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Barriers and Facilitators for Managers Adopting Protective Measures on Chemical Supply Chains to Deal With Flood-Related Natech Threats

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In the chemical industry, natural hazards can trigger chemical accidents and cause further impacts on the environment, community, and the economy. This type of disaster is called Natech. To protect supply chains from severe disruptions caused by Natechs, companies need to specifically consider the scenarios of different Natechs and develop plans proactively to ensure supply chain continuity. However, although natural hazards-related disruptions have been affecting businesses and their supply chains frequently and severely, little effort has been made to handle this problem. The study found that more than half of supply chain disruptions were caused by weather issues in 2011 [1]. In another study, [2] found that though most of the companies perceived exposure to natural hazards in their businesses, few of them (less than 20%) were worried about the impact [3]. This may be problematic because severe supply chain disruptions, lasting 10 days or more, caused 73% of companies to close or to suffer significant long-term impacts [3][4]. These examples indicate the importance of planning proactively to mitigate the consequences of prolonged disruptions. However, only about 40% of private companies have strategies or plans for dealing with climate-related risks such as flooding according to [5]. This overlooking of the impact of natural hazards on supply chain disruptions and poor application of protective actions illustrate the necessity of investigating the behavioral factors in decision-making regarding mitigation among supply chain managers. However, little attention has been paid to the field of behavioral supply chain risk management, especially regarding low probability but high consequence events.

This research aims to understand the protective motivation of supply chain managers in terms of flood-triggered chemical accidents (flood-related Natechs), and identify the significant barriers and facilitators for managers to make the decision of adopting protective behavior in their supply chains.

Previous studies related to business flood adaptation have focused on property-level adaptation measures such as [6] and [7]. [8] sheds light on the factors in the decision-making of supply chain networks in terms of flood risks and impacts in the automotive and electronics industries. However, there is no research to date investigating managers' protective behaviors regarding flooding risk specifically in the chemical industry, which may trigger flood-related Natech accidents.

Protection motivation theory (PMT) provides an ideal conceptual framework that combines threat appraisal and coping appraisal to predict individuals' coping behavior when they perceive a threatening situation. This study proposes a comprehensive framework, enriching the PMT (see Figure 1), by considering the different types of risk perception (affective, experiential, and deliberative), resource availability of the company, and several cognitive biases commonly found in managers when dealing with low probability but high consequence events.

This study distributes a questionnaire targeting supply chain managers in the chemical industry in Colombia. For the development of the questionnaire, several pre-tests were carried out, and a pilot test was conducted to evaluate the feasibility of the model and

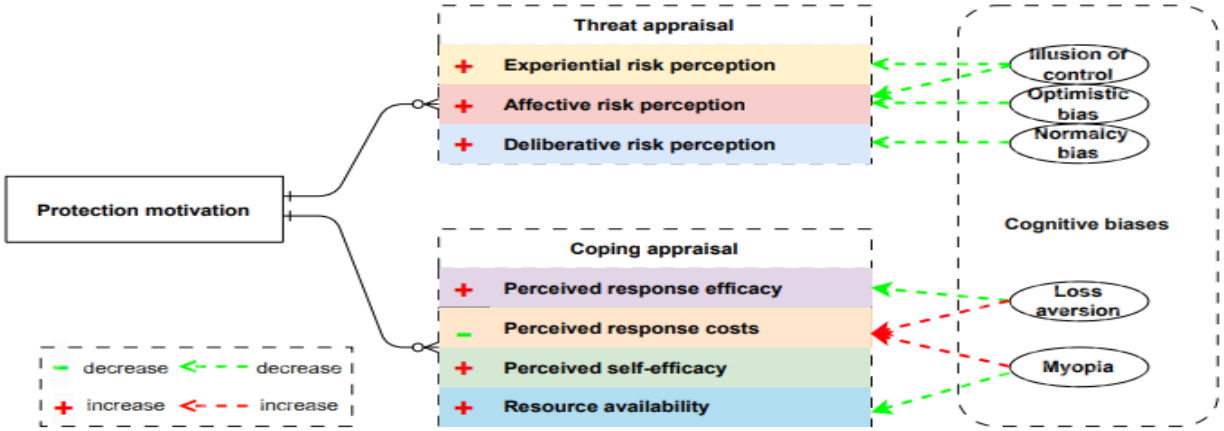

Figure 1. An enriched protection motivation theory model

to estimate possible results. Structural equation modeling (SEM) was utilized to analyze the relationships among the components of the enriched PMT. All models are analyzed in SmartPLS 4 software.

The pilot test result shows that perceived response efficacy and response availability are found to be potentially important facilitators for adopting protective behavior in terms of flood-related Natech accidents, and severity assessment and perceived self-efficacy are comparatively less important in facilitating the adoption. Although it is not significant, perceived response costs are identified as barriers to adopting protective actions. Besides, optimistic bias is found to significantly reduce severity assessment and myopia significantly affects resource availability negatively, and slightly increases perceived response costs. Finally, loss aversion also greatly increased the perceived response costs and further defers managers to adopt protective behaviors. It also shows that the three types of risk perception cannot predict protection motivation. This may be due to the fact that respondents of this test were mainly students majoring in engineering living around the world, instead of the targeted respondents of this questionnaire. For the same reason, the cognitive biases (optimistic bias, illusion of control, and normalcy bias) are also not influencing the risk perceptions in the way we hypothesized previously.

To conclude, the pilot result identifies several important facilitators and barriers to adopting protective behavior. Nevertheless, a more detailed analysis needs to be conducted to show more accurate correlations among the factors when we receive the data from the industry managers.

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