Examining the Influence of Safety Climate on River, Lake, and Water Transportation: A Case Study of South Sumatra Ferries

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Indonesia, with approximately 17,000 islands, is the world's second-largest archipelagic nation after Canada. With its huge geography at sea, maritime transportation is an essential vehicle for providing the mobility of people and goods and building the socioeconomic existence of coastal communities. However, maritime transportation has several problems, particularly with regard to safety risks, which are often caused by three important reasons: technical deficiencies, human error and nature. Natural causes include poor environmental conditions, while human causes include negligence and lack of procedures. On the other hand, technical causes include unsafe work practices and operational deficiencies on vessels. The conclusion of this study highlights the importance of instilling a good safety culture in the shipping industry. With a focus on ferry transportation at Tanjung Api-Api Port in Banyuasin Regency, an important transit location between Bangka Belitung Province and South Sumatra Province. This study investigated the relationship of communication, leadership, management commitment, and organizational trust shape the safety climate at two major ferry ports in South Sumatra. Through the application of Structural Equation Modeling (SEM), the research assessed the validity of the safety management model and identified key factors. These include the role of open communication in proposing leadership and management commitment, as well as the impact of leadership in increasing organizational trust.

Keyword: *Structural Equation Modeling (SEM) Analysis, Accident Causal Factors, Safety Culture, Safety Climate, Water Transportation.*

1. INTRODUCTION

Maritime transportation has long been the basis of world economic growth, most cost-efficient to transport products and raw materials internationally. It is not just a historic basis but an element driving economic development today as it offers unbeatable cost advantage for international logistics [1]. Indonesia is an archipelagic country of some 17,000 islands and the world's second largest archipelago after Canada. Oceans, rivers, and lakes are a vast network serving as major linking arteries among islands separated by seas and straits, and hence efficient transportation infrastructure is very important for inter-island connectivity. The country's transportation infrastructure is divided into three general modes including sea, land, and air. Among them, the sea transport plays a fundamental role, not only facilitating the movement of people and

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goods but also in supporting regional economic development and improving people's welfare.

Seaports worldwide experience high accident rates, making maritime transportation inherently hazardous. Economic effects of sea accidents are of greater consequence when more global business relies on ships [2]–[4]. For the improvement of safety purposes, sea accident reports and data banks are invaluable sources of research information. It has been a practice by multiple studies to do high-level summaries of accidents and examine single geographical regions and root causes. For example, there has previously been research into navigational incidents in China's Yangtze River [5] and incidents that occurred in adverse weather [6], [7]. In Indonesia, data from the National Transportation Safety Committee (KNKT) indicate that between 2020 and the second half of 2023, maritime accidents were due to 20 different causes, and technical malfunction, as well as human failure, was quoted as primary causes of accidents [8], [9]. In addition, climate factors such as severe weather conditions, sea level rise, and unstable ocean currents also pose an increasing risk of accidents. In Indonesia, climatic element, such as tropical cyclones induce severe weather conditions and heightened wave activity, which are major threats to maritime operation [10]. The aforementioned findings establish the urgent need for enhanced safety measures and adaptive processes to counteract environmental and operational hazards in maritime transport [11].

Sumatra dominates Indonesian trade with a hub in its geographical sea location and natural endowment. As one of the key sea transport points, Sumatra connects remote locations and allows for Indonesia's high-value exports such as palm oil, rubber, and coal, which are the height of Indonesian trade. In addition, Sumatra's sea facilities enable inter-island trade, tourism and jobs, and government investment in terminals such as Kuala Tanjung and Tanjung Api-Api enhances its economic contribution further [12]. This makes Sumatra a pillar of Indonesia's maritime economy and a leading driver of national development [13], [14]. Disruptions in sea transport in Sumatra, particularly due to climate or inclement weather, will have dire and far-reaching effects. Such disruptions would delay exports of key commodities such as palm oil, rubber and coal, lower Indonesia's share of trade in Sumatra and even cause long-term economic and social problems. Such problems would not only damage Sumatra but also Indonesia's national economy and global image in trade.

Understanding the influence of the safety climate on river and water crossing transportation at Tanjung Api-api Port (South Sumatra) and Tanjung Kalian Muntok Port (Bangka Belitung) is critical, given their strategic importance as centers of trade, tourism, and regional connectivity [13]. Ensuring safety in these transportation systems not only prevents accidents and operational disruptions but also improves efficiency, safeguards livelihoods, and supports sustainable economic growth. For example, Tanjung Api-api Port plays an important role in facilitating South Sumatra's exports, while Tanjung Kalian Muntok Port serves as a key link between Bangka Belitung and mainland Sumatra. Establishing a strong safety climate is critical to protecting these operations, minimizing economic losses, and enhancing the resilience of these ports, particularly in the face of climate-related challenges [15]. This study aims to analyze the impact of various factors on the safety climate, with the goal of improving the overall management and operational efficiency of river and water crossing transport at both ports.

2. Literature Review

2.1 Sea transportation in Indonesia

Maritime transport is the most used transportation in the world and one of the most common modes of transportation for the movement of goods, liquid petroleum fuels, products, and human beings [16]. The utilization of sea transportation for the benefit of passengers and the distribution of goods from other islands will be unimpeded if equitable economic development is not prioritized in the region [10]. Achieving the objectives of a commercial fleet necessitates ship management that prioritizes safety, thereby minimizing the risk of common accidents such as ship sinking, collisions, fires, and ship collisions [17].

Utilization of sea transport to the benefit of passengers and transmission of goods from other islands will not be affected if decent economic growth is not prioritized in the region. Commercial fleet success demands ship management with high concern for safety and minimizing the risk of common accidents such as ship sinking, ship collisions, fires, and ship strikes [17]. Maritime transport in Indonesia is among the primary engines of Indonesia's economic growth, as it is the backbone of trade, tourism and intra-island connections [18]. Being the world's largest archipelago, Indonesia is highly reliant on maritime infrastructure to transport people and goods among its 17,000 islands. Other studies have underscored the function of the Belawan, Tanjung Priok and Surabaya ports in supporting Indonesia's export-driven economy, predominantly commodities such as palm oil, coal and natural gas [19]. However, despite its significance, the industry still faces issues of underdeveloped infrastructure, bureaucratic inefficiencies, and vulnerability to impacts of climate change [20]. While recent research has briefly addressed the wider economic and logistics drivers, few efforts have been made to particularly address how climate change through heightened sea level rise, weather disasters, and impacting the safety of ports as well as their functioning may influence maritime policy as it evolves [21]. Understanding the limitations here is important to assist in the creation of climate-resilient maritime policy to safeguard Indonesia's marine transport sector.

2.2 Safety climate in preventing maritime accidents

Research on workplace safety encompasses a variety of frameworks and theoretical models from different disciplines, which provide a comprehensive understanding of the factors that influence safety behaviors and outcomes. Griffin & Neal (2000) introduced a model for assessing safety perceptions, which emphasizes the important role of safety climate in shaping organizational safety practices [22]. Safety climate, along with psychological safety and work motivation, is recognized as an important determinant of risk awareness and accident prevention [22]–[24]. The integration of perspectives from psychology, sociology, and management offers a multidimensional approach to understanding and improving workplace safety [25]. In maritime accident evaluation, the maritime environment and organizational management are treated as open parameters, which may introduce uncertainties and reduce the reliability and accuracy of safety assessment [26]–[28]. In addition, human factors are widely recognized as significant contributors to maritime accident [26].

However, assessing their role in accident progression necessitates a comprehensive investigation during the accident analysis phase, which can be challenging due to the complexity and qualitative nature of human-related factors. Given the inherently high-risk nature of maritime operations, fostering a strong safety climate is essential to mitigating risks, preventing accidents, and ensuring the overall safety and well-being of maritime personnel, highlighting the need for further empirical investigation in this domain.

2.3 Hypothesis development

Ensuring river, lake and water transport safety is a fundamental priority since it affects operational efficiency, accident prevention and long-term sustainability to a large degree. The safety climate theory has been of interest in maritime and transport research because it reflects prevailing collective perceptions, attitudes and beliefs concerning safety policy and practices within an organization [15], [17]. A mature safety climate is determined by a variety of organizational and managerial determinants, including leadership, open communication, management commitment and organizational trust [17], [29]–[31]. An examination of the relationships among these variables is critical to safety performance improvement and the creation of a strong maritime operational environment[17].

First, utilization of communication as a strategic asset is critical to the full utilization of information transmitted through transparency [32], [33]. When senior management places emphasis on open communication, they create a strong safety climate, reduce the chances of ship accidents, and improve overall safety operation [31]. Hence, we hypothesize: **H1. Transparency Communication has a positive effect on Leadership**

Transparent communication positively influences leadership effectiveness by building trust, enhancing safety awareness, improving compliance, enabling effective decision-making [31], [34], and strengthening the overall safety climate. When leaders communicate openly, they empower employees [32], encourage proactive safety behaviors, and ultimately reduce maritime accidents. Thus, we hypothesize: **H2. Transparency Communication has a positive effect on organizational trust**

When management communicates safety priorities clearly and consistently, it reinforces a strong safety climate, ultimately leading to safer maritime operations, reduced accident rates, and improved regulatory compliance. Communication builds organizational trust by reducing uncertainty and demonstrating authenticity [35], [36]. Thus, we hypothesize: **H3. Transparency Communication has a positive effect on Management Commitment**

Leadership significantly influences the safety climate in sea transportation by establishing safety priorities. When leaders actively engage in safety initiatives, they create a culture of accountability and shared responsibilities [30], [31], [37]. Thus, we hypothesize: **H4. Leadership has a positive effect on Safety Climate**

A workplace built on trust ensures that safety is not merely a regulatory obligation but a deeply embedded cultural value, resulting in fewer accidents and greater

operational efficiency. In this context, the dimensions of safety climate play a crucial role in shaping various aspects of organizational trust [38]–[40]. Thus, we hypothesize:
H5. Organizational Trust has a positive effect on Safety Climate

Management commitment to safety strengthens the safety climate, making stakeholders feel valued and secure [39]–[41]. This fosters organizational commitment and reduces turnover intention. Thus, we hypothesize: **H6. Management Commitment has a positive effect on Safety Climate**

Management commitment is a key driver of a positive safety climate in sea transportation, directly influencing organizational trust and its impact on managerial outcomes [40]. A strong commitment to safety not only protects lives and assets but also strengthens trust within the organization, leading to improved operational efficiency and regulatory compliance in the maritime industry [30]. Thus, we hypothesize: **H7. Management Commitment has a positive effect on Organizational Trust**

A positive safety climate fosters a shared sense of trust and mutual support within groups [42], [43], promoting collective responsibility for well-being. Additionally, when employees perceive that their safety is valued and prioritized by leadership, their trust in the organization strengthens, leading to greater organizational commitment [44], [45]. Thus, we hypothesize: **H8. Leadership has a positive effect on Organizational Trust**

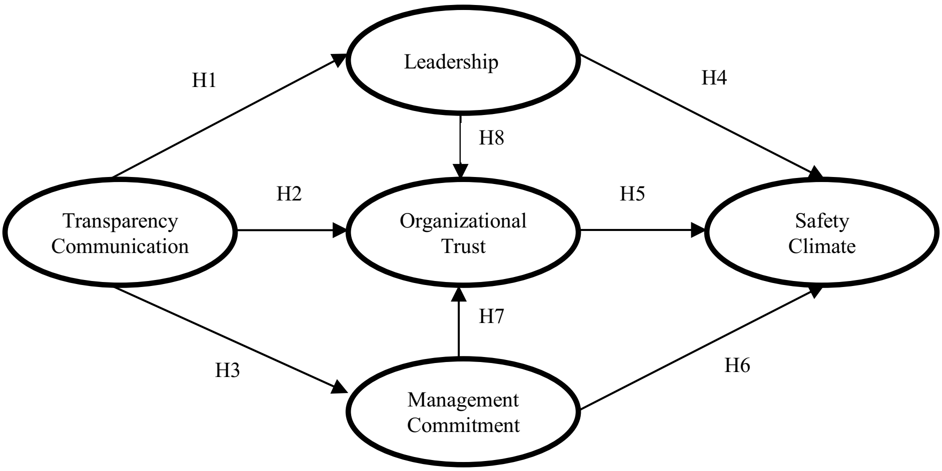

Figure 1. Hypothesis Framework

3. Methodology

A mixed-methods research approach is widely utilized in this study to comprehensively analyze safety, efficiency, and operational challenges. This methodology integrates quantitative data, qualitative insights, and primary data. By combining statistical analysis with in-depth contextual understanding, mixed-methods research enables a holistic evaluation of factors influencing maritime transportation, including human error, technical failures, and environmental conditions. This approach is particularly valuable in assessing safety climate, accident prevention strategies, and the impact of climate change on maritime logistics.

Figure 2. Research Location

This research was conducted at the Port of Crossing in the southern part of Sumatra, namely at the Tanjung Api-api port and Tanjung Kalian Muntok port, West Bangka. This crossing transports passengers and goods from South Sumatra Province to Bangka Belitung Province, Muntok. Tanjung Api-api Port is located on Jalan Raya Palembang-Tanjung Api-api, Rimau Sungsang, Banyuasin Regency, South Sumatra and according to the coordinates of the marked point. The research time was conducted from July 2023 to August 2023. Tanjung Kalian Port is located in Muntok sub-district, West Bangka Regency, Bangka Belitung and in accordance with the coordinates of the marked point.

3.1 Qualitative study: Interview

Interview is a technique using question and answer sessions for data collection between the author and the parties related to the research topic, where the research subject is the Tanjung Api-api Ferry Port staff. The purpose of the interview is to understand the general description and condition of the actual service quality of the shipping company. Researchers have the option to utilize various data sources through the collection of information spanning diverse timeframes, geographical areas, or viewpoints [46]. For instance, they might engage in interviews with individuals in different profession or position, such as executives and general staff within a specific sector. To match information between one informant and another, triangulation technique is used. Previous research from Natow (2020) employed a pattern-matching technique for triangulation, by cross-checked in the data from interviewees as construct validity [47].

3.2 Qualitative study: Survey

The data will collect using online questionnaire. The questionnaire is distributed by the researcher by giving it to the respondent in the form of a written statement, in this case the respondent responds to the survey in the form of their opinion. The questionnaire used in this study was a closed questionnaire. Closed questionnaires can make it easier for respondents to answer questions quickly and help researchers analyze data from all questionnaires collected. The following variables were used in the study and are listed in table 1 below:

TABLE 1. DIMENSION AND VARIABEL

No	Dimension	Variable	Reference
1.	Leadership	KL1. My supervisor strictly enforces safe work procedures in my work group. KL2. My supervisor takes a proactive stance on safety. KL3. My supervisor shows leadership by getting people to focus on safety. KL4. My supervisor takes the lead on safety issues. KL5. My supervisor is committed to improving safety. KL6. My supervisor strongly emphasizes safety in the workplace.	[24], [31], [48], [49]
2.	Trust in the Organization	KO1. I believe that ferry companies have high integrity. KO2. I believe I fully trust the ferry company. KO3. In general, I believe the ferry company's motives and intentions are good.	[17], [38], [40]
3.	Management Commitment	KM1. Our management conducts frequent safety inspections to improve worker safety. KM2. Our management provides safety equipment. KM3. Our management provides the power to perform safety in my work. KM4. After an accident, our management focuses on how to solve problems and improve safety rather than blaming specific individuals. KM5. Improving safety rather than blaming specific individuals. KM6. There is good preparedness for emergencies here.	[17], [49]–[51]
4.	Safety Climate	IK1. I actually communicate work-related information to each other.	[17], [49]–[51]

		IK2. I pay attention to my team's safety issues at work. IK3. I participate in my team's work safety goals. IK4. The company's concern for employee safety. IK5. I can openly discuss issues with other employees and managers.	
5.	Transparency Communication	KT1. Freely report all unsafe acts or conditions. KT2. Feel comfortable seeking guidance. KT3. My company provides workers with safety-related information. KT4. My company informs workers of the risks associated with their work. KT5. My company responds quickly to safety concerns. KT6. My company holds regular safety meetings. KT7. My company openly accepts ideas to improve safety. KT8. My company encourages open communication about safety. KT9. My company is easy to talk to about safety issues.	[17], [51]

3.3 Data analysis procedure

3.3.1 Reliability test

To examine the measurement scales and to identify dimensionality, principal component factor analysis will be applied to condense the collected data and internal consistency analysis (Cronbach's alpha) to confirm the reliability of each research factors. Pre-processing data consists of data measurement through statistical analysis such as item analysis, reliability, and exploratory factor analysis (EFA). The data analysis procedure uses SPSS software to measure reliability by Cronbach's alpha coefficient and the corrected item-to-total correlation observation from all items. The threshold of Cronbach's alpha is 0.7 to ensure the reliability of survey items [52], [53]. If the value is less than 0.7, it means the reliability of the aspect is currently insufficient. The primary purpose of EFA is to confirm each item can yield relevant information about its corresponding element [24], [54], [55]. As the data were collected using an online survey, common method bias (CMB) might arise. To assess possible common method variance statistically, confirmatory factor analyses will be applied.

3.3.2 Structural Equation Modeling (SEM)

Hair et al. (2016) state that Confirmatory Factor Analysis (CFA) is part of SEM in testing variables and measurable indicators in CFA factors called constructs [56].

Measurement theory is used to define how variables are measured and the structure contained in the model is explained logically and systematically. After testing CFA, the research continued with SEM (Structural Equation Modeling) techniques. The first step is to implement the model specification by developing a model that has a theoretical form in defining research to study the problem. Then explain the model with an examined conceptual structure and see its dimensions. The direction of the hypothesized relationship is clear and in accordance with the planned theory [56].

4. RESULT

4.1 Demographic Data

The survey collected opinions from 163 ferry travelers, which provided their demographic characteristics. The majority of the respondents were male (n = 140, 85.9%), while female respondents accounted for 14.1% (n = 23). If the age structure is considered, the largest percentage of respondents belonged to the productive age group of 26–40 years (63.8%), followed by 41–55 years (18.4%) and 18–25 years (16.6%). 4% of respondents were under the age of 17 or above 55. For educational level among company workers, 36.6% (n = 59) possessed a Bachelor's degree, and 32.5% (n = 52) had a Diploma 1 qualification. In addition, 27.6% (n = 44) indicated they had completed high school, while 2.3% (n = 6) had a Level 2 qualification and an extremely low percentage (1%, n = 2) had completed primary or middle school only. Employee job positions being classified showed that the employees were predominantly represented by staff members (60.1%), followed by operation staff (14.1%), ship officers (9.8%), engineers (8.5%), leaders (5.5%), and captains (2%).

In terms of experience at work, the majority of the respondents worked for 6–10 years (42.3%), followed by those working for 11–25 years (35.6%). The employees with experience of 1–5 years accounted for 18.4%, while merely 3.7% were serving for 26–30 years. The length of tenure within the department indicated that 38% (n = 138) were in post for five years, and 30% (n = 112) were in post for 2.5 to 5 years. The permanent staff with 1–2.5 years' service included 20% (n = 74), 10% (n = 36) had one to six months' service, and 1% (n = 8) had less than one month of service.

4.2 Reliability Test

The results of the data analysis, as presented in the table below, indicate that the Cronbach's Alpha values for all measured variables exceed the threshold of 0.6, confirming their reliability. Specifically, the transparency communication variable demonstrated a Cronbach's Alpha of 0.883, while the leadership variable recorded 0.824. The management commitment variable achieved a Cronbach's Alpha of 0.839, whereas the organizational trust variable yielded 0.808. Finally, the safety climate variable exhibited a Cronbach's Alpha of 0.882. Since all values surpass the minimum reliability criterion of 0.6, it can be concluded that the measurement instruments used in this study are statistically reliable [56].

TABLE 2. RELIABILITY TEST

No	Variabel	Cronhbach's Alpha	Construct Reliability (CR)	Average Variance Extracted (AVE)	AVE Square
1	Communication Transparency	0,883	0,90	0,50	0,707
2	Leadership	0,824	0,86	0,51	0,712
3	Management Commitment	0,839	0,86	0,50	0,709
4	Organizational Trust	0,808	0,76	0,51	0,713
5	Safety Climate	0,882	0,88	0,60	0,775

The results presented in the table above indicate that all the variable tools possess sufficient reliability, as evidenced by Construct Reliability (CR) values greater than 0.6. Moreover, the validity of the tools exists, since all the variable indicators provide Average Variance Extracted (AVE) values greater than 0.5, as presented in Table 2. This finding means that each construct has adequate variance extracted, and therefore the measurement model is valid. Such validated indicators can thus be employed as inputs for subsequent structural analysis in the study.

4.3 *Confirmatory Factor Analysis* (CFA)

In the initial CFA model, certain high-loading indicators were removed on the basis of modification indices in order to improve the Goodness of Fit of the measurement model and confirm that the model had achieved the desired criteria. The removed indicators include KL1, Kl4, KO1, KM1, KM2, KM4, IK4, KT1, KT7, and KT8. CFA results also confirm that all the other variables achieve the desired criteria, and this confirms that they effectively measure their respective latent constructs and contribute towards improving the model's overall validity.

TABLE 3. CFA GOODNESS OF FIT

Goodness of Fit Indices	Cut of Value	Measurement model result	Result
Chi Square	Smaller	151,656	Good Fit
Probability	>0,05	0,274	Good Fit
CMIN/DF	< 2,00	1,068	Good Fit
GFI	>0,90	0,915	Good Fit
CFI	>0,60	0,993	Good Fit
RMSEA	<0,08	0,02	Good Fit
AGFI	>0,90	0,886	Marginal Fit
TLI	>0,90	0,991	Good Fit
NFI	>0,90	0,901	Good Fit

Based on the table above, the model is fit for use, as it meets eight out of the nine fit criteria that indicate an overall good model fit. In empirical research, it is not necessary that a model must meet all the fit criteria; rather, the application of a model further ahead is left at the discretion of the researcher and the type of study. A well-fitting model suggests that the model represents the data and theoretical expectations accurately [56]. Additionally, a marginal fit is a model that meets incremental or absolute fit criteria to a moderate extent. Even if it does not ideally satisfy all conditions, it remains analytically useful, particularly when the deviations are minor and within tolerable limits [57], [58]. SEM model estimation equally begins with the observation of the R-squared of all dependent latent variables. The estimated results of the R-squared via AMOS are reported in the table 4 below.

TABLE 4. R-SQUARED ESTIMATION

Variable	R -Squared
Leadership	0,361
Management Commitment	0,463
Organizational Trust	0,633
Safety Climate	0,871

This study examines three main variables while observing the impact of other external variables. The R^2 value of the leadership variable is 0.361 (36.1%), which indicates that transparency communication, leadership, and leadership commitment combined explain 36.1% of leadership variance, and other unmeasured variables explain the rest of the variance. Similarly, the R^2 value of management commitment is 0.463 (46.3%), which shows that 46.3% of its variation is explained by the model and the rest by external factors that are not investigated in this study.

Furthermore, organizational trust also has an R^2 of 0.633 (63.3%) which means that leadership commitment explains a significant contribution to this variable, and other factors explaining the remaining 36.7% lie outside the scope of this research. The safety climate has an R^2 value of 0.871 (87.1%) which means that all three - leadership, management commitment, and organizational trust - together explain 87.1% variance in safety climate, and that the remaining 12.9% of this variance is from external environment factors. Following the measurement of the model, the next procedure is to perform a model fit test to ensure the structural model sufficiency. The test employs three types of fit indices: incremental fit index, absolute fit index, and parsimony fit index. According to Hair et al. (2016), CFA requires at least one fit measure from each index category to validate model adequacy [56].

TABLE 5. GOODNESS OF FIT INDICES OF STRUCTURAL MODEL

Goodness of fit Indices	Cut of Value	Structural model result	Result
Chi Square	Smaller	119,247	Good Fit
Probability	> 0,05	0,279	Good Fit
CMIN/DF	> 0,02	1,074	Good Fit
GFI	> 0,90	0,923	Good Fit
CFI	> 0,90	0,993	Good Fit
RMSEA	< 0,08	0,021	Good Fit
AGFI	> 0,90	0,894	Marginal Fit
TLI	> 0,90	0,991	Good Fit
NFI	> 0,90	0,907	Good Fit

The model is deemed to be fit for application, as 8 out of the 9 Goodness of Fit indices are greater than the thresholds required, and this indicates a general good model fit. A good fit implies that the model fits the observed data well and achieves the specified criteria. Though one of the indices is not strictly within the cutoff, it is in an adequate position, and that means that the model virtually meets the incremental fit or absolute fit requirements. Since this almost fulfils the requirements of Goodness of Fit, the model can be considered statistically valid and eligible for more thorough investigation.

4.4 Hypothesis Test

Based on the empirical model presented in this study, testing of existing hypotheses can be done by testing the coefficient of the structural path model equation. The table above shows the results of hypothesis testing based on the observed p-value. If the p-value <0.05, it is associated with significant variables. After the analysis model is found appropriate, the next analysis is to observe the degree of significance or meaningfulness of the relationship and interrelationship of the research variables. The AMOS test results produce a structural equation model that describes the relationship between endogenous, exogenous, and mediating variables. After finding the relationship between these research variables, we then discuss testing the hypothesis results. The SEM analysis results are displayed by plotting the coefficient values with the following variable paths: The importance of hypothesis testing to the results is shown in the table below.

TABLE 6. HYPOTHESIS TESTING RESULT

Relationship			Estimate	S.E.	C.R.	P
Leadership	<---	Transparency Communication	0.575	0.107	5.388	***
Management Commitment	<---	Transparency Communication	0.695	0.117	5.933	***
Organizational Trust	<---	Transparency Communication	0.481	0.167	2.876	0.004 **
Organizational Trust	<---	Leaderssship	0.286	0.136	2.110	0.035 *

Relationship			Estimate	S.E.	C.R.	P
Organizational Trust	<---	Management Commitment	0.297	0.162	1.828	0.068*
Safety Climate	<---	Leadership	0.168	0.107	1.567	0.168^{ns}
Safety Climate	<---	Management Commitment	0.369	0.131	2.822	0.005**
Safety Climate	<---	Organizational Trust	0.568	0.139	4.085	***

Based on the results of the hypothesis testing analysis in the table above, it is found that:

1) Hypothesis 1 (H1) states that “Transparency Communication has a positive effect on Leadership”. In this case, the estimated value is 0.575 (positive), with a CR value of 5.388 and a p-value of 0.000. Since the p-value <0.05, this hypothesis is accepted.
2) Hypothesis 2 (H2) states that “Transparency Communication has a positive effect on Management Commitment”. The estimated value is 0.695 (positive), with a CR value of 5.933 and a p-value of 0.000. Since the p-value is <0.05, this hypothesis is accepted.
3) Hypothesis 3 (H3) states that “Transparency Communication has a positive effect on Trust in the Organization”. The estimated value is 0.481 (positive), with a CR value of 2.876 and a p-value of 0.004. Because the p-value is less than 0.05, this hypothesis is accepted.
4) Hypothesis 4 (H4) states that “Leadership has a positive effect on Trust in the Organization”. The estimated value is 0.286 (positive), with a CR value of 2.110 and a p-value of 0.035. Because the p-value <0.05, this hypothesis is accepted.
5) Hypothesis 5 (H5) states that “Management Commitment has a positive effect on Trust in the Organization”. The estimated value is 0.297 (positive), with a CR value of 1.828 and a p-value of 0.068. Because the p-value <0.05, this hypothesis is accepted.
6) Hypothesis 6 (H6) states that “Leadership has a positive effect on Safety Climate”. The estimated value is 0.168 (positive), with a CR value of 1.567 and a p-value of 0.117. Since the p-value > 0.05, this hypothesis is rejected.
7) Hypothesis 7 (H7) states that “Management Commitment has a positive effect on Safety Climate”. The estimated value is 0.369 (positive), with a CR value of 2.822 and a p-value of 0.005. Since the p-value <0.05, this hypothesis is accepted.
8) Hypothesis 8 (H8) states that “Trust in the Organization has a positive effect on Safety Climate”. The estimated value is 0.568 (positive), with a CR value of 4.085 and a p-value of less than 0.05. Since the p-value <0.05, this hypothesis is accepted.

Thus, the hypotheses provide evidence that transparency communication, leadership, management commitment, and trust in the organization have a significant positive influence on various aspects of the organization that include trust, commitment, and safety climate.

5. Discussion

The discussion identifies the overriding importance of ensuring safety in river, lake, and water transportation since it directly affects operational efficiency, prevention of accidents, and long-term sustainability. Safety climate, as an expression of shared attitudes and perceptions concerning safety practices within an organization, has emerged as a core focus area for maritime research [29]. Positive safety climate is influenced by managerial and organizational factors such as leadership, open communication, management commitment, and organizational trust. These factors are all connected and play a fundamental role in enhancing safety performance and building a resilient maritime operational system.

Our findings highlight that transparent communication is a value-maximizing approach to optimally shared information, as emphasized by Mercer-Mapstone et al. (2018) and Trueman et al. (2022) [32], [33]. Leaders who have a preference for transparent communication promote a positive safety climate, diminish maritime accidents, and enhance operational safety. Transparent communication positively influences leadership performance through the building of trust, augmenting safety awareness, compliance, and enabling informed decision-making [34]. It also strengthens organizational trust by reducing uncertainty and demonstrating authenticity [35].

Additionally, the findings show that leadership is not a determining factor for the safety climate, it may be motivated by other factors such as behavior or culture. Safety climate factors have a major influence on organizational trust [17], [38] with management commitment acting as a key driver of a positive safety climate. When management demonstrates a strong commitment to safety, stakeholders feel valued and secure, which enhances organizational commitment and reduces turnover intention [39], [40]. This commitment not only saves lives and property but also strengthens trust in the organization, which leads to enhanced operational efficiency and regulatory compliance within the maritime industry.

Moreover, a positive safety climate fosters a shared feeling of trust and interpersonal support among employees, facilitating shared responsibility for well-being and safety [42], [43]. When employees perceive that their safety is prioritized by leadership, their trust in the organization deepens, resulting in greater organizational commitment [44]. These findings collectively emphasize the importance of integrating leadership, transparent communication, and management commitment to foster a resilient safety climate in maritime operations.

6. Conclusion

This argument shows the need for safety climate in achieving maximum operation efficiency, avoiding accidents, and ensuring river, lake, and water transportation sustainability. Open communication, management commitment, and organizational trust are determinant factors that are interdependent and are necessary in creating an effective safety climate. Open communication as a strategic factor becomes the determinant factor that facilitates the process of leadership, enhances organizational trust, and allows employees to be engaged in positive safety behaviour. Management commitment also strengthens safety climate via organizational trust, safety priority, and accountability. All of these together make up a strong maritime operating system that maximizes compliance and minimizes accidents. The outcomes highlight the importance of combining these elements together in an attempt to create a culture of safety and trust, which is key to the sustainability and effectiveness of maritime operations.

However, there are a couple of things that could be done differently. First, the conclusions are based mainly on what is accessible in literature and may not necessarily depict the exact problems and circumstances of a particular company or region. Second, analysis focuses on organizational and managerial factors at the loss of other elements naturally associated with the external environment, such as regulatory schemes, weather patterns, or technological innovations. Third, reliance on secondary data excludes generalization of results to maritime scenarios. Further research must employ primary data, for example, case studies or questionnaires, in order to substantiate these findings using other variables that can affect safety climate in maritime operation.

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