A Statistical Analysis-based Bayesian Network Model for Assessment of Mobbing Acts on Ships

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Abstract

Mobbing is a fundamental problem that disrupts the organization's structure and negatively affects its employees' safe work environment. The most critical issue in combating mobbing is increasing the awareness of victims, businesses and society about this problem. The importance of identifying this problem, which will adversely affect the professional life in the maritime profession, as in every professional group, is obvious. This study offers a statistical analysis-based dynamic Bayesian network to model seafarers' mobbing acts in merchant ships. In this research, measures against mobbing in the maritime industry are also recommended after determining the most frequent mobbing elements in ships. It is observed that the seafarers who have just stepped into onboard are more exposed to mobbing; in contrast, mobbing attacks experienced by seafarers decrease with an increase in age. The most frequent mobbing behaviours are listed as: "I am continually given new tasks", "My superiors restrict the opportunity for me to express myself" and "Unfounded rumours about me is circulated in the ship". The study reveals that while the maritime authorities such as Port State Control (PSC) and the International Transport Workers' Federation (ITF) have limited capabilities for solving mobbing related problems, the companies may have a crucial role to play in the process.

Keywords: Mobbing; seafarer; occupational safety; safe work environment; bullying

1. Introduction

Mobbing is defined as executing unwanted and potentially harmful acts against one or more persons repeatedly by one or more persons in organisations (Leymann 1990). Mobbing is an organisational problem leading to conflicts between individuals. It disrupts the organisation's structure and negatively affects workers' job satisfaction and tranquillity (Vveinhardt and Sroka 2020). There is an imparity of power between mobbing executers and victims. Mobbing behaviours are carried out with a strategy and intentionally. An executor aims to fray persons and causes them to leave by oppressing them, whom he does not desire to be in the organisation. Moral abuse, bullying at the workplace, physiologic terror, workplace injury, emotional lynching, verbal attacks, and hostile attitudes at work are other terms used instead of mobbing in the literature (Kum and Ertaş 2016; McKay et al. 2008).

Mobbing has been commonly encountered as a working place originated aggressive behaviour since 1980. Leymann (1990) was the first researcher that investigated mobbing issues in the workplace. According to Leymann (1990), mobbing is carried out in five steps. These are conflicts, aggressive behaviours, negative participation of the administration, being branded as a difficult personality or insane, and being fired. Leymann (1996) reports that an attitude to be accepted as mobbing must be repeated once at least a week for six months. However, some

researchers argue that this period may be shorter (Zapf et al. 2020). Mobbing, which may lead workers to become unproductive and end their careers, is encountered in almost every industry worldwide. Mobbing related studies include different sectors in association with civil servants (Tsuno et al. 2018), health care workers (Norton et al. 2017), academic personnel (Keashly 2021), teachers (Wachs et al. 2019) and cyberbullying (Chun et al. 2020). Studies reveal that frequencies for encountering mobbing at several job groups in Europe and America vary between 10% and 15%.

Marine transportation is an essential part of international logistics, and seafarers are the key workers who play an active role in realising these activities. As it happens in other occupational groups, mobbing adversely affects the career of seafarers. Although significant efforts have been made to protect seafarers in recent years, seafarers' health has received little attention in the maritime industry (Uğurlu et. al 2020a). Seafarers face many unfavourable conditions such as rough seas, storms, shipowner pressure, increased workload, internal-external audits, and fast crew cycle through their career. In addition to these challenging factors, seafarers are also subject to mobbing on board. As a result of mobbing, seafarers may face difficulties such as job dissatisfaction, reduction in communication-coordination, and decreased efficiency as in many industrial sectors.

There is a limited number of studies related to mobbing that seafarers are exposed to on ships in the maritime sector. Feijo et al. (2019) mentioned that mobbing behaviours can also have devastating effects on seafarers. According to the results of their study, mobbing is a significant risk that can cause seafarers to end their maritime careers quickly. Kitada (2021) stated that it will be beneficial to adopt company and government policies to provide seafarers with equal opportunities and a more liveable ship environment in the fight against harassment and bullying. Pineiro and Kitada (2020) stated that if harassment or bullying occur onboard, the victim may feel even more isolated and have difficulty of coping with life on board. Low (2006), and Nielsen, Bergheim and Eid (2013) reported that mobbing actions have consequences up to the loss of life at sea. According to Forsel et al. (2017), the frequency of these negative behaviours towards seafarers can be associated with the nature of the profession. Mayhew and Grewal (2003) provided a relationship between the inappropriate working conditions of seafarers and the psychological violence they are exposed to onboard. They reported that as seafarers' workload increases, the psychological violence they are exposed to on ships increases. Maybe this can be interpreted as the transfer of the commercial pressure created by the shipowner on the ship to the personnel by the ship managers (masters, chief officers, chief engineers, etc.). Kum and Yıldıray (2016), Hatem (2011) and Tavacıoğlu et al.

(2018) stated in their studies that seafarers are often hesitant to express the psychological violence they experience on ships due to the concern of job loss. With the increasing importance of technology in the maritime industry, the issue of cybersecurity has become a severe concern for today's seafarers, and cyberbullying, along with other types of mobbing, continues to exist as a threat to seafarers today (Fitton et al. 2015).

Therefore, the investigation of mobbing actions in which seafarers are exposed to ships is an important issue that concerns all transportation parties. This study aims to determine the mobbing actions that seafarers are most exposed to in light of current data, reveal the factors underlying these actions, and develop strategies on how to deal with this problem. The content of the study is as follows. The sub-sections under the introduction section describe the causes of mobbing and the effects on individuals and society. The second section includes the scope and steps of the research. In Section 3, statistical analyses of mobbing acts on ships and their results are conducted. In Section 4, a network structure modelling the mobbing actions experienced on ships is presented. The results of the study were then compared with the ones from the literature and recommendations were given as to how this problem is dealt with. The last section is the conclusion of the research.

1.1. Causes of Mobbing

Mobbing may arise for many reasons from any disagreements between the victim and the mobbing executer. Two main factors give rise to mobbing. These are the personality of the victim and psychosocial factors (Akinci, Yurcu and Ekin 2018). A study conducted in Norway on 2215 workers reveals an important relation between mobbing and organisational conditions (Leymann 1990). In organisations running with heavy work stress, mid-class managers may make mobbing to their underlings due to pressure from superiors; however, it is also observed that low-class managers may make mobbing to their seniors (Leymann 1996). According to Field (1996) and Namie (2003), mobbing executers aim to fail the target person by making him/her ineffective. The factors that direct mobbing executers for mobbing are lack of emotional intelligence, lack of empathy, cowardice, neurotic disorders, and lack of human and ethical values.

1.2. Effects of Mobbing on Individuals and Society

Mobbing leads to rather costly consequences on individuals, organisations, and also societies. Due to mobbing, victims may be exposed to adverse economic, social, and physiologic aspects (Tuckey et al. 2009). The hurt of social image for the person, losing friends by going into a depressive mood, and being seen as "unsuccessful" even in his or her own family

are typical examples of social consequences (Duffy and Sperry 2014). Personnel conflicts, collapse in organisational culture, and lack of confidence are the physiologic costs of mobbing. Mobbing behaviours spread quickly like a cancer cell and may result in the loss of vital functions in the organisation (Cangöl et al. 2018)

2. The Scope of the Study and Research Steps

In this study, the most frequent mobbing acts that the Turkish seafarers are exposed to in ships are determined. The relations among the socio-demographic and professional properties of seafarers and mobbing behaviours are examined. In addition, the effects of the measures to prevent mobbing are evaluated in the study. The steps of the study are presented below.

2.1. Determination of the Content of the Survey

In this study, Leymann's Inventory of Psychological Terror (LIPT) is used to determine the mobbing behaviours that seafarers are most frequently exposed to (Leymann 1990). While the original version of the questionnaire consists of 45 items, questions were revised and reduced to 43 to be compatible with seafarers' working circumstances. The reliability of the questionnaire was verified, applying a Cronbach's alpha test. In this study, the reliability of the questionnaire was verified by using a Cronbach alpha test. In many studies in the literature, a Cronbach alpha value above 0.80 was accepted as reliable (Hinton et al. 2014). In this study, Cronbach's α value for 43 items was $\alpha = 0.974$, indicating a relatively high-reliability level. The five-point Likert scale was used for evaluating each item of the questionnaire [1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree]. Data was collected in 2016-2017 by using Google Forms and face-to-face interviews with seafarers. Two hundred twenty-one voluntary seafarers were surveyed in the study to represent Turkish seafarers working on ships of various types and tonnages. In the first part of the questionnaire, seafarers' demographic data is gathered, and in the second part, a LIPT scale mobbing typology is utilised.

2.2. Establishing Hypothesis

This study's hypothesis is created by examining studies in different sectors related to mobbing (Jóhannsdóttir and Ólafsson 2004; Mikkelsen and Einarsen 2001). This hypothesis is used to investigate the relationship between seafarers' socio-demographic and professional properties and the mobbing acts. This study's socio-demographic properties are limited to gender, age, marital status, and education level. The professional properties are listed as professional experience, the crew number of the ship, position of the crew in the ship and the

ship type. These variables are used for determining the existence of relation among mobbing behaviours and socio-demographic and professional properties. The hypothesis of the study is given as:

H1: Mobbing behaviours significantly differ with gender.

H2: Mobbing behaviours significantly differ with age.

H3: Mobbing behaviours significantly differ from professional experience.

H4: Mobbing behaviours significantly differ with the number of crew on the ship.

H5: Mobbing behaviours significantly differ from the position of the crew on the ship.

H6: Mobbing behaviours significantly differ with marital status.

H7: Mobbing behaviours significantly differ with education level.

H8: Mobbing behaviours significantly differ with the type of the ship.

2.3. Statistical Tests

In this study, IBM SPSS Statistics 22 software is used for statistical tests. A One-Way ANOVA test was used for more than two multiple variables for comparing the data, and an independent t-test was used to determine the differences between the two groups. While the Post Hoc was used to detect differences among homogeny distributed groups, for the non-homogeny distributed groups, a Games-Howell Post Hoc test was preferred. A Pearson correlation analysis was used for searching the relationship between five mobbing question groups. Pearson correlation analysis is widely preferred for explaining the direction and degree of relationships between different variables (Taylor 1990). The study's statistical test results were assessed in a confidence interval of 95% and a significance level of 5%.

2.4. Bayesian Network (BN) Applications

In the BN applications section of this study, a dynamic network structure modelling the mobbing acts that seafarers were exposed to on ships was presented. The most important feature of the dynamic network structure is that the relationship between the nodes in the 1st and 2nd levels of the network (occurrence of mobbing behaviours) is based on statistical test results. This network structure allows analysing the mobbing acts in ships, both in quantitative and qualitative ways. Bayes applications consist of three steps. The first step is establishing a BN, the 2nd step is a validation of the network, and the last step is sensitivity analysis.

2.4.1. Establishment of Bayes Network

BN is a non-oriented circular probability network method, in which the variables are symbolised with nodes, and conditional dependency relations between these variables are represented with one-way arrows (Jones et al. 2010). A Bayes network consists of two main parts. These are the graphical part (illustration of relations between variables), and the conditional probability tables (CPTs). The graphic part consists of the main structure of BN. When two nodes in the network are interconnected with arrows, the node where the arrow starts is called the parent node, and a node at the end of this arrow is called the child node. The nodes that do not have parent nodes are named the root nodes, while the nodes without a child are called leaf nodes. The absence of an arrow from one variable to another means no probability relationship between this variable and other network variables. For this reason, these kinds of variables in the network have a marginal probability distribution. While establishing the network and the probability distribution for each variable, the interaction of each conditional variable with other conditional variables is investigated. This means combining conditional variables' values and forming a probability distribution matrix (Zhang et al. 2013).

Bayes network is based on the chain rule, which handles the joint probability distributions of variables. According to the chain rule, each node's marginal and conditional probabilities in the network can be calculated. Assuming there are the variables of U={X_1, X_2,…, X_n}, in this case, the joint probability of variable X_i can be expressed as (Nielsen and Jensen 2009):

$$P(U) = \prod_{i=1}^{n} P(X_i \mid P_a\,(X_i)) \tag{1}$$

where $P_a\,(X_i)$ is the parent set of variables and $j \neq i$. The probability of X_i is calculated as:

$$P(X_i) = \sum_{X_j} P(U) \tag{2}$$

The first step in BN establishment is the determination of nodes in the network. The network involves seafarers' descriptive features, mobbing acts encountered in ships, and the measures to combat these actions. In this study, the measures for combating mobbing represent the authorities' actions that have enforcements over ships. As a result of both expert opinions and literature surveys, three authorities were defined to be possibly effective for preventing mobbing in ships (Low 2006; Kum and Ertaş 2016; Uğurlu et al. 2020a). These are shipowners, the port or flag state (Port State Control (PSC)), and the International Transport Workers'

Federation (ITF). The other nodes in the network were constituted according to statistical data obtained in the previous step.

After defining the network nodes, the relation between the nodes and the conditional probability tables are formed. In BN studies, the relation between nodes, and conditional probability tables can be established according to two main approaches: use of statistical data and expert judgement. If necessary, these approaches may be used in a combined way (Pristrom et al. 2016). In this study, a combined approach is preferred. The variables in the network and the relations between those (the direction of arrows in the network) are based on the previous step's statistical data. At the same time, the conditional probability tables are constituted according to expert opinions. Steps for calculating the conditional probability values of the nodes in the network are presented as below:

i- Domain expert evaluations,
ii- Fuzzification,
iii- Aggregation, and
iv- Defuzzification (Creating of conditional probability tables).

2.4.1.1. Domain expert evaluations

In this study, the conditional probability tables were created according to the opinions of 6 domain experts. Experts' responses were weighted by taking their professional positions, competencies, and sea experiences into consideration. A score from 0 to 5 was assigned to each expert to reflect differences in expert weights. The expert group and their weight scores are presented in Table 1.

Table 1. Weight scores of experts

The calculation of the experts' weight scores was based on Equation (3) (Rajakarunakaran et al. 2015).

$$\text{Weighting factor of expert } (W_{\mu}) = \frac{\text{Weighting score of the expert}}{\text{Sum of all experts' weighting scores}} \quad (3)$$

where μ stands for expert μ within the group.

2.4.1.2. Fuzzification

Fuzzy membership functions are used for dealing with uncertainty in expert judgments. Different types of fuzzy membership functions have been used in the literature. The most commonly used are the triangular and the trapezoidal membership functions. In this study, a triangular fuzzy membership function is preferred. The scale consisting of seven linguistic terms, is selected (Table 2).

Table 2 Linguistic measurement scale (Rajakarunakaran 2015)

A triangular fuzzy number (TFN) represents a triple set of fuzzy probability values (a_1, a_2, a_3). For xϵA with the membership function $\mu_{\check{A}}(x)$, A is a fuzzy number in the range R→ [0,1]. Assuming that x is in the range $[a_1, a_3]$, $\mu_{\check{A}}(x)$ is calculated as follows (Kartal et al. 2019):

$$\mu_{\check{A}}(x) = \begin{cases} 0 & x \leq a_1 \\ (x - a_1)/(a_2 - a_1) & a_1 \leq x \leq a_2 \\ (a_3 - x)/(a_3 - a_2) & a_2 \leq x \leq a_3 \\ 0 & x \geq a_3 \end{cases} \quad (4)$$

2.4.1.3. Aggregation

It is important to reconcile the opinions of experts within a heterogeneous group because the positions of the experts within the group and the differences in their professional experience may cause uncertainty in the evaluation. Hsu and Chen (1994) proposed an algorithm for this problem.

$\widetilde{R1}$, $\widetilde{R2}$: A pair of expert opinions

$S_{UV}(\widetilde{R1}, \widetilde{R2})$: Degree of agreement (similarity) of two distinct expert opinions

$S(\tilde{A}_1, \tilde{A}_2)$: Degree of similarity between two fuzzy numbers

$AA(E_u)$: Average degree of agreement of experts

$RA(E_u)$: Relative degree of agreement of experts

CC(E_u): Experts' consensus coefficient

$\tilde{R}_{AG}$: Aggregated results of expert opinions

Step (i): Calculate the degree of agreement (similarity) $S_{UV}(\widetilde{R1}, \widetilde{R2})$ of the opinions $\widetilde{R1}$ and $\widetilde{R2}$ of a pair of experts E_U (u =1 to M).

According to this approach, $\tilde{A}_1 = (a_{11}, a_{12}, a_{13})$ and $\tilde{A}_2 = (a_{21}, a_{22}, a_{23})$ constitute two triangular fuzzy numbers. Thus, the degree of similarity between these fuzzy numbers can be obtained by using the defined similarity function.

$$S(\tilde{A}_1, \tilde{A}_2) = 1 - (1/3) \sum_{i=1}^{3} | a_{1i} - a_{2i} | \quad (5)$$

Step (ii): Calculate AA (average agreement) by M experts as follows:

$$AA(E_u) = \frac{1}{M-1} \sum_{u \neq v}^{M} S(\tilde{A}_u, \tilde{A}_v) \quad (6)$$

Step (iii): Calculate the degree of relative agreement (RA) by M experts as follows:

$$E_u (u = 1,2, \ldots\ldots, M) \ as \ RA(E_u) = \frac{AA(E_U)}{\sum_{u=1}^{M} AA(E_U)} \quad (7)$$

Step (iv): Calculate the CC (consensus coefficient) of M experts as follows:

$$CC(E_U) = \beta . w(E_U) + (1 - \beta) . RA(E_U) \quad (8)$$

β (0≤β≤1) is the relaxation factor of the proposed method. This shows the importance of $w(E_u)$ (weight factor of expert u) on $RA(E_u)$. When β=0, the expert's weight factor is ignored; there is a homogeneous distribution among the experts. When β=1, the expert has the same consensus coefficient (CC) and weight significance. In this study, β=0.5 was considered (Rajakarunakaran et al. 2015).

Step (v): Finally, the aggregated result $\tilde{R}_{AG}$ value of the expert opinions is calculated as follows:

$$\tilde{R}_{AG} = CC(E_1) \times \tilde{R}_1 + CC(E_2) \times \tilde{R}_2 + \ldots + CC(E_M) \times \tilde{R}_M \quad (9)$$

2.4.1.4. Defuzzification

Defuzzification is necessary to obtain measurable results from fuzzy numbers and clarify these numbers is essential for making decisions about uncertain issues. In this study, the defuzzification process is performed using the "centre of area" method for each condition in conditional probability tables (Sugeno 1985).

Defuzzification equation: $X^* = \frac{\int \mu_i(x)\, dx}{\int \mu_i(x)}$ (10)

For the triangular fuzzy number $\widetilde{A} = (a_1, a_2, a_3)$ the equation is as follows:

$$X = \frac{\int_{a_1}^{a_2} \frac{x-a_1}{a_2-a_1} x\, dx + \int_{a_2}^{a_3} \frac{a_3-x}{a_3-a_2} x\, dx}{\int_{a_1}^{a_2} \frac{x-a_1}{a_2-a_1} dx + \int_{a_2}^{a_3} \frac{a_3-x}{a_3-a_2} dx} = \frac{1}{3}(a_1 + a_2 + a_3) \quad (11)$$

2.4.2. Validation

Once the defuzzification process is completed, all network nodes' initial and conditional probability values are obtained. The network structure is completed by entering these probability values into the Bayes model. In this study, Genie software is used for Bayes applications. To prove the accuracy of the model outputs, a validation test is essential. It is necessary to test the model's validation, especially when expert judgments are included in the model due to the lack of data. Axiom tests are applied to prove the accuracy of the network structure and conditional probability values created in the study. Axiom tests are used in many BN studies to verify the network's accuracy (Pristrom et al. 2016; Jones et al. 2010). This study includes three axiom tests.

Axiom 1. A slight increase or decrease in each parent node's probabilities should result in the effect of a relative increase or decrease in the probabilities of the child node.

Axiom 2. The gradual change in each parent node's probability values should consistently affect the child node.

Axiom 3. For a child node with multiple parent nodes, the parent nodes' combined effects on the child node are always expected to be greater than their individual effect.

2.4.3. Sensitivity Analysis

The first step in sensitivity analysis is to identify the target node or nodes. The next step is to observe the effect of other nodes on the target node. Sensitivity analysis reveals the target node's sensitivity to variables in the network (Uğurlu et al. 2020b).

3. Statistical Analysis of Mobbing Actions Applied in Ships

The demographic data about seafarers, research groups, and their frequency distributions is summarised in Table 3. Ninety percent of the analysed seafarers are males. This situation may be considered normal for a male-dominated industry. Almost half of the surveyed seafarers are married. Regarding the attended seafarers' educational status, 84.6% of them have a bachelor's or postgraduate degree.

Table 3. Distribution of demographic variables for seafarers

The distributions of the answers for the mobbing questions are given in Table 4. Questions 1-10 are related to "*Effects on self-expression and communication*". The most common mobbing action in this group is found as "*My superiors restrict the opportunity for me to express myself"* with the highest value of 3.16. In the *"Interference with social contacts"* category (from questions 11 to 15), with an average value of 2.28 "*I am treated as I am invisible"* is the most frequent answer for Turkish seafarers. In the *"Effects on personal reputation"* category (questions from 16 to 29), with an average value of 3.12 "*Unfounded rumours about me are circulated in the ship"* is the most frequent answer for Turkish seafarers. When the responses for *"Effects on occupational situation and quality of life"* are examined (from questions 30 to 36), "*I am continually given new tasks"* is found as the most frequent mobbing behaviour with an average value of 3.41, followed by "*I am given meaningless jobs to carry out"* with an average value of 3.03. Studying the answers related to the last question group of *"Effects on physical health"* (questions from 37 to 43), "*I am forced to do a physically strenuous job"* is the most frequent answer with an average value of 2.70.

Table 4. Distributions of seafarers' answers to mobbing questions

Mobbing question group averages of seafarers attending the survey are given in Table 5. The findings show that the general mobbing level of Turkish seafarers is 2.24. According to the data, the most frequent mobbing behaviour is "*Effects on self-expression and communication"* with a value of 2.42. The lowest score is found as 1.78 in the *"Effects on physical health"* group.

Table 5. Averages of mobbing question groups for seafarers

The study investigated whether the groups had a normal distribution or not. Skewness and Kurtosis values were examined for this aim. If the data follows a perfect normal distribution, the Kurtosis and Skewness values should be 0, but this may not be very common. In this study, the Skewness value is between 0.49 and 0.998, while the Kurtosis value ranges between 0.34 and 1.547. If Skewness and Kurtosis values are between -2 and +2, the data follows a normal distribution (Mardia 1970). The Skewness and Kurtosis values in Table 5 are found within this range. Therefore, the groups in Table 5 follow a normal distribution.

3.1. Analysis of Research Hypothesis

3.1.1. Gender

The number of independent samples was different in the study, and the data was nonparametric. Therefore, Mann-Whitney U, one of the nonparametric test methods, was used for analysis. According to the Mann-Whitney U test results, no significant difference was found in mobbing behaviour groups (sources of variance) of the seafarers for gender (Sig. > 0.05). On the other hand, it was seen that in each source of variance, mobbing exposure averages of female seafarers (2.58, 2.15, 2.30, 2.79 and 1.94) were found slightly higher than their male colleagues (2.41, 2.12, 2.20, 2.38 and 1.77). A survey conducted by Namie and Sandvik (2010) with 6,263 participants analyses the mobbing actions in workplaces around the USA. It was stated that men were exposed to mobbing more than women. Contrary to Namie and Sandvik's (2010) conclusions, this study revealed that women are more commonly exposed to mobbing on ships than men.

3.1.2. Age

A One-Way ANOVA method is used to compare the difference between the means of 3 or more groups. One-way analysis of variance can be used whenever it is desired to understand if a variable differs for different groups. One-Way ANOVA was applied to analyse whether the

mobbing behaviours experienced by seafarers significantly differ with their age. As a result of analysis, a significant difference was found only for "*Effects on occupational situation and quality of life"* [(F(4.06), Sig. (0.019)]. A Post-Hoc test was applied to find out the difference between the age groups.

Post Hoc test results indicated a significant difference between the "*30 years and below*" and "*41 years and above*" groups [($p < 0.05$, Sig. (0.013)]. The study results are consistent with the ones obtained in other sectors in the literature (Bhattacharya 2015). A study conducted in Sweden (Leyman 1996) shows that individuals aged 21-40 are more exposed to mobbing behaviours than those aged 41 and over.

3.1.3. Professional Experience

According to the One-Way ANOVA test carried out for determining whether mobbing differs with professional experience, the only significant difference was found in *"Effects on occupational situation and quality of life"* [(F(2.86), Sig. (0.04)].

The Post-Hoc test carried out in the mentioned mobbing group reveals that 0-3 and 4-5 years' sub-groups have a higher mobbing exposure than the ≥10 years group. This situation indicates that, as in many other professions (McKay et al. 2008), young and inexperienced seafarers are more exposed to mobbing behaviours than experienced ones. In terms of fighting against mobbing, it will be useful to inform new seafarers about this phenomenon and warn experienced seafarers about the sanctions against mobbing.

3.1.4. Number of the Crew in the Ship

One-Way ANOVA was utilised to analyse the relation between mobbing levels and the number of crews on ships. It was understood that the crew number variable does not affect the mobbing exposure level [F(0.91), Sig. > 0.05].

3.1.5. Position in Ship

As expected, different mobbing levels were observed for the seafarers with various ranks and responsibility levels. Regarding this comparison, One-Way ANOVA was applied. According to the analysis, significant differences were found for all sub-groups except *"Effects on physical health"* [F(1.66), Sig. (0.133)]. In "*Effects on self-expression and communication"* [F(2.70), Sig. (0.015)] is obtained, in *"Effects on social contacts"* [F(2.53), Sig. (0.022)], in *"Effects on personal reputation"* [F(2.24), Sig. (0.041)], and "*Effects on occupational situation and quality of life"* [F(2.93), Sig. (0.009)].

Examining the mobbing behaviour groups which seafarers are exposed to, significant differences were found between the masters and the 3rd officers. 3. Officers were more exposed to mobbing behaviours than the masters of the ship. Perhaps this is because mobbing behaviours are likely applied to young officers by the ship's masters. The fact that officers terminate their professional career in a short time is a fundamental problem that the maritime industry has been experiencing for years (Uğurlu 2015, Uğurlu et al. 2020a). The results obtained show that the mobbing acts they face in ships may be behind this situation for newly graduated officers.

3.1.6. Marital Status

T-tests were used for detecting the differences in mobbing levels of seafarers regarding their marital status. According to the analysis result, for the variables of "*Effects on self-expression and communication*" [t (-2.51), Sig. (0.013)], "*Effects on personal reputation*" [t (-2.302), Sig. (0.022)], "*Effects on occupational situation and quality of life*" [t (-2.045), Sig. (0.042)] and "*General Mobbing Level*" [t (-2.202), Sig. (0.029)], significant differences were obtained. Single seafarers were more commonly exposed to mobbing behaviours compared to married ones. This finding is consistent with Çivilidağ's (2015) study on mobbing behaviours in different organisational structures.

3.1.7. Education Status

One-Way ANOVA was applied for examining the differences in seafarers' mobbing levels regarding their educational status. It was found that within the only significant group "*Effects on social contacts"* [F(3.01), Sig. (0.05)], the mobbing perception of seafarers with a high school or an associate degree qualification was the highest. In "*Effects on social contacts"*, seafarers with a high school and an associate degree qualification had the highest mobbing level. It is important to underline the role of education in fighting against mobbing.

3.1.8. Type of the Ship

One-Way ANOVA was used to analyse the differences in mobbing levels with the types of the ship which seafarers are currently working on. None of the mobbing groups were found to be significantly different (Sig. > 0.05). Despite harsh working conditions especially experienced in tankers and container vessels, no significant difference was found regarding mobbing levels with ship types.

3.2. Mobbing Level Correlation Analysis

A correlation analysis is conducted to determine if the given mobbing variables affect each other. Different correlation coefficient values are found among the variables; all *p* values are found at the level of less than 0.01.

The correlation coefficient (*r*) is the measure of the relationship between two variables and varies between -1 and +1. In this study, a relatively moderate correlation was found between "*Effects on physical health"* and *"Effects on occupational situation and quality of life*" (*r*=0.692). A high degree of relationship emerged for other sources of variance because the *r*-value was higher than 0.7. The results show that each source of variance positively affects each other. The variance pairs that indicate the highest correlations were found for "*Effects on personal reputation-General Mobbing Level* (r=0.974)", "*Effects on self-expression and communication-General Mobbing Level* (r=0.96)", and *"Effects on occupational situation and quality of life-General Mobbing Level* (r=0.953)", respectively. The results are presented in Table 6.

Table 6. Correlation analysis for mobbing variables of seafarers

** Indicates that the correlation coefficient found has a valid correlation coefficient at the significance level of 0.05.

4. A Proposed Bayesian Network Model for Analysing Mobbing Actions in Ships

The network comprises four levels and fourteen nodes. The first level represents the socio-demographic and professional properties of seafarers, the 2nd one is formed by the mobbing behaviour groups which seafarers encounter in ships, the 3rd one illustrates the mobbing attempts and preventive measures against these attempts, and the last one represents the mobbing (Figure 1). The nodes and relations between these nodes in the first two levels of the network are based on the statistical findings. Mobbing preventive measures in the third level of the network are obtained from the literature.

For the first two levels of the network, the nodes with a significant relationship resulting from the t-test and ANOVA tests are included in the network. The arrows are directed between the nodes if there is a statistically significant relationship between those nodes. For example, due to the significant relation between "*interference with self-expression and communication*" in the 2nd level and the variables of "*position in the ship*" and "*marital status*" at the 1st level, arrows are directed from these two 1st level variables to the "*interference with self-expression*

and communication" node (Table 7, Figure 1). Due to lack of statistical relations, no arrows are directed between the ISC node and any of the age, professional experience and education status nodes. In this study, nodes that do not involve statistical significance (gender, type of ships, crew number of ship, and effects on physical health) are not included in the network.

Table 7. Determining the nodes in the first two levels of the Bayesian network and relationships between them

Figure 1. A proposed Bayesian network model for analysing mobbing actions in ships

Total scores and weight factors of expert opinions of this study are presented in Table 8. The linguistic assessment results of the expert group, regarding the posterior probability values of nodes in the Bayes network are given in Table 9, fuzzy probability scores obtained as a result of aggregation are also presented in Table 10. The final network structure of the study is shown in Figure 2.

Table 8. Total scores and weight factors of experts

Table 9. The linguistic assessment results of the expert group

Table 10. Fuzzy probability scores for nodes

Figure 2. The results from the BN model

4.1. Validation of the BN Model

Axiom tests are performed for proving the accuracy of the Bayesian network. As a result of axiom tests (axioms 1-3), the validity of the Bayesian network established in the study is demonstrated.

4.2. Sensitivity Analysis Results

The effect of nodes in the network over target nodes is observed via sensitivity analysis. This study's target nodes are the mobbing behaviour groups located in the network's 2nd level and the final node represents the mobbing act. With the help of sensitivity analysis, the sensitivity of parent nodes over target nodes is analysed. The sensitivity analysis results of the nodes that have the most significant impact on the target nodes are presented in Table 11.

Table 11. Sensitivity analysis results

For mobbing attacks in "*interference with self-expression and communication*", it was realised that single seafarers were more often exposed to mobbing compared to married ones (Table 11, Figure 2). Among the single ones, cadets and ratings were typical. Similar results were obtained for "*interference with social contacts*". Seafarers holding a vocational school or lower degree qualification, face mobbing attacks most for "*interference with social contacts*". It was also realised that mobbing attacks reduce when the educational status advances. Cadets and officers were the most frequently mobbed seafarers, within the bachelor's degree education group. It was also observed that the attacks on "*interference with occupational situation and quality of life*" concentrated on seafarers aged 30 and under. Mobbing attacks experienced by seafarers decrease with an increase in age. As the sea-going experience increases, mobbing attacks to seafarers decrease. In the last level of the BN network, "*Mobbing*", three counter mobbing support variables were added as parent nodes. With the present condition, the mobbing probability value was found as 20%. According to sensitivity analysis, if the company has measures in place to combat mobbing attempts, mobbing probability reduces to a level of 6%. The effects of PSC and ITF alone for combating mobbing in ships were found to be insufficient. This situation points out that both PSC and ITF have limited capabilities for solving the mobbing problem alone, while the companies may have a lot to do to address the issue. Mobbing reduces to a low level of 2% when all three authorities take measure all together.

5. Fighting with Mobbing in Ships

According to the results of the study, the general mobbing level for Turkish seafarers is found as 2.24 out of 5. This result is considered to be high, compared to previous study results, which were obtained for seafarers (Kum and Ertaş 2016, Tavacıoğlu et al. 2018). According to the assessment which is carried out on the LIPT scale, interference with self-expression and communication (2.42), interference with occupational situation and quality of life (2.39) and interference with personal reputation (2.21) are three most frequent mobbing sub-categories, while interference with physical health, which also includes sexual harassment, takes the last place among other mobbing categories with 1.78. Sexual harassment acts are also considered in occupational safety and health (OSH) as a problematic factor, especially for women seafarers; however, the low values in these factors may be explained with possible victims' refrainment for the mobbing behaviours which they face (Pinero and Kitada 2020).

According to the study result, there is no significant difference in exposure to harassment behaviours for gender; however, there are reports in the literature that women seafarers are mobbed twice as much as men (Forsel et al. 2017).

Parallel with the study's sensitivity analyses, the literature also supports single individuals being exposed to mobbing more frequently than married ones (Feijo et al. 2019). Although there are many counter results, a strong relationship is found between the education level and the mobbing level, according to sensitivity analyses of the study. Furthermore, as an essential factor regarding mobbing behaviours, a negative relationship between age and the mobbing level is found. It is observed that mobbing decreases with an increase in age.

The most important countermeasure in fighting against mobbing is increasing the awareness of victims, companies, and society for this problem (Nielsen 2013). The result of this study reveals the fact that the companies (shipowners) play a vital role in the mobbing phenomena (Table 11). Thus, companies must establish ethical rules for fighting against mobbing and comply with these rules. As also stated by Kitada, Pineiro and Mejia (2019), the Guidence for Eliminating Shipboard Harassment & Bullying, which is jointly published by the International Chamber of Shipping (ICS) and the ITF, may be helpful to seafarers. As it takes places in many other sectors, managers should first identify possible mobbing actions specific to their ships and ensure that these actions are well-recognised by their employees. Thus, the mobbing victim will be able to perceive mobbing and fight against it effectively. For preventing mobbing, it is vital to be conscious.

Furthermore, to deal with harassment and bullying, it is necessary to provide a shipboard environment where all seafarers feel comfortable in reporting incidents following the company procedure (Pinero and Kitada 2020). Mobbing victims must first convince themselves that they do not deserve this situation and act accordingly. As for advice to administrations and ship owners, the Maritime Labour Convention (MLC) 2006 amendments that came in force in 2019 aim to provide seafarers with a safe and healthy working environment against bullying, gender inequality and harassment nonconformities (Kitada, 2021). The duty of the control mechanisms such as port state and the ITF in combating mobbing on ships will ensure that responsible and legitimate measures are taken to prevent mobbing, during the controls to be carried out in ports.

6. Conclusion

As in many other sectors, mobbing is an organisational problem that negatively affects physical and mental health, productivity, and, above all, seafarers' professional life on ships. In

this study, the mobbing behaviours that seafarers are most frequently exposed to on ships are *"I am continually given new tasks" (3.41), "My superiors restrict the opportunity for me to express myself"* (3.16), *"Unfounded rumours about me is circulated in the ship"* (3.12), *"I am given meaningless jobs to carry out*" (3.03). In this study, a significant relationship was found between seafarers' socio-demographic characteristics, age, professional experience, marital status, and mobbing behaviours they were exposed to onboard ships. However, no significant difference was found in terms of gender, education level, and ship type. Mobbing is not a destiny, and therefore awareness-raising of the workforce is essential. Ship-owners, who play a crucial role in combating mobbing, need to develop robust policies that clearly define these destructive behaviours to create an acceptably liveable and improved work environment on their ships. This study's results present advice for shipowners and other shipping beneficiaries in determining and adopting these policies.

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Table 1. Weight scores of experts

Constitution	Classification	Score
Professional position	Human resources manager	5
	Superintendent	4
	Seafarer	3
	Professor	2
	Lecturer	2
	Student	1
Competency	Master	5
	Chief engineer	4
	Officer	2
	Cadet	1
Professional experience in years	$\geq$ 16 years	5
	11-15 years	4
	6-10 years	3
	2-5 years	2
	$\leq$ 1 year	1

Table 2 Linguistic measurement scale (Rajakarunakaran, 2015)

Measurement Scale	TFN		
	a_1	a_2	a_3
Very low (VL)	0	0.04	0.08
Low (L)	0.07	0.13	0.19
Medium low (ML)	0.17	0.27	0.37
Medium (M)	0.35	0.5	0.65
Medium high (MH)	0.63	0.73	0.83
High (H)	0.81	0.87	0.93
Very high (VH)	0.92	0.96	1

Table 3. Distribution of demographic variables for seafarers

Variable	Groups	N	%
Gender	Male	200	90.5
	Female	21	9.5
Age	≤30	125	56.6
	31-40	82	37.1
	>41	14	6.3
Marital status	Married	99	44.8
	Single	122	55.2
Education status	Primary school	6	2.7
	High school	17	7.7
	Vocational school	11	5.0
	Bachelor	160	72.4
	Postgraduate	27	12.2
Professional experience (years)	0-3	80	36.2
	4-5	32	14.5
	6-9	47	21.3
	≥10	62	28.1
Number of ships in maritime firm	1-5	59	26.7
	6-10	49	22.2
	11-14	39	17.6
	≥15	74	33.5
Type of the ship	Bulk carrier	83	37.6
	Chemical tanker	56	25.3
	Crude oil carrier	24	10.9
	LPG/LNG tanker	3	1.4
	Container	31	14.0
	Ro-Ro	16	7.2
	Others	8	3.6
Tonnage of the ship	<3000 GT	13	5.9
	3000-9999 GT	71	32.1
	10000-19999 GT	46	20.8
	20000-29999 GT	18	8.1
	30000-49999 GT	30	13.6
	≥50000 GT	43	19.5
Number of crew	≤10	9	4.1
	11-15	32	14.5
	16-20	106	48.0
	≥21	74	33.5
Working period in ship (months)	0-4	90	40.7
	5-6	77	34.8
	7-8	28	12.7
	≥9	26	11.8
Position	Master	39	17.6
	1st officer	44	19.9
	2nd officer	60	27.1
	3rd officer	31	14.0
	Chief engineer	4	1.8
	2nd engineer	8	3.6
	3rd engineer	2	0.9
	Ratings	17	7.7
	Cadets	16	7.2

Table 4. Distributions of seafarers' answers to mobbing questions

Group of variances	No	Source of variance	Strongly disagree		Disagree		Neutral		Agree		Strongly agree			
			N	***%***	**N**	***%***	**N**	***%***	**N**	***%***	**N**	***%***	***Avr***	***St.D***
Interference with self-expression and communication	1	My superiors restrict the opportunity for me to express myself	15	6.8	75	33.9	28	12.7	65	29.4	38	17.2	**3.16**	1.3
	2	I am constantly interrupted in ship	28	12.7	99	44.8	20	9	55	24.9	19	8.6	**2.72**	1.2
	3	I am terrorized on the phone	48	21.7	77	34.8	17	7.7	50	22.6	29	13.1	**2.71**	1.4
	4	Written threats are sent	104	47.1	85	38.5	10	4.5	16	7.2	6	2.7	**1.80**	1.0
	5	Colleagues restrict my opportunity to express myself	41	18.6	97	43.9	38	17.2	31	14	14	6.3	**2.46**	1.1
	6	I am yelled at and loudly scolded	46	20.8	70	31.7	31	14	51	23.1	23	10.4	**2.71**	1.3
	7	My work is constantly criticized	45	20.4	79	35.7	28	12.7	48	21.7	21	9.5	**2.64**	1.3
	8	Oral threats are made	101	45.7	63	28.5	11	5	31	14	15	6.8	**2.08**	1.3
	9	There is constant criticism for my private life	91	41.2	81	36.7	18	8.1	21	9.5	10	4.5	**2.00**	1.1
	10	Contact is denied through body languages or gestures	52	23.5	95	43	26	11.8	37	16.7	11	5	**2.37**	1.2
Interference with social contacts	11	You cannot talk to anyone in the ship	55	24.9	131	59.3	14	6.3	13	5.9	8	3.6	**2.04**	0.9
	12	Colleagues do not speak with me anymore	84	38	112	50.7	14	6.3	6	2.7	5	2.3	**1.81**	0.8
	13	I am relocated to another room far away from colleagues	60	27.1	105	47.5	33	14.9	15	68	8	3.6	**2.12**	1.0
	14	I am treated as I am invisible	75	33.9	73	33	22	10	39	17.6	12	5.4	**2.28**	1.3
	15	Colleagues are not allowed to talk with me	87	39.4	90	40.7	20	9	21	9.5	3	1.4	**1.93**	1.0
Interference with personal reputation	16	People imitate my gestures, walk, or voice to ridicule me	63	28.5	97	43.9	16	7.2	25	11.3	20	9	**2.29**	1.2
	17	Unfounded rumours about me are circulated in the ship	26	11.8	42	19	65	29.4	55	24.9	33	14.9	**3.12**	1.2
	18	I am treated as a person with a mental illness	106	48	78	35.3	14	6.3	19	8.6	4	1.8	**1.81**	1.0
	19	My political or religious beliefs are ridiculed	59	26.7	76	34.4	25	11.3	43	19.5	18	8.1	**2.48**	1.3
	20	I am forced to do a job that affects my self-esteem	56	25.3	91	41.2	23	10.4	34	15.4	17	7.7	**2.39**	1.2
	21	My efforts are judged in a wrong and demeaning way	49	22.2	84	38	24	10.9	42	19	22	10	**2.57**	1.3
	22	My decisions are always questioned	31	14	88	39.8	30	13.6	50	22.6	22	10	**2.75**	1.2
	23	Sexual innuendoes are present	137	62	68	30.8	7	3.2	5	2.3	4	1.8	**1.51**	0.8
	24	People talk badly about me behind my back	69	31.2	83	37.6	26	11.8	27	12.2	16	7.2	**2.27**	1.2
	25	I am ridiculed	77	34.8	90	40.7	19	8.6	26	11.8	9	4.1	**2.10**	1.1
	26	My handicap is ridiculed	134	60.6	63	28.5	11	5	10	4.5	3	1.4	**1.57**	0.9
	27	I am forced to undergo a psychiatric evaluation	80	36.2	67	30.3	26	11.8	32	14.5	16	7.2	**2.26**	1.3

	28	My private life is ridiculed	94	42.5	77	34.8	24	10.9	20	9	6	2.7	**1.95**	1.1
	29	I am called by demeaning names	94	42.5	85	38.5	20	9	14	6.3	8	3.6	**1.90**	1.0
Interference with occupational situation and quality of life	30	I am given meaningless jobs to carry out	28	12.7	67	30.3	31	14	60	27.1	35	15.8	**3.03**	1.3
	31	There are no specific tasks for me	48	21.7	108	48.9	34	15.4	19	8.6	12	5.4	**2.27**	1.1
	32	Supervisors take away assignments so that I cannot invent new tasks to do	91	41.2	94	42.5	12	5.4	17	7.7	7	3.2	**1.89**	1.0
	32	I am given jobs that are below my qualifications	62	28.1	79	35.7	25	11.3	43	19.5	12	5.4	**2.38**	1.2
	34	I am given tasks that are way beyond my qualifications in order to discredit me	75	33.9	75	33.9	24	10.9	29	13.1	18	8.1	**2.28**	1.3
	35	I am given tasks that affect my self-esteem	71	32.1	87	39.4	14	6.3	29	13.1	20	9	**2.28**	1.3
	36	I am continually given new tasks	15	6.8	57	25.8	20	9	81	36.7	48	21.7	**3.41**	1.3
Interference with physical health	37	I am forced to do a physically strenuous job	38	17.2	83	37.6	30	13.6	47	21.3	23	10.4	**2.70**	1.3
	38	Threats of physical violence are made	106	48	83	37.6	12	5.4	17	7.7	3	1.4	**1.77**	1.0
	39	Physical abuse is present in ship	121	54.8	77	34.8	9	4.1	13	5.9	1	0.5	**1.62**	0.9
	40	Outright sexual harassment is present in ship	163	73.8	48	21.7	7	3.2	2	0.9	1	0.5	**1.33**	0.6
	41	Light violence is used to threaten me	136	61.5	70	31.7	6	2.7	7	3.2	2	0.9	**1.50**	0.8
	42	Damaging my workplace or cabin-5	94	42.5	78	35.3	18	8.1	20	9	11	5	**1.99**	1.2
	43	Causing general damages that create financial costs to me	90	40.7	86	38.9	18	8.1	16	7.2	11	5	**1.97**	1.1

Table 5. Averages of mobbing question groups for seafarers

Questions	Source of variance	N	Ave	St.D	Skewness	Kurtosis
1-10	Interference with self-expression and communication	221	2.42	0.89	0.49	-0.34
11-15	Interference with social contacts	221	2.12	0.81	0.989	1.244
16-29	Interference with personal reputation	221	2.21	0.87	0.787	0.82
30-36	Interference with occupational situation and quality of life	221	2.39	0.89	0.65	0.018
37-43	Interference with physical health	221	1.78	0.62	0.998	1.547
	General mobbing level	**221**	**2.24**	**0.79**	**0.696**	**0.167**

Table 6. Correlation analyses for mobbing variables of seafarers

Source of variance	Effects on self-expression and communication	Effects on social contacts	Effects on personal reputation	Effects on occupational situation and quality of life	Effects on physical health	**General mobbing level**
Effects on self-expression and communication	**1**					
Effects on social contacts	0.797**	**1**				
Effects on personal reputation	0.907**	0.815**	**1**			
Effects on occupational situation and quality of life	0.899**	0.787**	0.91**	**1**		
Effects on physical health	0.747**	0.709**	0.753**	0.692**	**1**	
General mobbing level	0.96**	0.868**	0.974**	0.953**	0.803**	**1**

** Indicates that the correlation coefficient found has a valid correlation coefficient at the significance level of 0.05.

Table 7. Determining the nodes in the first two levels of the Bayesian network and the relationship between them

	Effects on self-expression and communication	Effects on social contacts	Effects on personal reputation	Effects on occupational situation and quality of life	Effects on physical health
Gender	-	-	-	-	-
Age	-	-	-	+	-
Professional experience	-	-	-	+	-
Number of crew in ship	-	-	-	-	-
Position in ship	+	+	+	-	-
Marital status	+	-	+	+	-
Education status	-	+	-	-	-
Type of the ship	-	-	-	-	-

Table 8. Total scores and weight factors of experts

				Weight score				
Expert no.	Professional position	Competency	Operational experience (year)	Professional position (Score)	Competency (Score)	Professional experience in years (Score)	Total score	Weight factor
1	Professor	Master	19	2	5	5	12.00	0.21
2	2nd officer	OOW	2.5	3	2	2	7.00	0.12
3	Student	Cadet	1	1	1	1	3.00	0.05
4	Lecturer	Chief Eng.	17	2	4	5	11.00	0.19
5	Superintendent	Master	16	4	5	5	14.00	0.25
6	HR expert	OOW	4	5	2	2	9.00	0.16

Table 9. Linguistic results of the expert evaluation of nodes

NODES	No.	CONDITIONS				EXPERTS					
		Age	Professional experience	Position in ship	Marital status	E1	E2	E3	E4	E5	E6
Interference with Occupational Situation and Quality of Life (IOSQL)	1	≤ 30	5 years or less	Master	Married	-	-	-	-	-	-
	2	≤ 30	5 years or less	Master	Single	-	-	-	-	-	-
	3	≤ 30	5 years or less	Officer/Eng.	Married	MH	MH	M	H	M	ML
	4	≤ 30	5 years or less	Officer/Eng.	Single	H	H	MH	H	M	ML
	5	≤ 30	5 years or less	Rating	Married	MH	MH	MH	VH	H	L
	6	≤ 30	5 years or less	Rating	Single	H	MH	H	VH	H	L
	7	≤ 30	5 years or less	Cadet	Married	-	-	-	-	-	-
	8	≤ 30	5 years or less	Cadet	Single	VH	H	VH	VH	H	ML
	9	≤ 30	More than 5 years	Master	Married	-	-	-	-	-	-
	10	≤ 30	More than 5 years	Master	Single	-	-	-	-	-	-
	11	≤ 30	More than 5 years	Officer/Eng.	Married	MH	M	ML	MH	L	L
	12	≤ 30	More than 5 years	Officer/Eng.	Single	MH	MH	M	MH	L	L
	13	≤ 30	More than 5 years	Rating	Married	MH	M	M	H	M	L
	14	≤ 30	More than 5 years	Rating	Single	MH	M	MH	H	M	L
	15	≤ 30	More than 5 years	Cadet	Married	-	-	-	-	-	-
	16	≤ 30	More than 5 years	Cadet	Single	-	-	-	-	-	-
	17	31-40	5 years or less	Master	Married	-	-	-	-	-	-
	18	31-40	5 years or less	Master	Single	-	-	-	-	-	-
	19	31-40	5 years or less	Officer/Eng.	Married	ML	ML	ML	VH	M	VL
	20	31-40	5 years or less	Officer/Eng.	Single	ML	ML	M	VH	M	VL
	21	31-40	5 years or less	Rating	Married	M	ML	M	H	M	L
	22	31-40	5 years or less	Rating	Single	M	ML	MH	H	M	L
	23	31-40	5 years or less	Cadet	Married	-	-	-	-	-	-
	24	31-40	5 years or less	Cadet	Single	-	-	-	-	-	-
	25	31-40	More than 5 years	Master	Married	L	L	VL	ML	H	VL
	26	31-40	More than 5 years	Master	Single	ML	L	VL	M	H	VL
	27	31-40	More than 5 years	Officer/Eng.	Married	ML	L	L	ML	M	L
	28	31-40	More than 5 years	Officer/Eng.	Single	ML	ML	ML	M	M	L
	29	31-40	More than 5 years	Rating	Married	M	ML	ML	L	L	L
	30	31-40	More than 5 years	Rating	Single	M	ML	M	ML	L	L
	31	31-40	More than 5 years	Cadet	Married	-	-	-	-	-	-
	32	31-40	More than 5 years	Cadet	Single	-	-	-	-	-	-
	33	>40	5 years or less	Master	Married	-	-	-	-	-	-
	34	>40	5 years or less	Master	Single	-	-	-	-	-	-
	35	>40	5 years or less	Officer/Eng.	Married	ML	ML	ML	VH	M	M
	36	>40	5 years or less	Officer/Eng.	Single	ML	ML	M	VH	M	M
	37	>40	5 years or less	Rating	Married	ML	ML	M	VH	M	L
	38	>40	5 years or less	Rating	Single	ML	ML	MH	VH	M	L
	39	>40	5 years or less	Cadet	Married	-	-	-	-	-	-
	40	>40	5 years or less	Cadet	Single	-	-	-	-	-	-
	41	>40	More than 5 years	Master	Married	VL	VL	VL	VL	VL	VL
	42	>40	More than 5 years	Master	Single	VL	L	VL	VL	VL	VL
	43	>40	More than 5 years	Officer/Eng.	Married	ML	L	L	VL	L	VL
	44	>40	More than 5 years	Officer/Eng.	Single	ML	L	L	VL	L	VL
	45	>40	More than 5 years	Rating	Married	ML	ML	M	L	M	VL
	46	>40	More than 5 years	Rating	Single	ML	ML	MH	L	M	VL
	47	>40	More than 5 years	Cadet	Married	-	-	-	-	-	-
	48	>40	More than 5 years	Cadet	Single	-	-	-	-	-	-

	No.	Position in Ship	Marital Status	E1	E2	E3	E4	E5	E6
Interference with Self-expression and Communication (ISEC)	49	Master	Married	VL	L	VL	VL	VL	VL
	50	Master	Single	VL	MH	L	VL	VL	VL
	51	Officer/Eng.	Married	ML	L	L	L	L	VL
	52	Officer/Eng.	Single	MH	H	ML	L	L	VL
	53	Rating	Married	ML	M	M	M	M	VL
	54	Rating	Single	MH	M	MH	M	M	VL
	55	Cadet	Married	-	-	-	-	-	-
	56	Cadet	Single	VH	MH	H	MH	H	VL
	No.	**Position in Ship**	**Education Status**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Interference with Social Contacts (ISC)	57	Master	Prim. school or high school	M	ML	ML	M	M	VL
	58	Officer/Eng.	Prim. school or high school	MH	MH	M	H	M	VL
	59	Rating	Prim. school or high school	VH	M	MH	L	M	VL
	60	Cadet	Prim. school or high school	H	MH	MH	H	H	VL
	61	Master	Voc. school or bachelor	L	L	L	L	L	VL
	62	Officer/Eng.	Voc. school or bachelor	M	M	ML	MH	M	VL
	63	Rating	Voc. school or bachelor	VH	ML	M	VL	M	VL
	64	Cadet	Voc. school or bachelor	H	M	MH	MH	H	VL
	65	Master	Postgraduate	L	L	L	L	L	VL
	66	Officer/Eng.	Postgraduate	M	M	ML	MH	M	VL
	67	Rating	Postgraduate	-	-	-	-	-	-
	68	Cadet	Postgraduate	-	-	-	-	-	-
	No.	**Position in Ship**	**Marital Status**	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Interference with Personal Reputation (IPR)	69	Master	Married	VL	L	L	L	L	ML
	70	Officer/Eng.	Married	M	L	ML	M	M	M
	71	Rating	Married	MH	L	M	M	MH	MH
	72	Cadet	Married	-	-	-	-	-	-
	73	Master	Single	VL	L	ML	MH	L	ML
	74	Officer/Eng.	Single	M	ML	M	H	M	M
	75	Rating	Single	H	ML	M	H	MH	MH
	76	Cadet	Single	VH	H	H	H	H	L

Table 10. Fuzzy set values for nodes

NODES	No.	CONDITIONS				Aggregation results of basic events			Fuzzy probability score (FPS)
		Age	**Professional experience**	**Position in ship**	**Marital status**	a_1	a_2	a_3	
Interference with Occupational Situation and Quality of Life (IOSQL)	1	≤ 30	5 years or less	Master	Married	-	-	-	-
	2	≤ 30	5 years or less	Master	Single	-	-	-	-
	3	≤ 30	5 years or less	Officer/Eng.	Married	0.501	0.610	0.719	0.610
	4	≤ 30	5 years or less	Officer/Eng.	Single	0.606	0.695	0.783	0.695
	5	≤ 30	5 years or less	Rating	Married	0.654	0.730	0.806	0.730
	6	≤ 30	5 years or less	Rating	Single	0.720	0.782	0.844	0.782
	7	≤ 30	5 years or less	Cadet	Married	-	-	-	-
	8	≤ 30	5 years or less	Cadet	Single	0.790	0.844	0.899	0.844
	9	≤ 30	More than 5 years	Master	Married	-	-	-	-
	10	≤ 30	More than 5 years	Master	Single	-	-	-	-
	11	≤ 30	More than 5 years	Officer/Eng.	Married	0.327	0.419	0.512	0.419
	12	≤ 30	More than 5 years	Officer/Eng.	Single	0.403	0.495	0.587	0.495
	13	≤ 30	More than 5 years	Rating	Married	0.442	0.555	0.667	0.555
	14	≤ 30	More than 5 years	Rating	Single	0.482	0.588	0.694	0.588
	15	≤ 30	More than 5 years	Cadet	Married	-	-	-	-
	16	≤ 30	More than 5 years	Cadet	Single	-	-	-	-
	17	31-40	5 years or less	Master	Married	-	-	-	-
	18	31-40	5 years or less	Master	Single	-	-	-	-
	19	31-40	5 years or less	Officer/Eng.	Married	0.285	0.378	0.471	0.378
	20	31-40	5 years or less	Officer/Eng.	Single	0.315	0.414	0.513	0.414
	21	31-40	5 years or less	Rating	Married	0.354	0.469	0.584	0.469
	22	31-40	5 years or less	Rating	Single	0.390	0.498	0.607	0.498
	23	31-40	5 years or less	Cadet	Married	-	-	-	-
	24	31-40	5 years or less	Cadet	Single	-	-	-	-
	25	31-40	More than 5 years	Master	Married	0.184	0.246	0.307	0.246
	26	31-40	More than 5 years	Master	Single	0.246	0.324	0.403	0.324
	27	31-40	More than 5 years	Officer/Eng.	Married	0.162	0.254	0.347	0.254
	28	31-40	More than 5 years	Officer/Eng.	Single	0.223	0.336	0.448	0.336
	29	31-40	More than 5 years	Rating	Married	0.145	0.232	0.318	0.232
	30	31-40	More than 5 years	Rating	Single	0.185	0.285	0.385	0.285
	31	31-40	More than 5 years	Cadet	Married	-	-	-	-
	32	31-40	More than 5 years	Cadet	Single	-	-	-	-
	33	>40	5 years or less	Master	Married	-	-	-	-
	34	>40	5 years or less	Master	Single	-	-	-	-
	35	>40	5 years or less	Officer/Eng.	Married	0.349	0.459	0.570	0.459
	36	>40	5 years or less	Officer/Eng.	Single	0.375	0.492	0.608	0.492
	37	>40	5 years or less	Rating	Married	0.324	0.426	0.528	0.426
	38	>40	5 years or less	Rating	Single	0.360	0.455	0.550	0.455
	39	>40	5 years or less	Cadet	Married	-	-	-	-
	40	>40	5 years or less	Cadet	Single	-	-	-	-
	41	>40	More than 5 years	Master	Married	0.000	0.040	0.080	0.040
	42	>40	More than 5 years	Master	Single	0.010	0.053	0.095	0.053
	43	>40	More than 5 years	Officer/Eng.	Married	0.064	0.125	0.185	0.125
	44	>40	More than 5 years	Officer/Eng.	Single	0.064	0.125	0.185	0.125
	45	>40	More than 5 years	Rating	Married	0.181	0.280	0.379	0.280
	46	>40	More than 5 years	Rating	Single	0.202	0.296	0.389	0.296
	47	>40	More than 5 years	Cadet	Married	-	-	-	-
	48	>40	More than 5 years	Cadet	Single	-	-	-	-

	No.	Position in Ship	Marital Status	a_1	a_2	a_3	FPS
Interference with Self-expression and Communication (ISEC)	49	Master	Married	0.010	0.053	0.095	0.053
	50	Master	Single	0.070	0.119	0.167	0.119
	51	Officer/Eng.	Married	0.077	0.141	0.205	0.141
	52	Officer/Eng.	Single	0.257	0.326	0.394	0.326
	53	Rating	Married	0.267	0.392	0.517	0.392
	54	Rating	Single	0.388	0.508	0.629	0.508
	55	Cadet	Married	-	-	-	-
	56	Cadet	Single	0.681	0.749	0.817	0.749
	No.	**Position in Ship**	**Education Status**	a_1	a_2	a_3	FPS
Interference with Social Contacts (ISC)	57	Master	Prim. school or high school	0.251	0.372	0.492	0.372
	58	Officer/Eng.	Prim. school or high school	0.487	0.589	0.691	0.589
	59	Rating	Prim. school or high school	0.376	0.469	0.562	0.469
	60	Cadet	Prim. school or high school	0.673	0.742	0.811	0.742
	61	Master	Voc. school or bachelor	0.059	0.116	0.173	0.116
	62	Officer/Eng.	Voc. school or bachelor	0.328	0.448	0.569	0.448
	63	Rating	Voc. school or bachelor	0.287	0.374	0.462	0.374
	64	Cadet	Voc. school or bachelor	0.588	0.672	0.755	0.672
	65	Master	Postgraduate	0.059	0.116	0.173	0.116
	66	Officer/Eng.	Postgraduate	0.328	0.448	0.569	0.448
	67	Rating	Postgraduate	-	-	-	-
	68	Cadet	Postgraduate	-	-	-	-
	No.	**Position in Ship**	**Marital Status**	a_1	a_2	a_3	FPS
Interference with Personal Reputation (IPR)	69	Master	Married	0.073	0.135	0.198	0.135
	70	Officer/Eng.	Married	0.294	0.427	0.560	0.427
	71	Rating	Married	0.479	0.590	0.700	0.590
	72	Cadet	Married	-	-	-	-
	73	Master	Single	0.169	0.242	0.316	0.242
	74	Officer/Eng.	Single	0.399	0.528	0.657	0.528
	75	Rating	Single	0.611	0.701	0.791	0.701
	76	Cadet	Single	0.751	0.807	0.864	0.807

Table 11. Results of sensitivity analysis

Parent nodes	Conditions	Probability value of the target (child) node (%)	Name of target (child) node
"Position"	Single	51	Interference with self-expression and communication (Yes)
	Married	36	
"Position" and "Marital status"	Single-Master	24	
	Single-Officer	53	
	Single-Rating	70	
	Single-Cadet	81	
"Educational status"	Vocational school ≤	55	Interference with social contacts (Yes)
	Bachelor	40	
	Postgraduate	32	
"Educational status" and "Position"	Bachelor-Master	12	
	Bachelor-Officer	45	
	Bachelor-Rating	37	
	Bachelor-Cadet	67	
"Position"	Single	33	Interference with personal reputation (yes)
	Married	13	
"Position" and "Marital status"	Single-Master	12	
	Single-Officer	33	
	Single-Rating	51	
	Single-Cadet	75	
"Age"	≤ 30	45	Interference with occupational situation and quality of life (Yes)
	31-40	29	
	>41	24	
"Professional Experience"	0-5	44	
	5 <	31	
Anti-mobbing mechanisms	Company	6	Mobbing (Yes)
	PSC	17	
	ITF	18	
	Company-PSC-ITF	2	

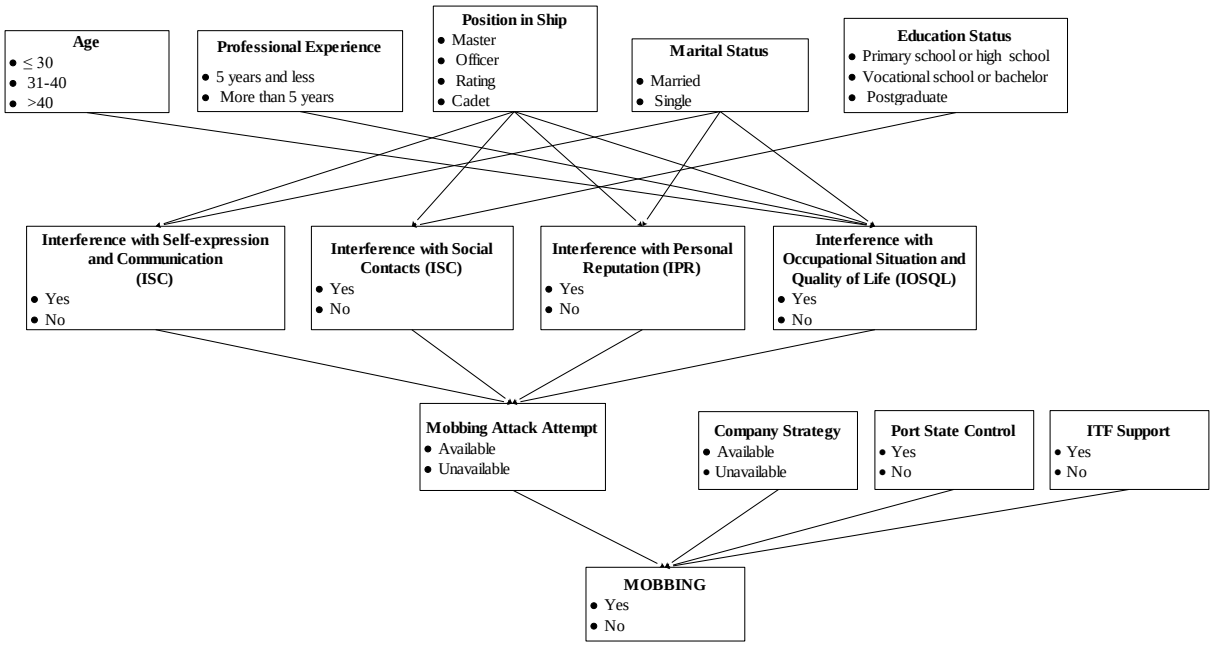

Figure 1. A proposed Bayesian network model for analysing mobbing actions in ships

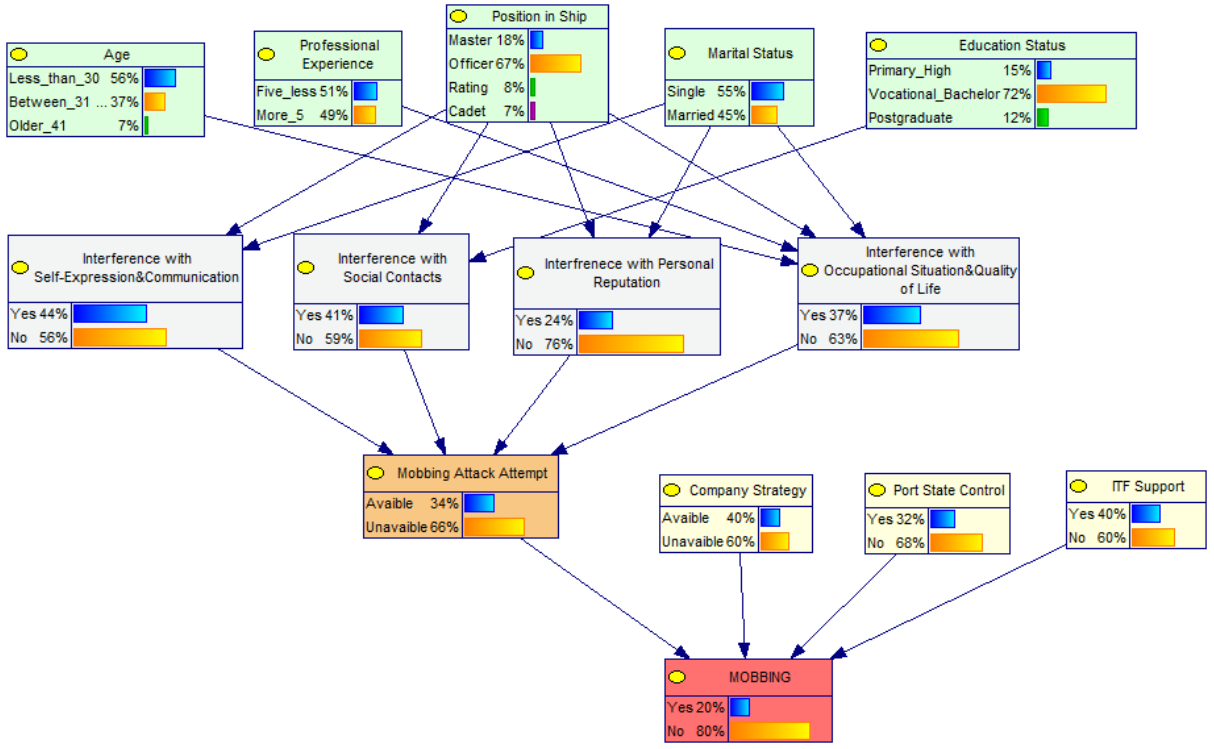

Figure 2. The results from the BN model