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A new model of the customer–supplier partnership in new product development

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Abstract

This paper proposes a new model of customer–supplier relationships with special interest in their new product development processes. The partnership model includes the following four types of distinctive index: satisfaction index, flexibility index, risk index, and confidence index. These indices measure the extent to which both the customer requirements and the supplier capabilities match or mismatch and therefore reflect the potential or risk of signing a project contract. The bidding party or parties with the most promising contract indices are considered further for awarding the contract.

Keywords: Supply chain; New product development; Early supplier involvement; Concurrent engineering; Internet; World wide web

1. Introduction

One of the prevailing findings from both Concurrent Engineering and Supply Chain Management research has been that great potential benefits can be achieved by both the customers and suppliers if they are involved in the new product development (NPD) process as early as possible [1–5]. The other side of the findings reveals that it has been a great challenge to implement this early supplier involvement (ESI) in NPD in industry [6–8]. Efforts are being made to facilitate the implementation. This research investigates into the two topical aspects. One is a customer–supplier interface model that is practically intuitive and yet theoretically thorough. The other is how this method can be incorporated into a web-based system on the Internet to enable better contact between the customers and suppliers.

This paper proposes a new model of customer–supplier relationships with special interest in their NPD processes. The partnership model includes the following four types of distinctive index: satisfaction index (SI), flexibility index (FI), risk index (RI), and confidence index (CI). These indices measure the extent to which both the customer requirements and the supplier capabilities match or mismatch and therefore reflect the potential or risk of signing a project contract. The bidding party or parties with the most promising contract indices are considered further for awarding the contract.

2. The partnership model

The partnership model proposed here includes the following four types of distinctive index:

(i) *Satisfaction index* is the measure of the extent to which a customer requirement is satisfied by a supplier capability. The larger the value of SI, the greater the potential that this pair of the customer and supplier become partners. SI is based on the overlap between the customer requirements and supplier capabilities.

(ii) *Flexibility index* is the measure of the extent to which a supplier capability exceeds a customer requirement. The larger the value of FI is, the more flexible the supplier to satisfy the changing customer requirement. FI is based on the surplus of the supplier capabilities.

(iii) *Risk index* is the measure of the extent to which a supplier capability fails to meet a customer requirement. The larger the value of RI is, the more risky the partnership between them. RI is evaluated through the shortage of the supplier capabilities.

(iv) *Confidence index* is the measure of trustworthiness of the supplier meeting the customer requirements over a period of specified time. The higher the value of CI for a longer time, the more reliable the supplier is.

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Longer term partnership may be considered, instead of using short-term competitive tendering. CI is evaluated through historical records of supplier performance as measured in selected indicators or inquiries.

These indices measure the extent to which both the customer requirements and the supplier capabilities match or mismatch and therefore reflect the potential or risk of signing a project contract. The bidding party or parties with the most promising indices are considered further for awarding the contract. In addition, supplier performance can be recorded in the system database. The difference between the actual performance and contract terms can be converted into what is called CIs. CIs can then be incorporated into the partnership indices as weighting factors. When the CI of a supplier is maintained at a high level for a sufficient period of time, a long-term partnership may be considered with this supplier.

In order to evaluate these indices, a model is needed for specifying the customer requirements and supplier capabilities. Because our special interest is in supporting the ESI in NPD, this model makes use of the design specifications as the basis for the customer to define the requirements and the supplier to specify the supply capabilities in quantitative terms. That is, the model of preparing design specifications is shared by both the customers and potential suppliers for defining their requirements and capabilities, respectively.

3. Evaluate partnership indices

Partnership indices are evaluated on the basis of customer requirements and supplier capabilities. Customer requirements and supplier capabilities may overlap. A supplier may have surplus or shortage of capability of meeting the customer requirement. These three concepts of overlapping, surplus and shortage are used to evaluate partnership indices. In our methodology and system, these concepts are first of all intuitively defined and visually illustrated before mathematical calculation is carried out.

Multiple inquiries are involved in the model of customer requirements or supplier capabilities. Therefore, the three types of partnership indices must be evaluated for all the inquiries one by one. Table 1 shows the formulas for calculating these three indices with respect to different kinds of value types and value tendency of range values.

In Table 1, R_s stands for the set of supplier capability for a certain inquiry. R_c stands for the set of customer requirement for a certain inquiry. OSI stands for the overall SI. OFI stands for the overall FI. ORI stands for the overall RI. N stands for the total number of inquiries evaluated. SI_i is the SI for ith inquiry item, FI_i is the FI for ith inquiry item, and RI_i is the RI for ith inquiry item. Because of the three types of customer requirements (or supplier capabilities), R_s and R_c can be defined as two sets with either continuous value or discrete value.

Different types of customer requirements (or supplier capabilities), indices must be evaluated differently. As far as the optional value is concerned, assume that the customer requires several colours, e.g. red, yellow and blue. The supplier is capable of providing green, red, yellow, blue and white. Thus, the supplier can satisfy the customer's requirement and provide two extra options: green and white. Therefore, this supplier's SI equals '1' and FI equals '$2/5 = 0.4$' and RI equals to '0'.

As for the Boolean type, consider the example inquiry 'Is the supplier ISO9000 certified?' The 'Yes' answer to this question indicates that this supplier meets this customer requirement. In this case, the supplier will have an SI of '1', FI of '0', and RI of '0', respectively, otherwise, the supplier is incapable of meeting this customer requirement. Therefore, this supplier's SI equals to '0' and FI also equals '0' and RI equals '1'. It must be pointed out that for the Boolean type, no flexibility exists, viz. FI always equals '0'.

There are two different tendencies of the range value. Therefore, the SI calculation can be further divided into two situations. Firstly, consider an example of 'the larger the better' inquiry. When a customer requires that the range of a machining dimension should be within 20–40 mm, the supplier has a machine tool that is capable of machining

Table 1
Equations to calculate partnership indices[a]

Value type	SI	FI	RI
Range			
R_s, the larger the better	$\frac{R_s \cap R_c}{R_c}$	$\frac{R_s - R_s \cap R_c}{R_s}$	$\frac{R_c - R_s \cap R_c}{R_c}$
R_s, the smaller the better	$\frac{R_s \cap R_c}{R_s}$	$\frac{R_c - R_s \cap R_c}{R_c}$	$\frac{R_s - R_s \cap R_c}{R_s}$
Option	$\frac{R_s \cap R_c}{R_c}$	$\frac{R_s - R_s \cap R_c}{R_s}$	$\frac{R_c - R_s \cap R_c}{R_c}$
Boolean	$\begin{cases} 1 & \text{if } R_s = R_c \\ 0 & \end{cases}$	0	$\begin{cases} 1 & \text{if } R_s \neq R_c \\ 0 & \end{cases}$
Overall	$\text{OSI} = \frac{\sum_{i=1}^{N} \text{SI}_i}{N}$	$\text{OFI} = \frac{\sum_{i=1}^{N} \text{FI}_i}{N}$	$\text{ORI} = \frac{\sum_{i=1}^{N} \text{RI}_i}{N}$

[a] Notes on set operators: $A \cap B$ is the intersection of sets A and B; $A - B$ is the difference between set A and set B.