

Understand Natech Risk Perception among Supply Chain Managers: An Extended Protection Motivation Model

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Introduction

Natural hazard triggered technological accidents (known as Natechs), can disrupt supply chains in the chemical industry leading to financial losses, lost sales, and other impacts [1] [2] [3]. For example, damages to industry [4], including an explosion at the Arkema chemical plant during Hurricane Harvey in Texas in 2017 resulted in billions of USDs in direct and indirect damages and losses, including prolonged shutdowns, causing severe shortages of petrochemicals that threatened global supply chains [5].

Problem statement

Disrupted chemical supply chains could significantly impact the economy and daily life as chemical products are used across a range of sectors. For example, during Hurricane Harvey, ethylene, an essential chemical material, experienced a 61% production capacity loss. This resulted in the shutdown of over 50% production of polyethylene plastic and 60% of polypropylene in the US, and in turn affected the production of other products ranging from cars to medical equipment and to nappies [6]. Though the chemical industry is relatively highly regulated, there is evidence that managers respond at different proactive levels when facing potential Natech hazards [7]. In particular, the impacts of natural hazards and potential Natech accidents on the supply chains are often underestimated [8]. However, little research has touched upon this issue. Thus, more research is needed to better understand supply chain managers' risk perception regarding these external threats.

Study purpose

The purpose of this paper is to propose a conceptual model that will guide the study of supply chain managers' risk management practices for Natech hazards from the perspective of risk perception and proactive protective behaviour.

Methodology

Data for this study was obtained through a literature review. The literature review can be divided into three parts. First, we reviewed the existing theoretical models in disaster risk perception, particularly regarding flood and chemical accident risk perception. Then, we evaluated and compared those models. Second, we reviewed papers that had examined essential variables in relation to protective intentions and behaviours. And third, we looked into research studies that focus on managers' or organisational risk perception and decision making.

Results and discussion

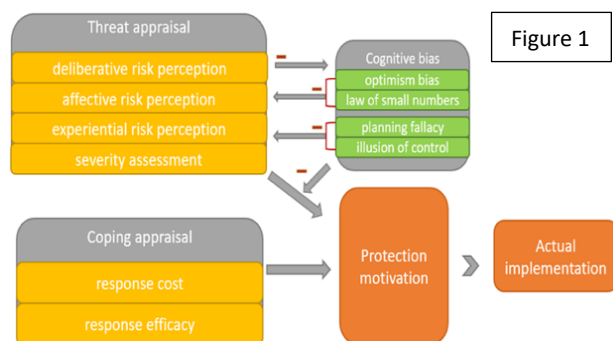
Based on the literature review, we propose an extended protection motivation theory (PMT) model for the purpose of understanding the influential mechanism of supply chain managers' risk perceptions on protective intentions under the threat of flood-triggered chemical accidents.

Protection motivation model

Protection motivation theory provides a conceptual framework for predicting coping behaviour when individuals perceive a threatening situation [9]. It consists of a threat appraisal process and a coping

appraisal process. The original threat appraisal consists of intrinsic and extrinsic rewards, severity, and vulnerability assessment. This study modifies the threat appraisal by including three types of risk perception based on the TRIRISK model proposed by [10]. These are deliberative, affective, and experiential risk perceptions. Previous research confirmed risk perception is a crucial predictor of protection motivation [11]. However, none had implemented the TRIRISK model for disaster risk perception. The coping appraisal process includes response cost, response efficacy and self-efficacy. In the present study, we excluded self-efficacy, considering the subject here is an organization instead of an individual. Cognitive biases are believed to influence risk perception and further affect decision-making [12]. Based on the literature review, four types of cognitive biases were included in the model: optimism bias, the illusion of control, planning fallacy, and belief in the law of small numbers [13, 14, 15, 16]. To understand how biases influence managers in perceiving flood-related Natech threats and proactively adopting supply chain disaster preparedness and prevention actions in the chemical industry, this study proposed four hypotheses in regards to the relationships among the four cognitive biases, the three types of risk perception, and protection motivation.

Figure 1 presents the proposed conceptual model.



Conclusion

This study adopts the protection motivation theory and develops a theoretical model to address the adoption of

prepare and mitigate measures in supply chain Natech risk management. The model is expected to be examined through a survey and contribute to improving Natech risk perception among supply chain managers in the chemical industry.

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