, drawing from the film "Avatar: The Way of Water," with applications to fishing activities. The final approach involves employing the Fogg Behavior Model to analyze fishermen's behavior concerning safety in their fishing practices.

3.2. Analysis of "Avatar: The Way of Water" Film Using a Semiotic Approach

Following this, the results of the analysis of the film "Avatar: The Way of Water" using the Semiotics approach will also be applied to videos featuring fishermen, utilizing the same approach. In Table 2, only one macro ergonomic element is presented, but it is essential to note that there are numerous identifications. This identification process will persist and be conducted for each macro ergonomic element.

Table 2 Analysis of "Avatar: The Way of Water" Using a Semiotic Approach

Data	Category	Movie Scenes	Denotation	Connotation	Myth
Personal Protective Equipment	Man		The medium-sized crew directs the team and navigates with their hand raised. They have a tattoo on their arm, wear orange personal protective equipment (PPE) attributes on their shoulders, an oxygen helmet that is transparent, and a sheath on their hand. The boat is equipped with colored holographic navigation in gray and has a futuristic shape.	A group of whalers on the planet Avatar possesses communicatio n equipment, top-notch security measures, sophisticated tools, and substantial power, all in a massive manner	There is superiority in strength, as well as established safety rules for mature work, although in different terrains. On Earth, humans are superior in technological sophistication, even though technology is sometimes used for criminal activities
			A number of boat crew members are currently heading into the wavy ocean equipped with personal protective equipment (PPE)	The ship's crew, comprising robust, steadfast, safe, and sturdy whalers, confronts a storm while heading to the Avatar planet for whaling	This very strong and solid crew demonstrates courage in exploring danger and bravely shaping reality as they explore and colonize the planet Avatar
			Somebody is holding tool ejectors while wearing protective helmets and personal protective equipment (PPE). Meanwhile, two other individuals are currently steering the boat towards the ocean. The boat is equipped with a tool ejector at the end	The crew is always ready, strong, and safe, facing the challenge of the vast and expansive sea horizon	This display showcases highly advanced Western technology that leaves a strong, great, and dominating impression

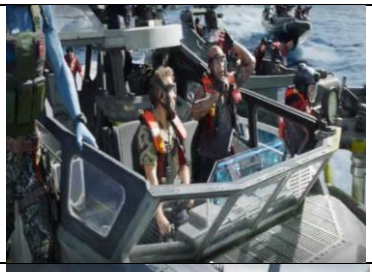
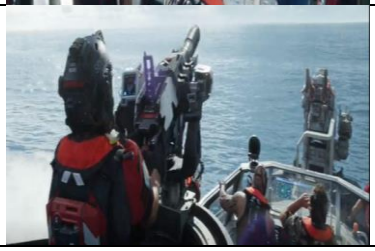
3.3. Identification of Safety in "Avatar: The Way of Water" Using a Macro Ergonomics Approach

The following is an identification of safety in "Avatar: The Way of Water" using a macroergonomics approach. In Table 3, each macroergonomic element is presented, serving as a reminder of the multitude of identifications. This identification process continues for each macroergonomic element.

Table 3 Safety Identification Using a Macro Ergonomics Approach

Color description:

:Safe :Not Safe

Data	Category	Picture	Safety Identification	Red Color	Green Color
Personal Protective Equipment	Man		The protective equipment used is almost complete, ranging from helmets, vests, and shoes to thick-material clothes. However, the clothes worn lack long sleeves		
			However, some individuals still opt for sleeveless attire, as it serves as a personal protective tool for fishermen who wear long-sleeved clothes		
			The protective equipment used is almost complete, starting from helmets, vests, and shoes to thick-material clothes		

3.4. Identification of Fishermen's Videos Using the Macro Ergonomics Approach

The following are the results of identifying fishermen's videos using a macroergonomics approach. In Table 4, only one macroergonomics element is presented as a reminder of the numerous identifications. This identification process will continue for each macroergonomics element.

Table 4 Safety Identification Using a Macro Ergonomics Approach

Color description:

: Safe :Not Safe

Element of Macro Ergonomics	Sub Elements of Macro Ergonomics	Picture	Safety Identification	Red Color	Green Color
Personal Protective Equipment	Man		Fishermen only use personal protective equipment (PPE) and swimming goggles		
			The artificial fish pond is constructed from long wood and nets, making it possible for a fisherman's fingers to easily get stuck, rubbed, or wounded if they do not use rubber hand guards		

3.5. Findings of Safety Culture in "Avatar: The Way of Water" Using a Semiotic Approach

The safety culture depicted in the film "Avatar: The Way of Water" reveals the application of Health and Occupational Safety culture through specific attributes and scenes. Employing Roland Barthes' Semiotics, scenes are reviewed as signs, analyzed with denotative meaning or the first layer of meaning, connotative meaning or the second layer of meaning, and examines the myths constructed and potentially believed by film creators and target audiences. It is recognized that Semiotics is a science that studies signs and meanings. In Piliang (2004) [7] Semiotics attempts to understand the connection of sign elements in a system based on certain rules and agreements. The conclusion drawn is that, in the first layer of denotational meaning, the film "Avatar: The Way of Water" exhibits technological sophistication and the implementation of Health and Occupational Safety culture in the exploration and exploitation of the planet Avatar by a team of hunters and military from Earth. Additionally, denotational meaning is also evident in the portrayal of the native inhabitants of the planet Avatar, highlighting a primitive culture and continuity in utilizing nature in harmony.

In the second layer of connotation in the film "Avatar: The Way of Water," there exists an Opposition - Binary relationship in the interaction between humans and the native inhabitants of the planet Avatar. The oppositional role assumed by humans, depicted as a nation of immigrants, is portrayed through images of extensive and formidable technology and military presence, including the Health and Occupational Safety culture, which positions them as an Opposition force. The Binary relationship depicts the native inhabitants as belonging to a primitive planet, distant from Health and Occupational Safety technology and culture.

Through the exploration of connotation and denotation, the film "Avatar: The Way of Water" reveals the values embedded in its myths. In this context, a myth represents an ideology or beliefs considered natural and true, as inferred from the visual signs presented in the film. The emerging myth portrays that the Health and Occupational Safety technology and culture present in humans make them appear greedy, invasive, and exploitative in nature.

Furthermore, the findings of Health and Occupational Safety are evaluated in macro ergonomics using five criteria: humans, organizations, technology, environment, and work. Overall, in every element of macro ergonomics, Health and Occupational Safety have been implemented effectively. However, there are shortcomings in several elements. These include deficiencies in the organizational element criteria, particularly in the Health and Occupational Safety policy and awards sub-criteria. Additionally, in the human element criteria, although individuals have appropriately used Personal Protective Equipment (PPE), there are still scenes where humans (hunters) do not wear long sleeves. Furthermore, in the work element criteria, there is no mention of work hours or shifts. In the technological element criteria, there is a lack of explanation in the film scenes regarding Standard Operating Procedures (SOPs) for equipment or machines. Despite these shortcomings, the overall findings of the Health and Occupational Safety culture in the film

"Avatar: The Way of Water" can serve as a practical implementation in the lives of fishermen. Perhaps this application can be phased in using simple steps in the daily lives of fishermen.

3.6. Findings of Safety Culture in Fishermen's Videos in Batam: Questionnaire and Forum Group Discussion (FGD)

In the video depicting fishermen in Batam, it is evident that the Health and Occupational Safety culture is significantly lacking. There are 5 criteria for macro ergonomics elements—namely humans, technology, environment, work, and organization—are evaluated, almost all sub-elements are marked in red. This indicates a minimal consideration for Health and Occupational Safety in the lives of fishermen, primarily stemming from their lack of awareness regarding Health and Occupational Safety. Unfortunately, this indifference can lead to work-related accidents and even fatalities from a Health and Occupational Safety perspective. Fundamentally, fishermen are aware that their current practices pose high risks, yet they perceive the implementation of Health and Occupational Safety measures as costly and of little importance. This perception motivates fishermen to continue their work as usual without prioritizing Health and Occupational Safety.

During the Fishermen Group Discussion (FGD), participants expressed keen interest in Health and Occupational Safety. The film "Avatar: The Way of Water" demonstrated the enthusiasm for incorporating Health and Occupational Safety practices, including the use of Personal Protective Equipment (PPE) attributes, into their daily routines. Findings from the questionnaire further indicated the fishermen's interest in integrating Health and Occupational Safety into their daily lives, though financial constraints sometimes serve as a hindrance. Fishermen acknowledge their past lapses, often attributed to a lack of awareness about Health and Occupational Safety. They express a desire to rectify these mistakes and implement Health and Occupational Safety practices in their fishing endeavors.

Therefore, the findings from the Fishermen Group Discussion (FGD) indicate that fishermen are open to the idea of implementing Health and Occupational Safety practices, akin to what is depicted in the film "Avatar: The Way of Water." Based on these findings, researchers have progressed to the next step in the study, which involves designing a Health and Occupational Safety control framework for fishermen in Batam. This design adopts a control triangle approach encompassing Personal Protective Equipment (PPE), administrative controls, engineering controls, substitution, and elimination. The researchers aspire that this control triangle design can be effectively implemented in the fishermen's daily lives. The PPE design has been crafted by certified Health and Occupational Safety experts to ensure optimal outcomes and continuous improvement for fishermen. While the advice provided to the fishermen may not be immediately applicable, it is intended for ongoing implementation, recognizing that meaningful improvements cannot be achieved hastily. Fishermen need to gradually adjust their daily fishing activities.

3.7. Correlation Between Safety Culture in the Film "Avatar: The Way of Water" and Fishermen's Videos

The questionnaire was distributed to 10 fishermen, and the results of the Correlation between the Safety Culture of the film "Avatar: The Way of Water" and the Fisherman's Video were computed using SPSS with 10 respondents and 20 questions. The calculated correlation coefficient (r) was then compared with the r-table value of 0.632. A validity test is deemed valid if all r counts > r-table (0.632). The results indicate that all r counts are greater than r-table, confirming the validity of the questionnaire. Subsequently, for reliability testing using the Cronbach Alpha approach, if the value approaches 1, the questionnaire is considered reliable. Based on the results of reliability test, it shows that the Cronbach Alpha value is 0.890, which closely approaches 1, indicating the questionnaire's reliability. The correlation test results demonstrate a robust correlation between the safety culture depicted in the film "Avatar: The Way of Water" and the Fisherman's Video. This suggests that the film effectively enhances fishermen's knowledge of occupational safety and health during fishing activities.

3.8. Designing Hierarchy Controls in Fishing Activities

For the effective, comfortable, safe, healthy, and efficient operation of a system, it is imperative to have proper planning. In the planning stages, adhering to the OHSAS 18001 standard [10] is crucial for organizations in constructing a Hierarchy of Controls [11]. During the process of identifying Health and Occupational Safety hazards, organizations need to assess whether there are existing controls in place and whether these controls are adequate for identifying potential dangers.

Hierarchy of control essentially prioritizes the identification and implementation of controls related to Health and Occupational Safety hazards. There are several groups of controls that can be formulated to eliminate or reduce Health and Occupational Safety dangers, including:

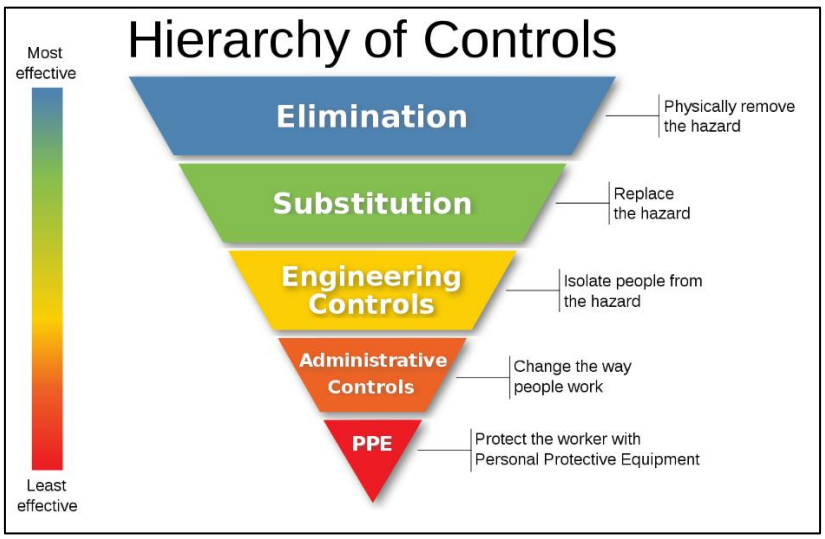


Figure 2 Hierarchy Control Danger

Fishing boats, fishing tools, and fishermen are three crucial factors supporting the success of fishing operations. The activity of catching fish involves various dangers and, of course, high risks. Fishing operations, especially at sea, present a significant level of risk due to unpredictable sea conditions. The fishing operation can take place in various types of waters, ranging from calm waters to areas with large waves, such as the open sea (oceanic). The choice depends on the fishing area and the targeted catch.

In compiling the Hierarchy of Control for dangers, it is essential to identify the risks at each stage of the work process (preparation, fishing, and handling the catch) to determine the types of potential hazards in the work area. This involves preventive measures and efforts to control and reduce the potential dangers. Additionally, information about Unsafe Actions and Unsafe Conditions of fishermen during each stage of the work process is required. After that, preventive actions can be implemented, including measures to prevent accidents related to environmental, human, and equipment factors. This may include local regulations or trusted guidelines for proper management.

If it is determined that prevention alone does not yield a significant impact, each control process should be implemented. This involves starting with elimination, substitution, engineering controls, administration, and Personal Protective Equipment (PPE). These measures are implemented to enhance the productivity of fishermen, ensuring the sustainable continuation of economic activities along the public coast. Based on the identification through approaches such as semiotics and macro ergonomics (refer to Table 5), the planning of Hierarchy Controls can be summarized as in Table 5:

Table 5 Design of Hierarchy Controls for Serving Activities

Color description:

Safe Not Safe

No	Element of Macro Ergonomics	Sub Elements of Macro Ergonomics	Color		Hierarchy Control's	Can be done (√)	Planning Hierarchy Controls
			Green	Red			
1	Man	Personal Protective Equipment			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls		
					PPE	√	Providing PPE to fisherman
		Outfits and Apparel			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls		
					PPE	√	Providing PPE to fisherman
2	Organization	Health And Occupational Safety Policy			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls	√	Creating a health and occupational safety policy by health and occupational safety experts
					PPE		

No	Element of Macro Ergonomics	Sub Elements of Macro Ergonomics	Color		Hierarchy Control's	Can be done (√)	Planning Hierarchy Controls
			Green	Red			
2	Organization	Award			Elimination	√	Eliminating the subelement "award" as fishermen typically do not fall under an organizational structure
					Substitution		
					Engineering Controls		
					Administrative Controls		
					PPE		
					Elimination	√	Eliminating the subelement "award" as fishermen typically do not fall under an organizational structure
3	Technology	Machine			Elimination		
					Substitution		
					Engineering Controls	√	Planning to enclose the ship's engine to minimize noise emission
					Administrative Controls	√	Designing SOP for the use of the ship's engine
					PPE		
		Equipment			Elimination		
					Substitution		
					Engineering Controls	√	Designing a storage box
					Administrative Controls	√	Designing SOP for the use of fishermen's equipment
					PPE		
		Technology-Based System Information			Elimination		
					Substitution		
					Engineering Controls	√	Using signaling sirens for fishermen in danger
					Administrative Controls		
					PPE		
6	Environment	Vehicle			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls	√	Designing SOP for the use of the boat
					PPE		
		Environment Around			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls		
					PPE	√	Providing PPE to fishermen
7	Work	Schedule and Working Hours			Elimination		
					Substitution		
					Engineering Controls		
					Administrative Controls	√	Planning shifts in intervals of 2 hours for sleep and wake-up for fishermen during each serving
					PPE		

4. Conclusion and Recommendation

From the results of this study, we can conclude that the safety culture depicted in the film "Avatar: The Way of Water" demonstrates the application of Health and Occupational Safety culture

through specific attributes and scenes. The examination of Health and Occupational Safety findings, utilizing macro ergonomics and considering 5 elements (humans, organization, technology, environment, and work), reveals that, overall, Health and Occupational Safety has been effectively implemented. However, there are shortcomings noted in certain elements, particularly in the criteria for organizational elements, specifically in the sub-criteria related to Health and Occupational Safety policies and awards.

In the video featuring fishermen in Batam, it was observed that the Health and Occupational Safety culture remains at a very minimal level. There are 5 criteria for macro ergonomics elements (humans, technology, environment, work, and organization), almost all sub-elements are marked in red. This indicates a lack of consideration for Health and Occupational Safety in the fishermen's lives, primarily stemming from their indifference towards these aspects. Unfortunately, this indifference can lead to work-related accidents and even fatalities from a Health and Occupational Safety perspective. Fundamentally, fishermen are aware that their current practices pose high risks, yet they perceive the implementation of Health and Occupational Safety measures as costly and of little importance. This perception encourages fishermen to persist in their usual work routines without prioritizing Health and Occupational Safety.

A design was formulated for three types of hierarchy controls, namely, developing Standard Operating Procedures (SOPs) for machines and equipment (administrative controls), designing ship engine covers to minimize noise (engineering control), and designing safety boxes (engineering control), in addition to the utilization of Personal Protective Equipment (PPE). Due to the challenges associated with elimination and substitution, as indicated by Health and Occupational Safety experts, these elements were not incorporated into the hierarchy control design.

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