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A proposal for inventory adjustment using "multiple-layers SEC–CIS model"

Tomofumi Sumita *, Masahito Shimazaki, Keisuke Matsuyama

Akita Prefectural University, Japan

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ABSTRACT

What constitutes a desirable inventory level in supply chain management (SCM) depends on the business model. While the level is being maintained, unexpected situations sometimes occur. The organization that manages the level must focus on adjusting the level to protect against such risks. The "multiple-layers SEC–CIS model" is useful as a framework to promote such a focus by enhancing understanding of the mechanism by which opinions of related players can be adjusted. Therefore, this study proposes that the "multiple-layers SEC–CIS model" is useful for inventory adjustment.

A desirable inventory level in a given business model corresponds to "a plan", and maintaining that inventory level corresponds to "the execution". At the stage of execution, the inventory level will be adjusted according to changes in quantity, quality, price or the date that the materials are procured or the products are ordered. If such changes fluctuate within the assumptions of the model, the inventory control system can cope with them based on the mathematical model. However, inventory adjustment based on the mathematical model is difficult when unexpected rapid change occurs. The framework is necessary for organizations to analyze existing information and new conditions, and to make decisions on how to cope with such risk.

For those purposes, we have proposed the "multiple-layers SEC–CIS model", which explains how knowledge value is cultivated based on communication between organizations. Prior to our model, the "SECI model" was proposed by Nonaka and Takeuchi [1995. The Knowledge-Creating Company. Oxford University Press, Oxford]. They regarded knowledge creation in an organization as a process of change from tacit knowledge to explicit knowledge. They described the four modes of knowledge creation: "S" (socialization), "E" (externalization), "C" (combination) and "I" (internalization). The well-known "SECI model" is named after this process. We got suggestions from the "SECI model" to develop our model: each organization goes through the cycle of "C–I–S–E–C", the cycle of "interpretation–thinking–transmission". In other words, information obtained from outside the organization is interpreted and becomes the basis of the next behavior. When two or more organizations share each mode, namely "S", "E", "C" and "I", knowledge can be shared between those organizations. Particularly, the knowledge which is most likely to be shared is explicit knowledge (information). We based our analysis on the assumption that the knowledge that can be gained from outside of the organization (player/layer) is always explicit knowledge, and that which can be introduced to other organization (player/layer) is only explicit knowledge.

* Corresponding author.
E-mail address: PED00063@nifty.ne.jp (T. Sumita).

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We then developed "SEC–CIS model", and explicit knowledge (information) were connected with another organization (layer) at the mode "C". Thus we have reached "multiple-layers SEC–CIS model", which were expressed three-dimensionally.

Using a case, we illustrate the usefulness of the "multiple-layers SEC–CIS model" to describe communications between layers about inventory-level setting.

1. Introduction

This paper discusses the flow of information needed to adjust inventory in an organization which takes charge of a part of the supply chain. What constitutes a desirable inventory level in supply chain management (SCM) depends on the business model. To make clear the essence of the information used for inventory adjustment, we presume, in this paper, the business model of a firm that procures a kind of goods and sells them. The inventory level is maintained on the basis of a mathematical model if the quantities of both procured and sold goods fluctuate within an assumed range. However, the level cannot be maintained if the quantity of either procured or sold goods changes beyond the assumed range. Such conditions cause the following two losses. When the quantity of sold goods is less than the quantity of procured goods, actual stocks increase above the desirable inventory level. Then, the cost of the unnecessary stock depresses the profit. When the quantity of demanded goods is greater than the quantity of procured goods, the stock is all sold, and the firm will suffer from an opportunity loss. Against the possibility of such losses (= risk), the firm must adjust inventory, and to do so must capture the possibility of the change in the quantity of either procured or demanded goods as information. This information is based on the following four items for both the procured and the demanded goods: quantity, price/cost, quality and timing.

In this paper, we show that the "multiple-layers SEC–CIS model" of Sumita et al. (2004b) is useful as a framework to explain how an organization can cope with information that describes the possibility of such changes. Then, using this model, we propose a method by which the inventory adjustment system can be made responsive to situations beyond the control of the mathematical model. And using a concrete case, we illustrate the usefulness of the "multiple-layers SEC–CIS model" to describe communications between layers (parts) about inventory-level setting.

2. Inventory risks and adjustment

2.1. Modeling of "risk"

Japan Standards Association (2003) define "risk" as the "combination of the probability of an event and its consequence". This definition can be formalized as follows. The numerical subscript of j is used to count the number of risk factors. The numerical subscript of i is used to count the number of items influenced by the factors. At this time, the jth factor is not based on the items. Therefore, when we suppose that each factor is independent of the others, the occurrence probability of the jth factor is p_j. On the other hand, the jth factor has a different consequence for each item. Therefore, the amount of loss that the ith item suffers as a result of the jth factor can be written as D_{ij}. When there are m (j: $1 \ldots m$) kinds of factors, the received risk (the amount of expected consequence) R_i in the ith item is given as

$$R_i = \sum_{j=1}^{m} p_j D_{ij} \tag{1}$$

2.2. A basic model for trading a company's inventory

We presume the business model of a firm that procures a kind of goods and sells them because the essence of the information for inventory adjustment in such a model is clear. We then consider the risk factors of the business model qualitatively. The relation between the material flow and the inventory stock at the firm is shown in Fig. 1.

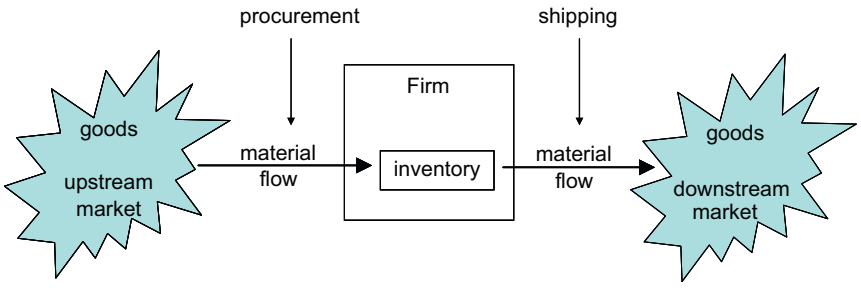

Fig. 1. A basic model for a firm and its inventory.