KEY PERFORMANCE INDICATOR FOR MANAGING CONSTRUCTION LOGISTICS PERFORMANCE

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1 BACKGROUND/KNOWLEDGE GAP

Logistics is the umbrella term covering materials management and physical distribution (Gattorna and Day 1993), while a lean delivery emphasises a cost-effective and on-time handover with no delay or quality issues. Measurement of logistics is an important step to performance improvement. Performance measurement is a process of quantifying the efficiency and effectiveness of past actions, while a performance measure is a parameter used to quantify the efficiency and/or effectiveness of past actions ((Neely, Adams et al. 2002).

Previous studies indicate that performance measurement has a notable effect on the development and effectiveness of benchmarking (Costa, Formoso et al. 2006). This is mainly because tracking performance identifies uncompetitive management practices which promotes investigation of changes. Sillanpää (2015) claimed that measuring the supply chain is the basis of developing it. KPIs are general indicators of performance that focus on critical aspects of outputs or outcomes. For performance measurement to be effective, the measures or indictors must be accepted, understood and owned across the organisation (Collin 2002). Also, only a limited and manageable number of KPIs is maintainable for regular use. Having too many and/or too complex KPIs can be time and resource consuming, data collection thus has to be as simple as possible. Another essential criterion of a KPI is that it can translate practices and measures into practical knowledge and make it possible to identify and adopt superior performance standards (Costa, Formoso et al. 2006).

However, the construction firms do not usually have continuous data collection systems for logistics measures (Vogl and Abdel-Wahab 2014). In New Zealand, the practice in industry is in line with this claim (Page and Norman 2014). Research points towards the fact that the construction industry does not effectively address, or have the skills to solve, logistics problems. At present, the lack of knowledge is masked by a lack of immediacy in recognising that there is a problem at all. It is recognised that major barriers about awareness of logistics costs include invisible logistics costs, disconnect between investment in construction logistics and benefit, and no recorded data relating to logistics performance (Blumenthal and Young 2007, Omar, Hassan et al. 2009).

2 RESEARCH AIM AND METHODOLOGY

The guiding purpose of this study was to contribute to the knowledge about measuring logistics performance by setting a KPI using the number of vehicle movements to the construction site. The focus of the work was on identification of the main performance aspects measured by the total numbers of vehicle movements. It also sought to understand why vehicle movements can be used as a KPI, as well as questions of how to use the vehicle movements in improving logistics

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performance. A case study with a qualitative and quantitative approach was used as this approach is appropriate when the research problem requires understanding of complex phenomena that are not controlled by the researcher and when the research questions have a how and why nature (Yin 2009).

It is important to select a critical case that can explicitly demonstrate. The choice of a commercial project in the largest city (by population and area) in NZ reflects typical problematic issues for construction logistics which critically demonstrates the "how-problem" (Yin 2009). The case study described in this paper was a commercial project hosted by a University located in central Auckland, implying special requirements in terms of logistics and physical distribution. Auckland is notable for its "Urban Sprawl" (Ministry of the Environment 2005). The city also has a substantial reliance on road transportation since public transport system has historically not kept up with population growth needs. The $100 million project consisted of a 13 level tower block with a rooftop plant room surrounded by a lecture theatre and student facility. The new construction integrated several existing buildings on campus. The construction had three stages: ground works, structure, and fit-out. The contract was fixed price, with the client being allowed certain flexibility in the scope without extra charge.

Special attention has been paid to the numbers and patterns of vehicle movements, since it was expected that appropriate interventions to improve construction logistics could be identified through analysing these elements. The vehicle movements were recorded by the gates-person on the site. Details such as delivery company name, date, time, truck type, materials, and activities were noted on printed tables. These details were then transferred to electronic documents and analysed using MS Excel and MS Access.

3 RESEARCH FINDINGS

This paper has discussed initiatives to develop a performance measurement indicator for benchmarking logistics performance in construction projects. Vehicles delivering materials and removing waste at the construction site physically link the supply logistics and site logistics. Vehicle movements thus could reflect the potential issues in both types of logistics. Using the numbers of vehicle movements as a KPI, the evidence provided in the case study demonstrates the indictor can effectively and efficiently describe and monitor site logistics performance. This study has pointed out benefits and opportunities for taking initiatives and implementing such a KPI.

The work presented here assess the ability of vehicle movement as a KPI in measuring the "invisible" transportation costs. In this project, the transportation costs of ready-mix-concrete, which is JIT delivery, is more than 10% of the material selling price. It is reasonable to assume that the project transportation costs would be much higher than this number, since the majority of the contractors delivered materials ad hoc. Based on the implications drawn, the findings of this study have the potential to be implemented by construction management companies building recorded database and thus to increase the likelihood of logistics management adoption by the construction industry.

It is arguable that logistics is far more than transportation costs. Thus, the major limitation using vehicle number as KPI is its ability of measuring restricted aspects of construction logistics. However, the research suggests the proposed indicator is simple and well designed to establish a project logistics performance measurement system and incorporate the measures into the project routine. It could be used as a starting point to measure the "invisible", bring the awareness to the industry and promote performance benchmarking at the operational level.

Moreover, the data presented in this paper focusing on one construction project. More inquiries are required in the form of case studies, such as other projects located in various geographic context, to generalise the material delivery pattern. Future studies also need to investigate whether firms with different supply chains characteristics demonstrate similar transportation costs and logistics efficiency