Risk Assessments for Ports and Waterways

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Abstract

The objective of this research is to ensure that the ports and waterways management system can establish and maintain a reasonable level of safety level during high density passenger operations. The research model was developed included computer based model that could be used that can be used to measure and monitor risk and evolved overtime. The research methodology provides model for assessing relative risk and evaluating risk reduction measures. The risk analysis based on expert judgement was refined overtime. They provide a basis for risk reduction and risk management policies and strategies. The evaluation and validation of risk model and development of data, methods, tools required to measure, monitor and evaluate ports and waterway risk was implemented.

Introduction

To maintain an acceptable level of safety in the ports and waterways implies the ability to measure and to quantify both the level of risk in ports and waterway and the risk reduction value of safety interventions such as navigation systems and vessel traffic systems. It is difficult to establish justifiable criteria for ports requiring vessel traffic systems and for determining the level of sophistication of the vessel traffic management system required. The research case was based on U.S ports and waterways and was involved a research institute of Louisiana State University and the George Washington University with demonstrated a academic and analysis skill to accomplish the project. This research report present a process for developing a port and waterways evaluation model to be used as the basis for a systematic approach for identifying ports for establishing the level of technology required. The research model is based on the technologies of eliciting and structuring the judgment of experts representing port used, and combining this knowledge base with available quantitative data to estimate the current level of safety in a port and the potential reduction in risk achievable.

The level of investment for a Vessel Traffic System should be determined by the possible risk reduction resulting from that investment. A potential decision matrix is shown in Figure 1.

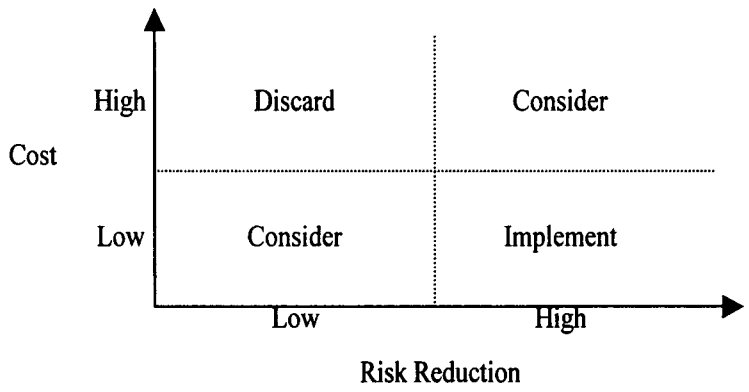


Figure 1. Cost / Risk Reduction.

To rate the safety improvement of a risk assessment accurately would require a full risk assessment. This would be too costly and too lengthy a process to perform for ports or waterways under consideration. The alternative is a small timeframe, low cost approach that gives rough estimates of the safety improvement. Various questions must be considered by the modeling approach:

- What are the dominant hazards in the waterway as seen by all stakeholders?
- What are the possible causes of these dominant hazards?
- What are the probabilities of occurrence and the consequence of each dominant hazard?
- What are the dominant organizational and situational factors the drive the risk in the system?
- What interventions can be practically implemented to reduce the occurrence of these major hazards and their causal factors?
- Are there any adverse side these interventions?
- Where does the VTS program fit within a ranking of the possible risk reduction interventions?

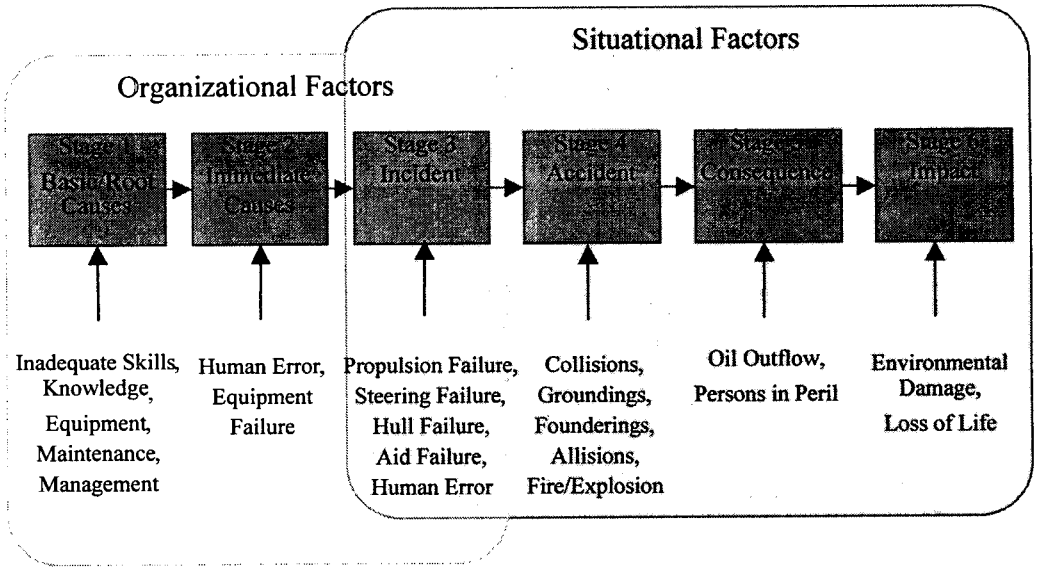


Figure 2. A structure of the accident event chain.

Figure 2 shows a structure of the events that lead to a maritime accident. The effect of the organizational and situational factors is also shown. The assessment model should take the role of these factors into account.

The methodology proposed uses the AHP approach and was implemented using the Expert Choice software. The research team facilitated workshops. A report was written after each of the workshops to allow feedback on the model and further explanation of how the approach can be applied. The development will be an iterative process to ensure the quality of the final product.

The research approach involves five research phases. This involves identifying the major indicators of risk assessment. This will include the traffic conditions, weather and waterway configuration indicators that lead to a high accident probability along with the factors that affect the impacts and consequences of accidents that may occur. A research model was also developed to assess risks to a port or waterway of the various levels of VTS implementation. The hazard identification, hierarchical model development and expert judgment codification that are involved in the approach should be performed for the designated ports. The model was identified the current risk, known as the baseline risk, and then estimate the effect on the risk of VTS .

Research Steps

Phase 1. Gathering Information
- A. Identify and consult stakeholders and experts
- B. Obtain historical data and reports

Phase 2. Development of initial risk assessment model
- a. Analysis of historical incidents and accidents
- b. Identify risk reduction measure
- c. Develop AHP vessel risk model
- d. Develop situational model
- e. Develop impact model

Phase 3. Analyze and evaluate the model
- a. Relative intervention cost model
- b. Feasibility test

Phase 4. Refinement and Validation Model

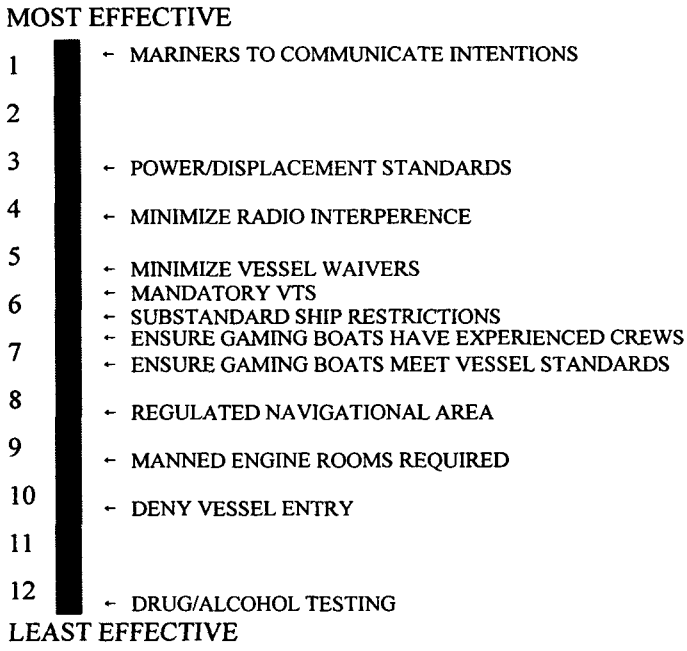
a. significant risk trends and correlation
b. Present model and test scenario
c. Situational risk monitoring model

Phase 5. Recommend Risk Reduction Measure

Results

Estimated relative effectiveness of risk reduction measures of risk management study.

Comparisons of the Effectiveness of Risk Reduction Measure



The number of accidents in a system is presented the product of the frequency of occurrence of a system state times the probability of an accident occurring in that system. The risk assessment process requires the identification os system states; the estimation of the frequency of occurrence of the system, and the estimation of the probability of an accident within a particular system state (figure 3).

	EXPECTED NUMBER OF INCIDENTS/MONTH	STD. DEV. AVG. INCIDENTS/MONTH
25% 1993 TRAFFIC	0.41	0.13
50% 1993 TRAFFIC	0.93	0.32
75% 1993 TRAFFIC	1.56	0.47
100% 1993 TRAFFIC	2.27	0.64
125% 1993 TRAFFIC	3.12	0.94

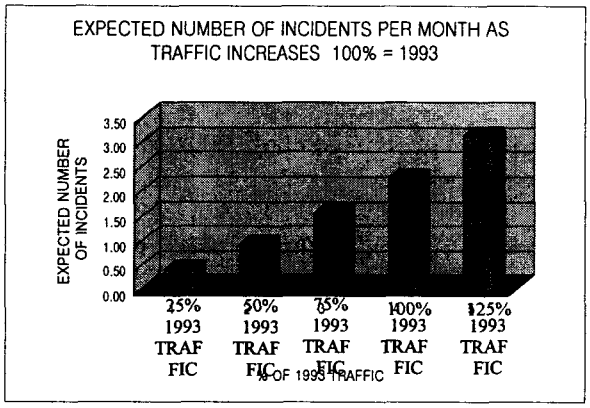


Figure 3. Expected Number of Incidents for Traffic Intensity.

The effect of adding gaming vessel on the expected number of incidents per mile.

	EXPECTED NUMBER OF INCIDENTS/MONTH	STD. DEV. AVG. INCIDENTS/MONTH
NO GAMING VESSELS	2.24	0.63
ONE GAMING VES DOWN	2.27	0.81
TWO GAMING VESSELS	2.31	0.69
THREE GAMING VESSELS	2.69	0.93

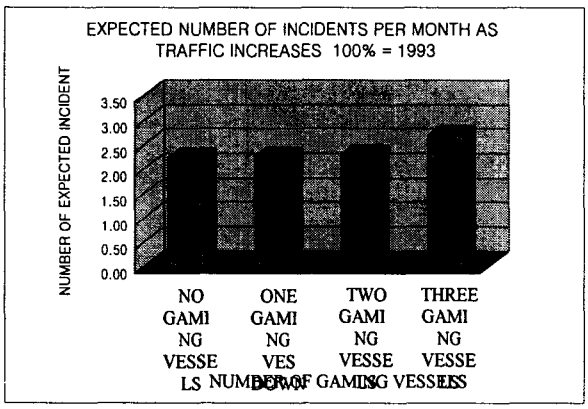


Figure 4 Expected Number of Incidents as a Function Additional Gaming Vessels.

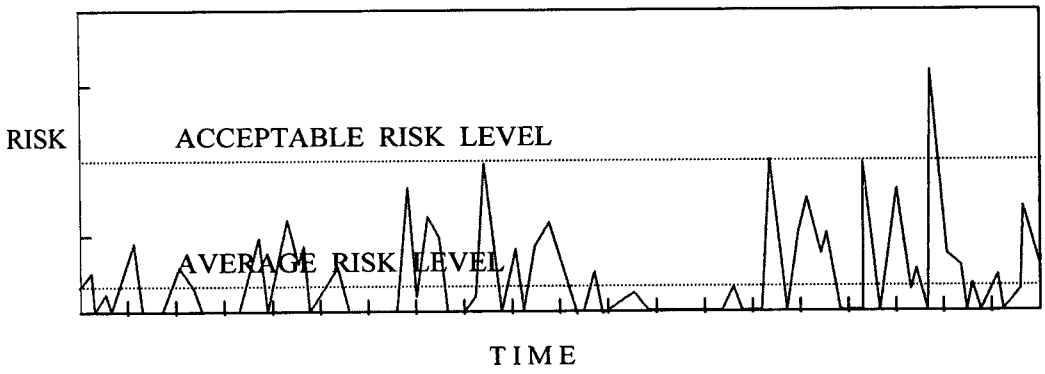


Figure 5. A Process control approach to risk management

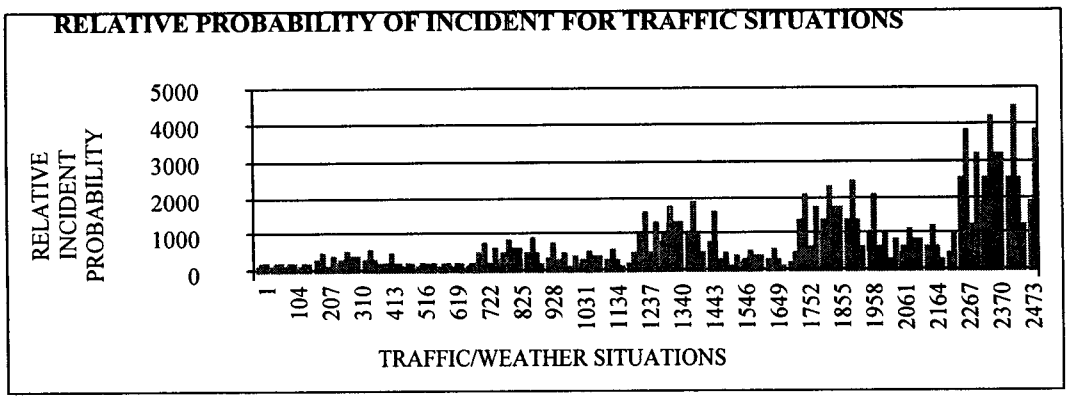


Figure 6. Relative incident probability

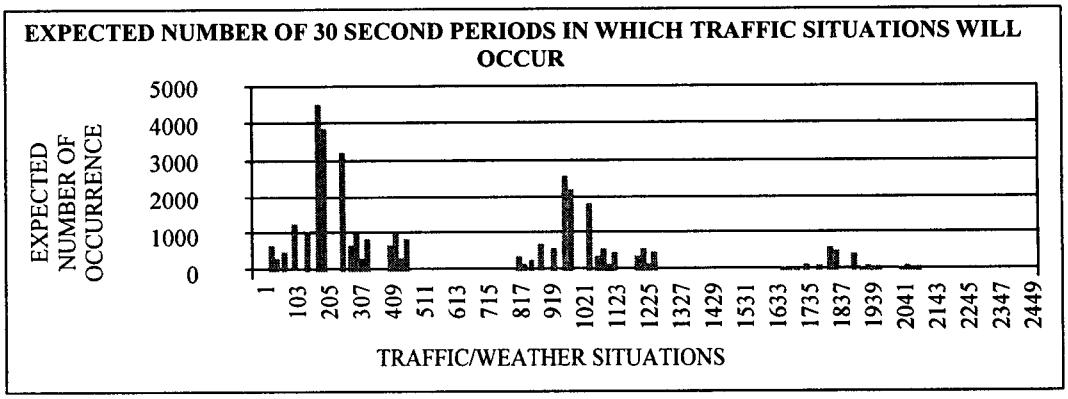


Figure 7. Expected number of occurrences

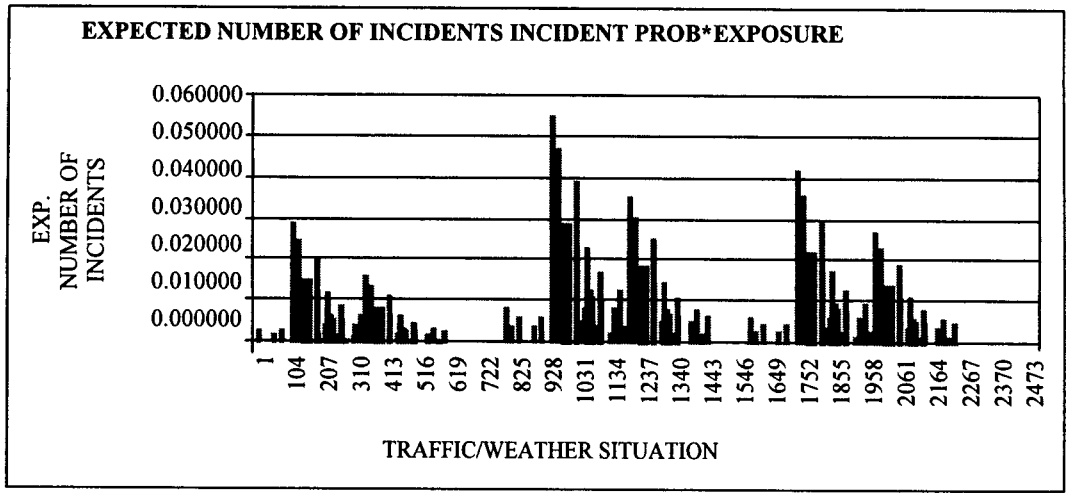


Figure 8. Expected number of incident

Conclusion

The research model produced important results. An increase in probability of an accident due to the addition of passenger vessel is relatively small, the effect on the potential impact of a casualty is very large. The impact of a casualty involving a gaming vessel would be significantly greater than other type of vessels. The model creates the ability to quantify the risk of operational scenarios and the effect of risk mitigation intervention. It provides an integrated systems perspective of the factors that affect risk on the waterways. The evaluation on relative effectiveness of risk reduction interventions was not able to be tested. The effective interventions were determined improve communications between vessels, improve vessel displacement requirement, minimize radio frequencies, providing mandatory vessel traffic.

The result of this research which is based on the methodologies was limited to basic assumption, and validity of those assumptions. However, the result of this research is unique and extensive in the future.

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