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Formulating a Maritime Risk Matrix Based on Ancient Text Quantification: Man-Made versus Natural Risks

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Abstract: Contemporary maritime safety management generally relies on technical approaches, whereas historical analyses can provide a fundamental perspective regarding disaster taxonomy. This research aims to elaborate on the threat weight divergence between human-induced risk variables (Man-Made Risk) and Natural Risk extracted from a corpus of ancient texts, as well as to examine their implications for mapping the ALARP tolerance limits in maritime regulations. This study employs an explanatory quantitative approach integrating computational linguistics with the Formal Safety Assessment (FSA) framework. Ten maritime hazard keywords were converted into absolute numerical units using the Hisab Al-Jummal system of the Masyriqi school, normalized, and calibrated with empirical probabilities to map the Risk Score on a 5×5 matrix. The analysis results prove that Man-Made Risk, specifically the keyword *zulm* meaning negligence and regulatory violations clearly dominates the hazard hierarchy in the Unacceptable Region with the highest score. Conversely, natural physical threats such as high waves with the keyword *mawj* have been effectively reduced to acceptable levels due to the standardization of modern ship architecture. The findings indicate prioritize regulatory enforcement that extreme natural conditions essentially act as an initial trigger, while negative human intervention is the primary catalyst for mass maritime tragedies. In conclusion, the results of this study are crucial in encouraging a shift in maritime mitigation strategies so that they do not solely focus on avoiding extreme weather, but rather prioritize regulatory enforcement, regulatory audits, and the strengthening of safety culture.

Keywords: ALARP, Formal Safety Assessment, Hisab Al-Jummal, Human Error, Maritime Safety.

INTRODUCTION

Maritime safety constitutes a fundamental pillar in the global maritime ecosystem, integrating aspects of technical seaworthiness, navigational security, and disaster risk management. Operationally, international maritime safety risk assessments generally adopt the Formal Safety Assessment (FSA) instrument and standard risk assessment matrices

(International Maritime Organization, 2018), as well as ISO 31000:2018-based risk management governance (Tsopa et al., 2024). This standardization is applied to measure operational hazard levels using the As Low as Reasonably Practicable (ALARP) principle to determine maritime risk tolerance boundaries (Langdalen et al., 2020). Nevertheless, these conventional risk assessment models often exhibit a high dependence on the availability of historical accident data and expert perception subjectivity (Fan et al., 2020). These limitations raise questions regarding how systems cope with linearity-related challenges when confronted with high-uncertainty scenarios. This demands urgent exploration of more objective alternative heuristic weighting methods to improve risk mitigation in the maritime transportation sector.

A review of prior literature reveals that academic discourse in maritime safety management predominantly focuses on structural reliability evaluation and the physical limit strength of vessels, as well as deterministic statistical modeling of crew performance (Wu et al., 2022). Meanwhile, in the Indonesian regulatory context, although maritime safety governance in Indonesia has been legally anchored, the current portrait from the National Transportation Safety Committee (KNKT) and extreme maritime weather observation data from the Meteorology, Climatology, and Geophysics Agency (BMKG) consistently indicate that accident trends in Indonesian waters originate from the dynamic intersection of human negligence (Man-Made Risk) and natural factor anomalies (Natural Risk) (Direktorat Meteorologi Maritim BMKG, 2026). Although this disaster phenomenology is very real in the field, there is a significant research gap: the absence of a multidisciplinary approach capable of transforming historical-theological texts into quantitative parameters. The rigid separation between ancient philological studies and pure engineering science has eliminated opportunities to exploit historical textual data extraction as a comparative reference for modern risk management systems.

To address this problem, this research synergizes maritime risk management doctrine with historical computational linguistics methodology. As a theoretical foundation and methodological novelty, this study contextualizes the use of Hisab Al-Jummal (Gematria System). The Hisab Al-Jummal theory is a classical alphanumeric coding system used to convert textual characters from ancient corpora into absolute numerical values (Syed Omar et al., 2025). The quantitative values precisely extracted from ancient texts are then mapped, normalized, and integrated into modern risk assessment matrices based on global parameters to produce an empirically calibrated alternative weighting model.

Based on the problem formulation and theoretical framework, this research aims to innovatively formulate a maritime safety risk matrix based on the comparative quantitative values of ancient texts. Systematically, this study aims to: (1) elaborate on the threat weight divergence between Man-Made Risk and Natural Risk variables through the lens of historical codification; and (2) analyze the theoretical and practical implications of this formulation for mitigation strategies, ALARP tolerance limit mapping, and decision-making in the current maritime regulatory landscape.

METHOD

This research employs a quantitative approach with a multidisciplinary explanatory design integrating historical computational linguistics with maritime transportation risk management. The primary focus is to compare risk value weightings between Man-Made Risk and Natural Risk extracted from ancient text corpora, subsequently transformed into a modern maritime safety matrix. The use of text mining for computational hazard value extraction aligns with contemporary maritime hazard analysis frameworks (Zhong et al., 2020). To provide comprehensive understanding, the methodological framework in this section is elaborated through data collection methods, alphanumeric system-based data processing stages, risk analysis instruments, and mathematical formulations used.

Data Collection Method

The data in this study are classified into primary textual data and secondary validation data. Primary data were obtained through the extraction of specific keywords from historical and theological text fragments representing maritime phenomena and maritime disaster taxonomy (Dominguez-Péry et al., 2023; Fan et al., 2020). The primary source used as the data corpus in this study is the Quranic text. In terms of population, this sacred text corpus contains hundreds of lexical terminologies intersecting with elements of the sea, weather conditions, navigation, and human behavior.

To filter this initial population, sampling was conducted using purposive sampling. The inclusion criteria were strictly limited to verses conceptually equivalent to the hazard taxonomy in modern maritime FSA instruments. To maintain comparative balance and meet the range requirements of Min-Max Normalization calculation, 10 main keywords were extracted proportionally: five variables representing Natural Risk (hydrometeorological variables such as storms, adverse winds, and darkness), and five variables representing Man-Made Risk (negligence, boundary-transgressing acts, and destruction), each was precisely traced to their chapter and verse origins. Secondary data based on FSA guidelines were used as calibration parameters to validate risk tolerance limits and determine coordinate mapping visualization on international standard risk matrices (International Maritime Organization, 2018).

Data Processing

The quantitative data processing in this study was executed in stages through a series of structured algorithmic approaches: (1) hazard taxonomy identification, (2) Hisab Al-Jummal alphanumeric coding, (3) data normalization, and (4) Risk Score calculation. The critical processing stage begins with converting textual characters from ancient corpora into absolute mathematical values. In the coding stage, each alphabetic character of the ancient text keywords was converted into absolute numerical units based on Gematria or Abjad numeral rules (Syed Omar et al., 2025).

In this research, the school adopted in this study is the Masyriqi School, which historically arranges letters based on classical phonetic patterns: Abjad-Hawwaz-Huththi-Kalaman-Sa'fash-Qarasat-Tsaikhadz-Dzaghah. The selection of the Masyriqi method is critical due to numerical value differences with the Maghribi School for certain key characters. For example, in the Masyriqi system, the letter Syin (س) has a value of 300 and Dza (ظ) has a value of 900, whereas in the Maghribi system, Syin has a value of 1000 and Dza has a value of 800. Consistent use of Masyriqi parameters in this study ensures high reproducibility and valid mathematical accuracy when extracting hazard weight values. The absolute conversion values for all Arabic alphabet characters based on the Masyriqi School are presented in Table 1.

Table 1. Alphanumeric Conversion Matrix of Hisab Al-Jummal Standard Masyriqi School

Arabic Letter	Letter Name	Numerical Value
ا	Alif	1
ب	Ba	2
ج	Jim	3
د	Dal	4
هـ	Ha	5
و	Waw	6
ز	Zayn	7
ح	Haa	8

Arabic Letter	Letter Name	Numerical Value
ط	Tha	9
ي	Ya	10
ك	Kaf	20
ل	Lam	30
م	Mim	40
ن	Nun	50
س	Sin	60
ع	'Ain	70
ف	Fa	80
ص	Sad	90
ق	Qaf	100
ر	Ra	200
ش	Syin	300
ت	Ta	400
ث	Tsa	500
خ	Kha	600
ذ	Dzal	700
ض	Dhad	800
ظ	Zha	900
غ	Ghayn	1000

Source: (Syed Omar et al., 2025)

Using the reference matrix in Table 1, for the character Ta Marbutah (ة), its codification value is equated with Ha (هـ) = 5, or equated with Ta (ت) = 400, depending on its functional position in the waqaf/washal reading of the related ancient text. The data processing continues with letter-by-letter conversion until obtaining the total accumulated value of each keyword (Taufik & Alwi, 2024). The total numerical conversion results (V) from all ten keywords will be presented comprehensively in Table 2 in the Results and Discussion section.

Data Analysis

The analysis tools used in this study integrate ancient text interpretation with modern maritime risk management instruments. As an objective quantification foundation, data analysis requires standardized parameters recognized globally. Therefore, this study fully adopts the risk assessment tool from the Formal Safety Assessment (FSA) guidelines published by the International Maritime Organization (IMO) (International Maritime Organization, 2018). The detailed description of the interval scale 1 to 5 definitions for the Severity/Consequence (C) and Probability/Frequency (P) dimensions is as follows:

- Consequence (C) Scale 1 (Minor): very mild impact, only resulting in minor injuries requiring first aid, and minor damage to vessel structure that does not interfere with operational stability.
- Scale 2 (Significant): locally significant impact, resulting in moderate to partial severe injuries requiring emergency medical treatment, and damage to certain technical components while the vessel remains capable of continuing navigation.

- Scale 3 (Severe): severe or critical impact, resulting in a single fatality or very severe injuries, and massive structural damage eliminating main operational function requiring tug assistance.
- Scale 4 (Catastrophic): major disaster, resulting in multiple fatalities, fatal hull breach, uncontrolled fire, or partial vessel sinking.
- Scale 5 (Disastrous): total destruction; resulting in multiple fatalities or loss of all lives on board, accompanied by complete sinking of the fleet to the ocean floor.

- Probability (P) Scale 1 (Extremely Remote): Very rare, occurrence probability near zero, historically estimated to occur only once or never throughout the operational life of the vessel.
- Scale 2 (Remote): infrequent, having low probability but recorded in maritime history, estimated at one occurrence per 20-year period.
- Scale 3 (Reasonably Probable): quite frequent, incidents having realistic probability in regular maritime operations with occurrence statistics of at least once per calendar year.
- Scale 4 (Frequent): often occurring, recurring safety or security disturbances that are common in the field, with occurrence frequency several times per year.
- Scale 5 (Very Frequent): very frequently, incidents occurring constantly in months or weeks, and constituting a dominant factor contributing the highest accident rate in annual investigation reports.

The final results of these parameter weightings are then mapped into a 5×5 risk matrix. This visualization tool is used to comparatively analyze the severity ratio between Man-Made Risk and Natural Risk.

Mathematical Formula

The mathematical stages linking ancient corpus data processing to modern risk analysis instruments are executed through three core equations:

Keyword Alphanumeric Value Formulation

The total mathematical calculation of a hazard keyword (V) is formulated through equation (1):

$$V = \sum c_i (i=1 \text{ to } n)$$

Where: V = cumulative quantitative value of the text keyword; c_i = exact numerical value of the i-th letter character; n = total number of letters in the word.

Min-Max Normalization Scale Formulation

Transformation of raw numerical values (V) to match the ordinal scale of the risk matrix (scale 1 to 5) is performed to avoid data asymmetry, using Min-Max Normalization adapted from data preprocessing standards (Pratheebha et al., 2021; Sharma et al., 2023; Th Yaseen, 2021), as stated in equation (2):

$$S = 1 + [(V - V_{min}) / (V_{max} - V_{min})] \times 4$$

Where: S = normalized scale value ranging 1–5; V = quantitative keyword value being measured; V_{min} = minimum value in the corpus population group; V_{max} = maximum value in the corpus.

The S result is rounded to the nearest whole number to determine the coordinate point on the matrix.

Final Risk Score Formulation

Referring to the global maritime safety assessment standard guidelines (International Maritime Organization, 2018), the Risk Score value is formulated as a multiplication function between Probability/Frequency (P) and Consequence (C), calculated using equation (3):

$$R = P \times C$$

Where: R = Risk Score; P = occurrence probability derived from text occurrence frequency; C = hazard consequence level derived from S value in equation (2).

Risk Matrix Criteria Evaluation and Determination

Risk analysis in this study uses a semi-quantitative approach by transforming dimensional multiplication results into a 5×5 Risk Matrix. The evaluation framework and decision zone division adopt FSA methodology standardized by IMO (International Maritime Organization, 2018) and ISO 31000:2018 global risk management governance standards. The green zone (Acceptable Region, score 1–5) indicates risks so minimal they require no additional mitigation, only standard operational monitoring. The yellow zone (Tolerable/ALARP Region, score 6–12) means threats are tolerable but require periodic mitigation to reduce risk to the lowest operationally and financially feasible level. The red zone (Unacceptable Region, score 15–25) represents risks that cannot be accepted at all as they could trigger fatal system failure, requiring immediate operational evaluation and rigid regulatory intervention with active protection.

RESULTS AND DISCUSSION

Data Extraction, Corpus Selection, and Masyriqi Parameters

The first stage involved extracting keywords from historical-theological texts with direct correlation to maritime phenomenology and disaster taxonomy. The primary source used as the data corpus was the Quranic text. The sampling process used purposive sampling, with terminology limited to verses conceptually equivalent to the hazard taxonomy in modern maritime FSA. Ten main keywords were extracted proportionally: five variables representing Natural Risk and five variables representing Man-Made Risk, each traced to their chapter and verse origins.

Value transformation of each alphabetic character was performed using the Hisab Al-Jummal system of the Masyriqi School. This parameter was selected because it provides the most relevant codification precision with classic Abjadiyah standards where Syin 300 = (ش), Dza 900 = (ظ), Ghayn 1000 = (غ), thus thereby ensuring consistency in quantitative corpus value extraction. Keyword details, verse references, and total numerical conversion values (V) are presented in Table 2.

Table 2. Quranic Keyword Extraction and Hisab Al-Jummal Conversion Values (Masyriqi)

Hazard Variable	Keyword	Source Reference (Chapter: Verse)	Contextual Meaning	Character Details	Total Value (V)
Natural Risk	ريح (Rih)	Yunus: 22	Strong Wind/Storm	ر, ي, ح	218
	موج (Mawj)	An-Nur: 40	Extreme Waves	م, و, ج	49
	طوفان (Tufan)	Al-Ankabut: 14	Great Flood/Typhoon	ط, و, ف, ا, ن	146
	ظلمات (Zulumat)	An-Nur: 40	Poor Visibility	ظ, ل, م, ا, ت	1371
	غرق (Gharaq)	Yunus: 90	Sinking	غ, ر, ق	1300
Man-Made Risk	ظلم (Zulm)	Al-Baqarah: 59	Negligence/Violation	ظ, ل, م	970

Hazard Variable	Keyword	Source Reference (Chapter: Verse)	Contextual Meaning	Character Details	Total Value (V)
	فساد (Fasad)	Ar-Rum: 41	Damage/Sabotage	ف, س, ا, د	145
	سرقة (Sariqah)	Al-Ma'idah: 38	Piracy/Theft	س, ر, ق, ة	365
	شقاق (Syiqaq)	Al-Baqarah: 137	Crew Dispute	ش, ق, ا, ق	501
	حريق (Hariq)	Al-Buruj: 10	Fire	ح, ر, ي, ق	318

Min-Max Normalization Analysis

The range variation of raw alphanumeric data (V) in Table 2 has a very wide gap, ranging from the lowest value of 49 to the highest value of 1371. To eliminate data asymmetry and align the indicators to the Severity/Consequence (C) dimension of the global standard maritime safety risk matrix, data transformation was performed using the Min-Max Normalization method.

Based on the extracted sample population, the absolute lower bound (Vmin) was set at 49 (represented by keyword mawj) and the absolute upper bound (Vmax) at 1371 (represented by variable zulumat), yielding a range of $V_{max} - V_{min} = 1371 - 49 = 1322$. These parameter values were substituted into the mathematical function in equation (2) to obtain the normalized scale value (S), subsequently rounded to the nearest whole number to determine the consequence scale.

As an example in the natural hazard cluster, the normalization calculation for keyword mawj is: $S = 1 + (49-49)/1322 \times 4 = 1.00$, placing it at Scale 1 (minor). Results for all Natural Risk variables are presented in Table 3.

Table 3. Normalization Results and Scale Rounding for Natural Risk Variables

No.	Keyword	Meaning	V	Scale Value (S)	Consequence Scale (C)	Criterion (C)
1	Mawj	Extreme Waves	49	1	1	Minor
2	Tufan	Great Flood/Typhoon	146	1.29	1	Minor
3	Rih	Strong Wind/Storm	218	1.51	2	Significant
4	Gharaq	Sinking	1300	4.78	5	Disastrous
5	Zulumat	Poor Visibility	1371	5	5	Disastrous

The same mathematical procedure was applied to the Man-Made Risk hazard cluster. For keyword fasad (V = 145): $S = 1 + (145-49)/1322 \times 4 = 1.29$, rounded to Scale 1 (minor). Full normalization results for all Man-Made Risk variables are presented in Table 4.

Table 4. Normalization Results and Scale Rounding for Man-Made Risk Variables

No.	Keyword	Meaning	V	Scale Value (S)	Consequence Scale (C)	Criterion (C)
1	Fasad	Damage/Sabotage	145	1.29	1	Minor
2	Hariq	Fire	318	1.81	2	Significant
3	Sariqah	Piracy/Theft	385	1.96	2	Significant
4	Syiqaq	Crew Dispute	501	2.37	2	Significant
5	Zulm	Negligence/Violation	970	3.79	4	Catastrophic

Determination of Probability (P) Values for Maritime Safety Risk

After the Consequence (C) dimension was formulated through alphanumeric value quantification of ancient texts, the next methodological stage was identifying the Probability (P) values or incident frequency. To avoid bias and interpretation subjectivity, probability scale determination was rigidly calibrated to five maritime operational safety standardization criteria. Operational data determining the P scale were derived from empirical records of two national authorities: The Meteorology, Climatology, and Geophysics Agency (BMKG) for Natural Risk variables and the National Transportation Safety Committee (KNKT) for Man-Made Risk variables.

Natural Risk Probability Justification Based on BMKG Data. Probability values for Natural Risk variables were aligned with atmospheric and maritime hydrometeorological activity records in the Indonesian Oceanographic Meteorological Bulletin (Direktorat Meteorologi Maritim BMKG, 2026). Weather dynamics in Indonesian waters are dominated by Asian Monsoon winds triggering periodic extreme weather. The keyword rih (strong wind) was set at $P = 5$ (very frequent) as BMKG documents confirm constant strong winds blowing within weeks and months in equatorial southern waters during active monsoon phases. The keyword mawj (high waves) was categorized at $P = 4$ (frequent) as BMKG spatial distribution maps show significant and temporally widespread increases in sea wave heights. The keyword zulumat (poor visibility) was set at $P = 3$ (reasonably probable) due to monthly rainfall accumulation of 300–600+ mm per month capable of suddenly reducing navigational visibility (Direktorat Meteorologi Maritim BMKG, 2026). Similarly, gharaq (sinking) occupies $P = 3$ (reasonably probable) based on maritime safety correlation with bad weather; vessel physical failure incidents have realistic probability recorded periodically at least once per calendar year. Finally, tufan (typhoon) was classified at $P = 2$ (remote) as Indonesia's equatorial position minimizes tropical cyclone formation, making typhoons rare with estimated occurrence once per 20-year period.

Man-Made Risk Probability Justification Based on KNKT Data. The probability dimension for Man-Made Risk hazards was calibrated using the Transportation Accident Investigation Statistical Report (Komite Nasional Keselamatan Transportasi, 2025). The keyword zulm (negligence/regulatory violations) was set at $P = 5$ (very frequent) based on KNKT investigation statistics documenting a 23% surge in accidents where human error absolutely dominates above 80%. Negligent acts including ignoring vessel seaworthiness, manifests manipulation, and overloading occur constantly within months or weeks. The keyword hariq (fire) was classified at $P = 3$ (reasonably probable) as KNKT periodically investigates ship fire cases triggered by corrosive electrical short circuits or improper arrangement of hazardous cargo. The keyword sariqah (theft/piracy) occupies $P = 2$ (remote) as maritime piracy has low probability in certain domestic shipping lanes, though recorded in history. The keyword syiqaq (crew dispute) occupies $P = 1$ (extremely remote) as accidents directly caused by internal crew conflict are very rare, estimated at near zero probability. Similarly, fasad (intentional structural damage) is $P = 1$ (extremely remote) as intentional hull

destruction or vital maritime infrastructure sabotage is historically estimated at near zero throughout the entire operational life of national commercial fleets(Komite Nasional Keselamatan Transportasi, 2025). All empirical probability values are summarized in Table 5.

Table 5. Probability (P) Values of Maritime Safety Hazard Variables

Hazard Variable	Keyword	Meaning	P Value	P Criterion
Natural Risk	Rih	Strong Wind/Storm	5	Very Frequent
	Mawj	High Waves	4	Frequent
	Zulumat	Poor Visibility	3	Reasonably Probable
	Gharaq	Sinking	3	Reasonably Probable
	Tufan	Typhoon/Storm	2	Remote
Man-Made Risk	Zulm	Negligence/Violation	5	Very Frequent
	Hariq	Fire	3	Reasonably Probable
	Sariqah	Piracy/Theft	2	Remote
	Syiqaq	Crew Dispute	1	Extremely Remote
	Fasad	Damage/Sabotage	1	Extremely Remote

Final Risk Score (R) Analysis and Mapping

The final stage in the FSA framework is performing dimensional integration to obtain the Final Risk Score (R). This calculation multiplied the Severity/Consequence (C) values obtained from ancient text normalization by the empirically justified Probability/Frequency (P) values, as formulated in equation (3). The results were evaluated and classified into operational decision zones based on ISO 31000:2018 and ALARP tolerance parameters. The accumulated $P \times C$ values for all ten hazard variables are presented comprehensively in Table 6.

Table 6. Final Risk Score (R) Calculation for Maritime Safety

Hazard Variable	Keyword	Meaning	P	C	R	Risk Category (ALARP)
Natural Risk	Mawj	High Waves	4	1	4	Low (Acceptable)
	Tufan	Great Flood/Typhoon	2	1	2	Low (Acceptable)
	Rih	Strong Wind/Storm	5	2	10	Moderate (Tolerable)
	Gharaq	Sinking	3	5	15	High (Unacceptable)
	Zulumat	Poor Visibility	3	5	15	High (Unacceptable)
Man-Made Risk	Zulm	Negligence/Violation	5	4	20	High (Unacceptable)
	Hariq	Fire	3	2	6	Moderate (Tolerable)
	Sariqah	Piracy/Theft	2	2	4	Low (Acceptable)
	Syiqaq	Crew Dispute	1	2	2	Low (Acceptable)
	Fasad	Damage/Sabotage	1	1	1	Low (Acceptable)

To facilitate visualization and decision-making, the quantitative distribution in Table 6 is spatially mapped onto a 5 x 5 Risk Matrix, where the ordinate represents the Probability value (P) and the abscissa represents the Consequence value (C).

Probability (P)	5		<i>Rih / Strong Wind/ Storm</i>		<i>Zulm / Negligence/ Violation</i>	
	4	<i>Mawi / High Waves</i>				
	3		<i>Hariq / Fire</i>			<i>Gharq / Sinking Zulumat/ Poor Visibility</i>
	2	<i>Tufan / Great Flood/ Typhoon</i>	<i>Sariqah / Piracy/ Theft</i>			
	1	<i>Fasad/ Damage/ Sabotage</i>	<i>Syiqaq / Crew Dispute</i>			
		1	2	3	4	5
		Consequence (C)				

Source: Research Results

Figure 1. Maritime Safety Risk Matrix

The risk matrix mapping reveals important theoretical findings. Three main variables occupy the red zone (Unacceptable Region). The most significant finding does not originate from the natural hazard category, but is led by Man-Made Risk variable *zulm* (negligence/regulatory violations) with peak score R = 20. This high threat score results from the combination of very frequent field occurrence probability (P = 5) and catastrophic operational severity impact (C = 4). The dominance of human error aligns with the premise that low regulatory compliance in developing countries often produces intolerable operational risk levels (Maternová et al., 2023; Xiao et al., 2025).

The next two positions are occupied by catastrophic Natural Risk variables: *gharaq* (sinking) and *zulumat* (poor visibility), each scoring R = 15. The relational analysis of these three critical variables reveals that total maritime system failure generally occurs when systemic human negligence (*zulm*) coincides with poor visibility conditions (*zulumat*), ultimately culminating in fleet sinking disaster (*gharaq*). In maritime safety theory, this chain interaction is classified as Systemic Risk where natural hazards act as trigger factors, but human error amplifies the severity to a fatal disaster level (Wang et al., 2020; Waskito et al., 2024).

On the other hand, this ancient-text-based approach also validates modern maritime engineering resilience. For example, *mawj* (high waves) is recorded as very frequent in the field (P = 4), yet modern vessel stability regulations and seaworthiness design have reduced its physical impact to the minor level (C = 1). Consequently, high waves were suppressed to an acceptable risk (R = 4). This risk reduction success provides empirical evidence for the effectiveness of modern vessel hull standardization and maritime architecture implementation mandated by international regulations (Latt, 2024; Melnyk et al., 2024).

Based on this comparison, it can be concluded that maritime safety mitigation orientation should not focus solely on avoiding extreme weather. Mitigation strategies must be directed toward law enforcement and strict audits to eliminate human negligence and violations (*zulm*),

as negative human intervention has been empirically and historically proven to be the primary catalyst transforming natural anomalies into mass maritime tragedies (Singh et al., 2023).

CONCLUSION

This research revealed significant threat weight divergence between Natural Risk and Man-Made Risk hazards in the maritime safety ecosystem. Through the integration of historical theological text codification using Hisab Al-Jummal of the Masyriqi School and empirical accident data, the results demonstrate that natural anomalies are not the absolute highest threat. Man-Made Risk variables, specifically Zulm meaning regulatory negligence and violations, dominates the hazard hierarchy and occupy the peak of the Unacceptable Region. This confirms the theoretical foundation that extreme natural conditions generally only act as trigger factors, while negative human intervention and negligence serve as the escalation catalyst leading to major maritime disasters.

The implications of this formulation provide an important paradigm shift for ALARP framework mapping and modern maritime mitigation strategies. The data shows that contemporary vessel architecture resilience has effectively reduced natural physical exposure, such as extreme waves (mawj), to the Acceptable Region. Therefore, current maritime regulatory decision-making and intervention are insufficient if they solely focus on structural technical engineering or simply on avoiding bad weather.

The significance of this research lies in its success in bridging the wisdom of historical texts with modern FSA instruments, producing a new perspective that the root of risk management is human behavior control. As an applied recommendation, this risk weighting framework is recommended for adoption by Indonesian maritime safety authorities, namely KNKT and the Ministry of Transportation, as both a philosophical and quantitative basis for designing STCW (Standards of Training, Certification and Watchkeeping) curricula that place greater emphasis on improving safety culture and human element integrity.

Future research is recommended to expand the data corpus by exploring other historical texts or testing value comparisons using different codification systems, such as the Maghribi school, to examine mathematical consistency. Furthermore, this interdisciplinary methodological framework has significant potential for replication in other transportation safety sectors, such as aviation and railways, to map the universality of human-machine interaction-based hazards in the modern era.

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