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Comparing the value of information sharing under different inventory policies in construction supply chain

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Abstract

Measuring the value of information sharing (VIS) in different inventory policies can help general contractor to improve materials and equipments management in construction supply chain. The models for measuring the VIS under (s, S) and Periodic Review (PR) inventory policies are established. A method to compare the VIS is given in a two-level construction supply chain, which aims to measure the impacts of supply quantity information of materials on general contractor's service level and total inventory cost under different inventory policies. A numerical example is proposed to explore the gap of VIS between (s, S) and PR inventory policies in a rebar supply chain. The results show that general contractor's service level in (s, S) inventory is higher than PR's and total inventory cost in (s, S) inventory is lower than PR's in the case of no information sharing. In the case of information sharing, general contractor's service level in PR inventory policy is higher than (s, S) policy; however, it is implemented by the increase of total inventory cost. This research provides valuable information to help general contractor to make correct decision on inventory management in supply chain at firm-level.

Keywords: Information sharing; Value of information sharing; Construction supply chain; Inventory policy

1. Introduction

There are various kinds of materials and equipments involved in the process of construction supply chain management, including not only the one provided with high-volume and large amount (e.g. rebar, door & window, formwork, concrete, block etc.), but also the one supplied with one-unit and small batch (e.g. elevator, HVAC facilities, tower crane etc.). In the construction process, the consuming status of the materials and equipments with various attribution and function is different and the inventory policy should be adjusted and make correct decision in time at firm-level. The information on supply quantity of materials or equipments plays significant role in inventory policy decision making, which affects the progress of construction and further affects the performance of projects and general contractor (GC) (Min and Bjornsson, 2008). To quantitatively measure the value of information sharing between supplier and GC will offer more scientific information to support making correct decision on inventory management.

Inventory management is one kind of critical activities or factors for successful supply chain operation, which requires collaborative working together among multiple stakeholders (Cachon and Fisher, 2000). In general terms, continuous review inventory policy (s, S) and periodic review inventory policy (PR) are the two popular inventory management policies in supply chain. The (s, S) policy has been investigated for nearly six decades since the introduction of period review inventory model by Arrow, Arrow et al. (1951). (s, S) inventory policy

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requires that 'an order be placed when the level of inventory on hand plus that on order falls below the level *s*, and the amount of the order be the difference between *S* and the present level of inventory on hand and on order , i.e., order amounts are "placed up to S"' (Fu, 1994). When applying PR inventory policy, an order is placed periodically following a base stock on inventory position, and arrives at the stocking location after a lead time (Tagaras and Vlachos, 2001). More details on these two inventory policies are presented in the case of CSC inventory management in the following sections.

Information sharing plays a significant role in the process of improving performance of supply chain inventory management (Fawcett et al., 2007). There are many researchers that take more efforts to investigate the value of information sharing in supply chain in difference cases from the inventory management viewpoint (e.g. Lee et al. (1997, 2000), Gavirneni et al. (1999), Cachon and Fisher (2000), Chen et al. (2000), Raghunathan (2001), Zhao et al. (2002), Gaur et al. (2005), Croson and Donohue (2006), Yao and Dresner (2008), Chen and Lee (2009)). The general purpose of these researches on the value of information sharing in supply chain is to correctly get more decision information and further make correct decision on supply chain inventory management. Most of these researches focus on one inventory policy to evaluate the value of information sharing in supply chain. However, little research aims to measure the gap of the value of information sharing under different inventories policies.

As for construction supply chain, many researches have been carried out to investigate its management issues from different perspectives, such as information flow (Ergen and Akinci, 2008), subcontractor management (Eom et al., 2008), intelligent agent-based coordination (Tah, 2005; Xue et al., 2005; Xue et al., 2009), value stream analysis (Arbulu et al., 2003), integration (Cheng et al., 2010; Palaneeswaran, et al., 2003), decision support system and optimization tool (Castro-Lacouture, et al., 2007; Polat et al., 2007), and simulation platform (Park et al., 2011). However, there is little research to measuring the value of information sharing in inventory management at firm-level (Min and Bjornsson, 2008; Walsh et al., 2004). The reasons can be concluded as (1) construction process has different characteristics comparing with the other domains of economic sectors (e.g. manufacturing), such as fragmentation, one-time production, conflict relationships among stakeholders, and uniqueness of construction project, which reduce the possibility of collaborative working in inventory management. So little researcher has interests to do research on measuring the value of information sharing in construction supply chain; (2) there are many types of materials involved in different construction projects, which results the complexity and diversity of inventory management, which means that GC could need to adopt, i.e. to make decision to chose, different inventory policies to meet different demands of each construction projects. However, modern construction business operates in a globally competitive environment. Collaborative working has been identified as the critical success factor of construction firm survival and performance improvement (France, 2002; Hartmann et al., 2009). Collaborative construction supply chain management would become the reality in construction process. Moreover, innovative model of inventory management, such as centralized procurement through company's procurement center, has been widely implemented in practice (Dorée, 2004; Kwan and Ofori, 2001; Love et al., 1998). These raise the need as well as offer the opportunity to researchers to investigate the value of information sharing in construction supply chain inventory management.

Taking a two-level supply chain composed by GC and construction material supplier as the case, this paper proposes a method to compare the value of information sharing under the (s, S) inventory police with that under the periodic review (PR) inventory policy, which are two kinds of ordinary inventory policies that be normally employed in construction material management. The aim of this paper is to study the value of information sharing under different inventory policies in construction supply chain (CSC) and to treat the impact of information sharing on the service level, which can be seen as the probability of meeting the demand of project materials, and the inventory cost of GC.

The rest of the paper is organized as follows. Section 2 presents the theoretical foundation for measuring the value of information sharing (VIS) in CSC. Some hypotheses are set in Section 3. Models for measuring VIS under PR and (s, S) inventory policies are illustrated in Section 4. Section 5 presents the method to compare VIS under different inventory policies. A numerical example is explored to compare VIS in CSC in Section 6. Conclusions are provided in the final section.

2. Theory foundation

2.1. Principle of measuring the value of information sharing

Information sharing indicates that the participants in the construction supply chain, including the GC, subcontractors, and suppliers and so on, possess the information which would improve the operation process of a supply chain. In general, information is a kind of knowledge about the action of some object or subject (the knowledge on the objective laws or the consensus on something), and it may be some verity or a piece of news (not clear of this sentence). Early in 1948, Shannon pointed out that any could be called information if it can reduce the uncertainty (Shannon, 1948). The function of information to the decision making realizes by influencing the faith of decision maker. From the view of the supply chain system, the information in the information flow of the construction supply chain includes the change of owner's requirement (design change), the integrated project plan of the GC in the level of the entire enterprise (the integration of the plan to all the projects of the contractor), the project plan and practical progress (project department), the plan and practical progress of subcontractor, the requirement of material and equipment (from the project department to the GC and from the GC to the suppliers), inventory and producing information (suppliers), the status of the transportation of material and equipment, the status of the quality of material and equipment, the capacity of the members of supply chain(the producing capacity of suppliers and the technical level of subcontractor, etc.) and other kinds of