Chapter 8: Development of a Normative Framework for Strategic Logistics Infrastructure Risk Management

8.1 Introduction

In this research, logistics infrastructure projects have been investigated from a risk management perspective. In literature, various authors have mentioned the growing importance of risk management in logistics infrastructure projects globally and locally in India. The cost structure in infrastructure projects are dynamic, and it is imperative to study risks involved in large duration and capital intensive infrastructure projects. It is essential to determine their effect on the budget and scope of the Infrastructure projects. Static decisions based on one particular scenario in Infrastructure projects may be detrimental for the success of Infrastructure projects. The traditional project management models and frameworks are focused on goals that are known as triangle iron in project management. The risk management in logistical infrastructure projects has been under-looked in the literature. In this research, risk management in logistics infrastructure projects has been investigated.

First, a qualitative assessment of risk sources through heat maps (Probability-Impact method) is being studied and discussed. Heat maps were developed at risk attribute, risk factor and then major risk category level. Second, we developed a risk assessment model for logistics infrastructure projects using Analytic Network Process (ANP) method. ANP provides relative priority for major risk categories obtained in the first part of the research study. The generic risk sources identification and assessment framework were integrated with logistics infrastructure projects. An Analytics Network Process (ANP) model that is useful for both qualitative and quantitative risk factors for the Indian logistics infrastructure project context has been developed. In the third stage assessment, a Monte Carlo simulation model been used to show the effect of financial risks on the project profitability.

In the final step, we assessed the organizational process variables that help in implementing a risk management model for the logistics infrastructure projects. The integration of two methodologies ANP and Monte Carlo simulation is unique, and these methods are appropriate for risk assessment in logistics infrastructure projects today's global volatile economic environment. First, a qualitative assessment of risk sources through heat maps is being prepared. (detailed discussion is provided in chapter 4) were used as qualifying criteria for second stage assessment. In the second and third stage, three essential criteria like cost, time and scope from risk structures, were being used for the final section of logistics infrastructure projects.

Based on the above research objectives, we propose the logistics infrastructure projects risk management normative framework as given in Fig. 8.1. The Normative framework connects the three-stage risk assessment and risks enabling assessment that works as a guide for risk management.

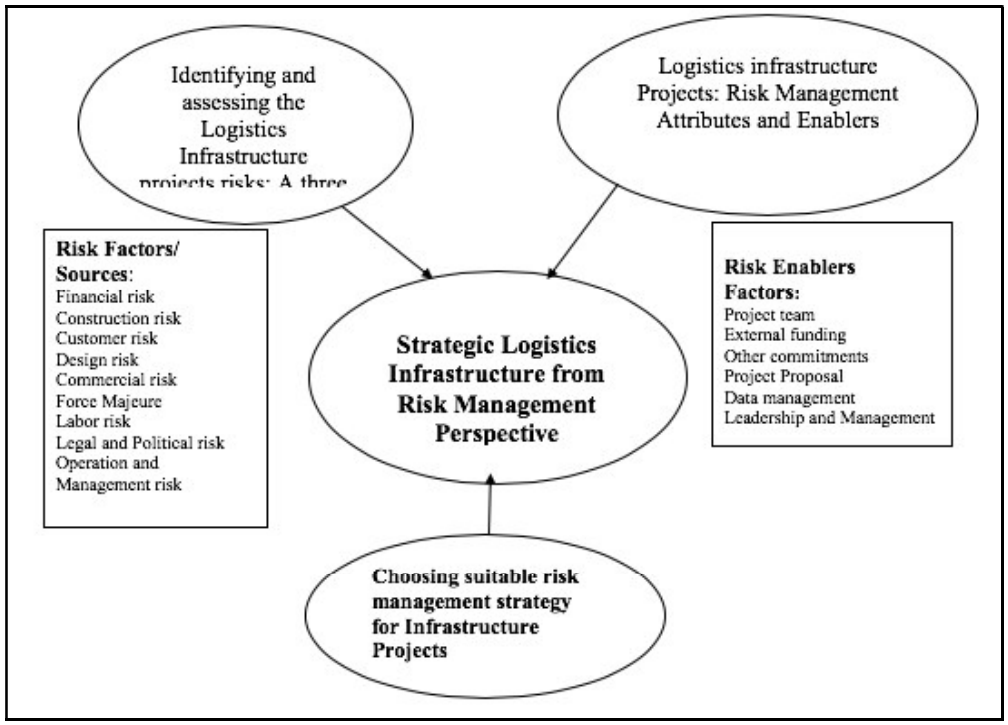

Fig. 8. 1 Normative Framework for Logistics infrastructure projects risk management

8.2 Environment Scan: Logistics Infrastructure projects

There has been a focus on infrastructure development in India with significant emphasis on construction, engineering, IT, entertainment, textiles, food, and utility. Large scale infrastructure ventures such as privatization of large metro airports, Delhi, Mumbai and Hyderabad airports, the Delhi– Mumbai Industrial Corridor, for which the government has collaborated with Japan for financial and technical support has been part of Government focus areas.

The infrastructure industry in India is highly fragmented and has about 300,000 construction companies operating nationwide. Till Nov 2019, Projects that were under Pre-Construction Stage', or 'Under Construction' as on April 1, 2012, or 'Awarded' after that and with Project Cost >INR 50 crore with classification as Government Infrastructure Projects (Traditional mode), Government Infrastructure Projects under PPP mode and private sector projects. 9245 projects were underway with a combined value of INR 68,28,908 crores in Communication, Energy, Social and Commercial Infrastructure, Transport Infrastructure, Water and Sanitation projects. With 3788 Nos. The transport sector has the maximum number of Projects.

8.3 Identifying and Assessing the strategic logistics infrastructure projects risks: A three-stage model

Risk management consists of four steps in a generic sense that are risk identification, risk assessment, risk response and risk monitoring with feedback. In the complete process, the most crucial step is a risk assessment on which risk response depends. In literature, various assessment techniques have been used in the context of projects. The risk assessment process may be robust by making the hierarchical assessment model. In this thesis, a three-stage model has been proposed to quantify risks in logistics infrastructure projects. In the first phase as part of this study the risk factors that are present in the industry, and their probabilities with their impact on the three project goals have been identified through extensive literature review and close interaction with the management professionals to get the industry perspective.

Logistics infrastructure disruptions have not been widely researched for all the industry sectors. logistics infrastructure disruptions happen at different tiers at different stakeholder's levels. Contractor/subcontractor stoppages, natural/ man-made disasters, various material vendors financial stress, vendor' union issues and economic volatility are some of the external factors that may lead to logistics infrastructure disruptions (Seck et al., 2015). Researchers concluded that the project firms take much time to rectify the adverse effects of disruptions and risk treatment and management becomes costly in the later stages of projects. No project sponsor wants disruptions and risk events in the planning and execution of projects, and these are undesirable because of adverse effects and time penalties. Project success entirely depends on business continuity and stakeholder satisfaction (Wei et al., 2018).

Current logistics infrastructure project's risk management practices, built based on the low bidders in case of subcontractors, or low labour cost, may no longer fit the current environment. This kind of practices further increases the burden on projects and lengthens the project duration; thus, a new system needs to be explored to overhaul the logistics Infrastructure projects (Das and Nayak, 2017). Risks in a logistics infrastructure project could be identified through linkages between various stakeholders (Lockamy and McCormack, 2012). Different stakeholders have different knowledge of risks and varied information about projects.

Commonly, projects sponsors do not keep risk data. Risks data may exist at a qualitative or quantitative level. In this research first, a comprehensive list of project risk was prepared in consultation with experts in logistics infrastructure project. Risks probabilities and impact elicitation through experts yielded valuable information about the project that would be useful.

This study tries to integrate and draw linkages between various risk factors through a hybrid model that consists three stages, which considers both repetitive historical data and the expert judgment as part of risk assessment (Fanoni et al., 2005). Thus, proposed three-stage modelling for 'Risk

Assessment Index' captures both subjective and objective data, and it is more useful in situations where there is data scarcity in developing nations like India. Data has been obtained from secondary sources and subject experts for subjective factors like project planning and many behavioral risk disruptions probabilities. Collection of the secondary data for objective factors has been one of the essential academic contributions of this research. This shows that the Indian logistics infrastructure industry has taken quite a few steps to rectify the amount of effect the risk indicators and counter-measures to address logistics infrastructure disruptions/ outages have been adopted.

A total of twenty-nine risk factors, (List of twenty-six risk factors is given in chapter-4, table 4.6 have been identified from the literature and details including their description and references have been given in Table 4.6 in chapter-4. Three leading risk indicators – time risk, cost risk and scope risk have been examined for the Indian logistics infrastructure industry. Further, these 26 factors have been categorized into 9 risk categories. Nine risk categories, namely Financial risk, Construction risk, Customer risk, Design risk, Commercial risk, Force Majeure, Labor risk, Legal and, Political risk, Operation and Management risk. In the second part of risk assessment, these nine risk categories have been considered for further risk prioritization using Analytic network process (ANP). ANP methods consider the feedback loops (Interaction between level and factors) using pair-wise comparison method. Through ANP, two essential risk categories that were obtained Contraction risk and Financial risk. In the third part of the assessment, further financial risk model was developed to get a better understanding. For financial risk modelling, Monte Carlo simulation method was used for BOT highway projects.

8.4 Determining the current state of strategic logistics infrastructure projects risks: Bayesian Network analysis of enablers

Excessive and intricate involvement of many stakeholders in large infrastructure projects and with initiatives like outsourcing of project planning

and control activities to third parties has increased vulnerability of logistics infrastructure projects to cost overruns, delays (Kleindorfor and Saad, 2005; Snyder et al., 2012). Cost overruns, delays and scope issues in large infrastructure projects can lead to substantial economic losses (Aspa, 2017). It is vitally important to minimize the rate of disruptions and improve recovery time from disruptions. The large infrastructure projects need to examine the interplay and maintain a balance between enablers and risks to work out a strategy to mitigate the risks at all levels and areas of large infrastructure projects and identify/ address implementation challenges. In this step, the first establishment of the risk assessment developed through Risk map matrix, ANP model, the risk factors have been identified, followed by critical success factors modeling using Bayesian network thereof. The research question facilitating and guiding the current study is to identify the underlying factor structure of enablers of risk management in the logistics infrastructure projects. Responses were collected through an administered survey in the form of a structured questionnaire from respondents belonging to senior management cadre in logistics infrastructure projects. Bayesian network tools have been used for this part of the research. The research framework analyses the risks in the prioritized order and also discusses critical success factors, which have risk implications.

Bayesian analysis was conducted by taking the probabilistic scores of the various factors - Project team, external funding, other commitments, project P\proposal, data management, leadership and management.

The findings of Bayesian analysis suggest that the team motivation and availability of finds has a more substantial impact on the logistics infrastructure projects than the other enablers. Strategies to overpower the risk factors and strengthen the enablers have been evolved. The study has highlighted various factors which have led to this critical situation facing the industry. Managers have to immediately focus on improving the risk management (identification, monitoring and mitigation plans) processes, dissemination of information to partners, aligning the stakeholders with the strategy of logistics infrastructure.

This is possible only through developing a trust relationship between the stakeholders in the logistics infrastructure projects and improving their project planning processes through investment in technology and strong strategic leadership at the top.

8.5 Validation of the Strategic Risk Management (SRM) in infrastructure projects: Normative Framework

In this section, the SRM normative framework is validated by conducting a survey of logistics infrastructure management professionals and various stakeholders and eliciting their opinions and reflections on the proposed SRM normative framework. Besides, the proposed project selection model has been validated using a case study. The survey included a one-page introduction about normative risk management framework with a description of significant parts of the framework. Validation questionnaire contained a description and one-page containing relevant questions. The objective of performing the validation survey was to carry out test of usefulness of the developed framework in this research and doing the adjustments in the if required. It was essential to seek the inputs from an adequate number of logistical infrastructure projects professionals and project stakeholders. The investigator contacted experts in logistics infrastructure projects. Through personal contacts, face to face interviews has also been conducted. Important questions included in the survey are stated below

Q1 Which models, framework, or guidelines do you use for Risk Management (RM) logistics infrastructure projects?

Q2 What are your comments about the proposed RM normative framework?

Q3 Is there anything in the RM normative framework, which needs elaboration?

Q4 How would you like to position the RM normative framework in comparison to other framework available in RM area?

Comments received from the professionals and managers were treated anonymously. These varied from being short to few being quite comprehensive. Respondents observed the framework to be comprehensive and exhaustive as well as of real use, in terms of risk assessment, especially logistics infrastructure projects and could be of interest to many others as well. Experts appreciated that for risk assessment, P-I method is not sufficient; instead, a precise method is required. One respondent observed that the model is part of risk management, a fundamental framework in a logistics infrastructure context. The developed framework is really useful for Risk Management (RM) that for dealing project interruptions caused by logistics infrastructure disturbances. It has been received a very positive feedback from Infrastructure professionals in dealing with project disruptions. This framework provides a new way to look at logistics Infrastructure network. The importance of calculating logistics Infrastructure risk exposure has been incorporated into the model.

The tools/techniques adopted include the brainstorming with the management team to find out/ analyze critical risks faced by logistics infrastructure projects. Specific risk management framework is not employed by the industry, and logistics infrastructure disruption model is not available.

95% of respondents in validation survey agreed on completeness of the framework and have said that it is a complete guideline for RM in logistics infrastructure projects. Knowing about logistics infrastructure risk index has been appreciated, and one respondent commented that developed framework should be more detailed way, because each risk factors requires different kind of attention. It is an eye-opener for strategists. The model being simple is easy to understand, and as it also covers RM in logistics infrastructure projects implementation part, it is beneficial for top managers. Project managers struggled to fix logistics infrastructure disruption problem and fight hard against supply network risks. One of the comments stated that in today's highly uncertain environment it would be tedious task to build a comprehensive model covering all risks in a single framework. There is a structure suggested for

enablers in logistics infrastructure projects and has been observed to be workable. One respondent proposed that more elaboration on how enablers could be enhanced are needed in the model. Like all other models, it will be difficult to get buy in of people in the organization for implementation of any framework as it sought answers to strategic questions from decision-makers as well as challenging to quantify the risks and intangible cost factors in probabilistic terms. P-I matrix is used for this, and then suitable actions are devised. The model is self-explanatory and covers all generic steps of RM, and that nothing should be deleted.

It seemed that the respondents, despite some reservation regarding complexity and a larger amount of information needed by model, agreed that the model was easy to understand and provides completeness for risk management strategy selection. The respondents agreed that the model could be useful for RM in logistics infrastructure projects professionals and all those concerned with risk management in the logistics infrastructure. Intended users of the framework are project managers, team members and other project stakeholders. The model can be converted for use in other industries also.