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ScienceDirect

Procedia Engineering 212 (2018) 467–474

Procedia Engineering

www.elsevier.com/locate/procedia

7th International Conference on Building Resilience; Using scientific knowledge to inform policy and practice in disaster risk reduction, ICBR2017, 27 – 29 November 2017, Bangkok, Thailand

Identification of the "Pathogenic" Effects of Disruptions to Supply Chain Resilience in Construction

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Abstract

In today's interconnected world, disruptions arising from one party in a supply chain network could cause disruptions to other parties in the chain. Indeed, recent evidence suggests that supply chain disruptions had caused a wide-scale impact to the construction industry in various developing countries including the Malaysian construction industry, with increasing report on project performance deficiencies such as cost and time overruns of severe magnitudes. Although risk management is widely practiced in construction, the challenge now is to make systems and construction supply chains sufficiently resilient so that the project organisations can bounce back and thrive from catastrophes and disruptive events. Past studies of supply chain resilience however tend to overlook the underlying latent conditions that reside in the system that made an organisation vulnerable to such disruptions in the first place. The "pathogen" metaphor is used in this study to reflect these inherent hidden vulnerabilities that remain dormant in a system until a critical failure occurs. Although these pathogens are hidden and may not be causing any problem at the moment, they might trigger a later onset problem causing cascading impacts to the supply chain and its operations. While disruptions in construction are often difficult to foresee and is hard to eliminate entirely, these pathogens, however, can be identified and mitigated before a disruptive event occurs, which this paper aims to discuss. This paper therefore presents the identification of key pathogenic effects in the Malaysian construction industry through preliminary interviews with four experts in the field. Overall, the identification of the pathogens in the study will help the researcher to assess how vulnerable the project organisations are to making significant errors in a systematic way, thus providing the foundation to build appropriate strategies for their prevention and build the resilience of the construction supply chain to disruptions.

Peer-review under responsibility of the scientific committee of the 7th International Conference on Building Resilience.

Keywords: supply chain; resilience; Malaysian construction industry; supply chain disruptions; public projects; risk management

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1877-7058
Peer-review under responsibility of the scientific committee of the 7th International Conference on Building Resilience
10.1016/j.proeng.2018.01.060

1. Introduction

The modern supply chains in today's global economy are becoming highly complex and interdependent through globally dispersed assets and international trade of products and services. The interdependency among supply chains in the uncertain environment has brought an increasing number of interconnected risks that transcend beyond the organisation boundaries. This includes risks such as supply chain disruptions, natural disasters, geopolitical risks and unforeseen events that caused disruptions to business operations and great losses to organisations. It is indeed challenging to identify and anticipate such risks as they could emerge from any direction of the linked parties in the supply chain and its operating environment. The impact of such risks could also spread across related and unrelated parties, causing significant disruptions to their operations. This is prevalent especially in the construction industry. The main difference between the construction industry from other industries is that it deals with temporary supply chains that work on different start and end dates in several phases of one-off construction projects. This makes it difficult for construction parties to gain full visibility of their supply chain operations and its associating risks, making them highly vulnerable to any disruptive events [1]. Understandably, managing these risks and parties from different tiers of the supply chain in construction is indeed challenging especially when disrupted with disruptions that cause large swings in capacities and resources in project delivery. This is evident not just in the developed countries, but also in various developing countries, whereby increasing report on project performance deficiencies were reported due to supply chain disruptions [2,3].

One of the developing countries that have been hit hard by supply chain disruptions is the Malaysian construction industry. Similar to other developing countries, the local projects in Malaysia have frequently end up being delivered late, causing cost overruns and poor project delivery [4,5,6]. The recent report on local public sector projects [7] also identified several supply chain disruptions in project delivery such as non-conformance of work to specifications, low quality, unreasonable price, wastage and transportation disruptions that caused poor project performance. For instance, the second Penang Bridge, which has recently been completed, faced delay for more than 12 months due to additional technical aspects that were not considered in the early stages [4]. This shows that despite the formal risk management plans imposed by the public organisations, managing supply chain disruptions had constantly become an issue to the public organisations in meeting their project objectives.

Indeed, it is difficult for the public organisations to have full visibility of their supply chain operation due to the large scale of public projects and the extent of their supply chain network. This could be problematic as it makes it harder for the public organisations to detect any hidden problems or latent conditions that lie within their supply chain network. These latent conditions, also known as "pathogens", tend to be overlooked by the public organisations in its current risk management practice. Although these pathogens are hidden and may not be causing any problem at the moment, the pathogens might trigger later on and manifest into catastrophic disruptions [8] if they are not identified and mitigated much earlier in the project. While disruptions in construction are often difficult to foresee and is hard to be eliminated entirely, these pathogens, however, can be identified and mitigated before a disruptive event occurs, which this paper aims to achieve. The aim of the paper is to therefore identify the critical inherent pathogenic influence within the public organisations and its supply chain network that make them vulnerable to such disruptive events in the first place. The identification of these pathogens will help the researcher to assess how vulnerable the project organisations are to making significant errors in a systematic way, thus providing the foundation to build appropriate strategies for their prevention and build the supply chain's resilience to disruptions in public projects.

2. Literature Review

2.1. Supply chain disruptions and resilience in construction

Supply chain disruptions can be defined as an event that can affect the performance of the supply chain causing deviation of their operation from meeting the project objectives [9,10]. Previous literature exists on managing supply chain disruptions from the manufacturing, retail [11,12], automotive and oil and gas sector [13], but little attention has been paid to the disruptions faced by the supply chain in construction industry, especially in the developing countries, such as in the context of this study. The Malaysian construction industry has faced several supply chain disruptions [4,5,6] that deter the government's goals to become a developed country by the year 2020.