Case-Based Reasoning for Logistics Outsourcing Risk Assessment Model

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Abstract The importance of managing logistics outsourcing risk has been realized by both scholars and managers. Thus, after we study the basic flow for CBR method, and analyze the connotation, characteristics and classification of logistics outsourcing risk, we construct a logistics outsourcing risk assessment model by way of Cased-Based Reasoning method to assess logistics outsourcing risk, and then discuss it in detail on how to search, match and rectify the new case with reference to the most matched case.

Key words Case-Based reasoning, Logistics outsourcing, Risk assessment model

1 Introduction

After entry into the 21st century, with the intense globalization of economics and further development of society, the modern companies have made great efforts to increase their core competence, thus having a new trend for them to outsource some of their business that are not in their core competence. This has become a tendency for logistics industry in the recent years. More and more companies have realized that they need cooperate with the special logistics service providers, so that they can focus on their core competence. However, during this process, there exist various risks from all kinds of aspects of internal and external environment, process management, information flowing, etc. Many companies always hesitate to involve logistics outsourcing and have a negative impact on their business performance. In order to avoid the possible risks generating in the process of logistics outsourcing, the company must build an effective risk alarming system to analyze logistics outsourcing risks’ level, to assess the possibility of risk and its damage degree and thus to offer supports to the decision-making and countermeasures for risks control.

Under the current circumstance, there are some literatures that have made studies on the logistics outsourcing risk. Reference [1] conducts a deep analysis on the outsourcing risks of enterprises’ logistics, and points out all kinds of risks and its factors in logistics outsourcing; reference [2] summarizes the logistics outsourcing risk, and builds a risk alarming system based on comprehensive fuzzy assessment. The above-mentioned studies, to some extent, have supported to make decisions for the companies, and have certain theoretical value. As is known to all, the factors that influence logistics outsourcing risk are quite complex and the traditional methods are limited. The logistics risk assessment and control need involve all kinds of talented people, thus, we put forward that we can make full use of Case-Based Reasoning to build a logistics outsourcing risk assessment model that offer a new feasible method to control logistics risk and improve their business performance.

The Case-Based Reasoning (CBR) method was put forward by Schank, a Professor from Yale University, in his work, “Dynamic Memory: A Theory of Reminding and Learning in Computers and People”. The CBR is one of hotspots in modern science research. Many scholars take deep research on it [3], [4]. In recent years, application of CBR method in the decision-making process of manufacturing, purchasing, operating and controlling has an increasing tendency [5]. But no one had ever put forward a centralized CBR model theory to solve the logistics outsourcing risk assessment decision. In this study, we put forward a risk assessment model on logistics outsourcing by way of CBR methods, and hope to offer a new thinking on this kind of problems to the companies that have logistics business.

2 The Case-Based Reasoning Method

The CBR method is according to the natural process, searches the case closing to the new problems,
compensates the aspects that don’t match, and forms the aided solution project of the problems. The basic assumption of CBR method is in that the similar condition and case will generate similar result, and the solution process is also similar. The core thinking to solve the problem is to utilize the knowledge existing in the case that can be found in the previous successful solutions. The CBR method is as same as the thinking mode of human beings, for instance, a lawyer will refer to the previous case to judge the current one, and the doctor will diagnose and cure the patients in accordance to the past similar case.

With the above thinking in mind, we can use CBR method and its model to solve logistical problems. Actually, the CBR model uses fuzzy cluster method to pick up characters of logistics outsourcing risk, and provides them fuzzy judging value. It sets up case database based on picking-up characters, and then establishes the assessment model of the case database. In order to compensate all the differences between searching case and decision problems, the model uses certain feasible method to match and train the decision project.

The basic step for CBR model to solve problems is as follows,

(a) Case description. The target case is described with certain characters, and the various indicators of the case are used to define the case. Then we need input all the indicators to the CBR system.

(b) Case retrieval. By way of searching similar indicators of the case, we can find the matched case from the database.

(c) Case resolving. We rectify and modify the optimally similar case, and solve the target case with reference to the similar case.

(d) Database refurbishment. The final step is to add the target case and its solution to the case database for future reference.

The solving step of the CBR model is illustrated in Fig 1.

With the above-mentioned reasoning steps, we can find effective and efficient suggestions to the real problems with reference to the previous experience. Different from the traditional knowledge, the knowledge stored in the CBR system is mainly the exact case record that has been successfully solved.
CBR method treats the problems, describes the characters of the cases, forms a series of solution to the case and stores them in the database. When the new problems come out, the system will find the similar cases that match the problems most. If the previous case is consistent with the new case, we can take the solution to the previous case as the new one to the new case; or we can rectify the new case, thus find the new solution to the new problems (that is, the new case).

3 Analyses on Logistics Outsourcing Risk

Before the logistics outsourcing risk assessment model based on CBR methods being constructed, the foundation for us is to analyze the logistics outsourcing risk existing in the process of logistics operations. Thus, in this part, we will research the connotation, characteristics and classification of logistics outsourcing risk.

3.1 Definition of logistics outsourcing risk

Generally speaking, risk means the difference existing in the real condition with the expected result, That is, the loss generated in this process. The loss can be absolutely quantity reduction in some cases, or the relatively reduction or opportunity loss. And the appearance of loss can be indeterminate and will happen in a certain probability, which cannot be predicted in advance [6]. Therefore, risk has two connotations, one is that risk means loss, or some unrealized expected goals; the other one is whether the loss will appear or not, is an indeterminate, or unexpected. The logistics outsourcing risk means the loss or the result that happen in the process of logistics outsourcing.

3.2 Characteristics of logistics outsourcing risk

Risk is a universal phenomenon in the real world. This is the same with logistics outsourcing risk. It generally includes the following aspects.

3.2.1 Randomicity

The risk and its outcomes have characteristics of randomicity. Whether the risk will happen, when it will happen and what it will affect cannot be changed by human beings. For instance, it is difficult to predict when the warehouse will catch a fire, when the traffic will be jammed thus having a vital effect on the transportation and distribution, and so on.

3.2.2 Mutation

Mutation of the logistics outsourcing risk means that the risk happen in a discontinuous or discrete way and it is difficult to find its real rule. In reality, the changes of logistics industry policies, indetermination of market demand, etc., are all such kind of risks.

3.2.3 Linkage

Linkage of the logistics outsourcing risk reflects the relevancy of risk factors. That is, one risk factor can induce the other risk. In the process of logistics outsourcing, the logistics parties are linked in the form of contract. Under such condition, the risk of one party must spread to the other parties. As for the operation of logistics service, the business is correlated. Thus, if transporting material gets wrong, the storage, market sales and service standard, and so on will be definitely influenced.

3.2.4 Objectivity

The risk is determined by the factors that will generate the risk. No matter the risk has been realized, the risk will come out, once the factors of risk have appeared. This absolutely cannot be changed.

3.3 Classification of logistics outsourcing risk

There exist different kinds of risks for the logistics outsourcing. Generally, they can be classified into the following types, taking the perspective of risk sources:

3.3.1 Information risk

It can be quite often found that there exist unsmooth communication, delayed information feedback and false information transmission between the logistics outsourcing companies and the third party logistics service providers. This will definitely increase the information asymmetry for logistics outsourcing. Once the cooperative companies cannot share their information, then the whole information flow will be unsmooth, and the information risk will come into being.

3.3.2 Managerial risk

The managerial risk for logistics outsourcing refers to the risk generated by the difference of the
managerial modes between the logistics outsourcing companies and 3PL service providers, after the logistics business are outsourced to the 3PL companies.

3.3.3 Financial risk
The other risk for logistics outsourcing is the internal financial risk of the companies. When the logistics business are outsourced to the 3PL companies, the logistics operation cannot reach the optimal condition, and logistics cost are overspent, and thus causing the financial risk to the companies.

3.3.4 Market risk
The market risk means the return loss of invest, caused by the market price fluctuation in the target market. When the logistics business are outsourced to the 3PL companies, if the market price fluctuates, the logistics innovation capability of the companies will be reduced, and generally forming the risk in the logistics outsourcing market.

3.3.5 Technology and information resources risk
Information sharing can help the companies to know better on the market demand, to arrange their production in a better way, to distribute product immediately and to increase customers’ satisfaction on the same time. However, information sharing will increase the risk cost. The companies will be harmed when the 3PL companies turn to cooperate with the other companies, or the market opponents.

3.3.6 Decision risk
Decision risk is caused by the lack experience or false decision of the companies. For instance, if the companies cannot define the exact scope of the logistics outsourcing business, or don’t know what their core competences are, it usually will cause decision risk. Actually, the relationship between the logistic outsourcing companies and 3PL service providers is entrust-agent type, and there is information asymmetry between them. Thus, the information asymmetry will induce to the false or weak decision, that is, the decision risk.

4 Logistics Outsourcing Risk Assessment Model Based on CBR Method

Based on the characteristics of logistics outsourcing risk discussed in the Part 3, and combining the basic flow of Case-Based Reasoning, in this part we construct a logistics outsourcing risk assessment model with the help of CBR method. In Practice, the model not only is fast, simple and reliable for acquiring the previous case knowledge, but also improves the quality and speed of case searching and case reasoning.

The logistics outsourcing risk assessment model based on CBR method is illustrated in Figure 2.

![Figure 2 Logistics Outsourcing Risk Assessment Model Based on CBR Method](image)

In the above risk assessment model, the key processes for the case reasoning are related to the
4.1 Description and organization of case

Description of case is the basic for the CBR method. As is discussed in the Part 3, the factors that cause logistics outsourcing risk are numerous, and the risk forming mechanism is also complicated. The different logistics outsourcing case usually has different character. Thus, it is quite crucial to design a certain digital frame to describe the cases’ characters that can be used and stored in the CBR database. Considering the characteristics of logistics outsourcing risk and the requirement of CBR method, we design a case frame for logistics outsourcing risk as illustrated in Table 1. And the cases are stored in the database in the way of relative database.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Frame Name</th>
<th>Case Name of Logistics outsourcing risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 1</td>
<td>Description of Risk symptom</td>
<td></td>
</tr>
<tr>
<td>Layer 1.1</td>
<td>Classification of Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 1.2</td>
<td>Description of Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 1.3</td>
<td>Reasons for Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 2</td>
<td>Risk Characters</td>
<td></td>
</tr>
<tr>
<td>Layer 2.1</td>
<td>Character 1 (Indicator 1, Weight 1; I2, W2; --- In, Wn)</td>
<td></td>
</tr>
<tr>
<td>Layer 2.2</td>
<td>Character 2 (Indicator 1, Weight 1; I2, W2; --- In, Wn)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Layer 2.m</td>
<td>Character m (Indicator 1, Weight 1; I2, W2; --- In, Wn)</td>
<td></td>
</tr>
<tr>
<td>Layer 3</td>
<td>Result Set</td>
<td></td>
</tr>
<tr>
<td>Layer 3.1</td>
<td>Exact Time for Risk happening</td>
<td></td>
</tr>
<tr>
<td>Layer 3.2</td>
<td>Loss after Risk happening</td>
<td></td>
</tr>
<tr>
<td>Layer 4</td>
<td>Related Knowledge</td>
<td></td>
</tr>
<tr>
<td>Layer 4.1</td>
<td>Reasons for Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 4.2</td>
<td>Process of Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 4.3</td>
<td>Countermeasures after Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 4.4</td>
<td>Lessons from the Risk</td>
<td></td>
</tr>
<tr>
<td>Layer 4.5</td>
<td>Preventing measures for Risk</td>
<td></td>
</tr>
</tbody>
</table>

In the Table 1, we use data bytes to describe the characters of cases. This is not only the storing form for the case in the database, but also the description way for the new cases.

4.2 Searching matched case

The reasoning process for CBR method is to search the most matched case with reference to the matched case to assess the risk level for the new case. In the CBR methods, there are usually three methods to search matched case. The first one is Nearest Neighbor Algorithm, and it is suitable to find matched case when the character values of the case are in numerical value form. The algorithm defines and calculates the near value (or the match value) between the cases, and the case with the nearest value is the one that we can use to refer. The second one is Induction Algorithm. It abstracts the difference between the characters of the cases, and constructs a layer network with these characters. When searching the matched case, we adopt the policy of decision-tree. It is fit for the independent characters of cases or the reasoning solution with only one character. The third one is Knowledge-Guided Indexing. It searches the already-known cases to distinguish the important characters and organizes or search in the case database. With the above-mentioned methods in mind, considering the characteristics of the logistics outsourcing risk assessment that most of which are descriptive, we suggest to construct a method mixed by the Induction and Nearest Neighbor Algorithm to search the most matched case in the way of SQL inquiry.

4.3 Rectification of solution

After finding the original result by searching cases, we have only got the risk assessment for the previous similar cases. In reality, the time, place, degree and environment when then risk case comes out
have been changed, thus we need to rectify the original solution to the new case considering the differences between the new case and the matched case. The rectification of solution can be two ways: auto-rectification and expert rectification. If the major factors that affect reasoning are limited and measurable, we can adopt the auto-rectification.

One simple way of rectification is as follows:

$$E = E_c \times \alpha_1 \times \alpha_2 \times \alpha_3 \times \beta$$  \hspace{1cm} (1)

Here in (1), $E$ is the original risk assessment result by searching cases; $\alpha_1$ is time rectification coefficient, using it under the condition that need considering the time differences between the cases, for instance, some seasonal or sequel indicators; $\alpha_2$ is place rectification coefficient under the condition that considers place differences or different logistics cooperative parties; $\alpha_3$ is degree rectification coefficient for different risk indicators; $\beta$ is integral rectification coefficient for the other indicators.

For the accidental risk assessment, we can adopt the expert rectification aided by computers in that not all the indicators that affect the find solution are included in the case database. The managerial staff can analyze the difference between the matched case and the current case, then set rectification methods and their coefficients, as well as considering the other environmental indicators.

5 Conclusions

In this paper, we have addressed an important issue within the realm of logistics outsourcing: using the CBR method to construct a risk assessment model to decide the logistics outsourcing risk. To address this problem, we have made three significant contributions: First, we have made a deep analysis on the logistics outsourcing risk, to find its connotation, characteristics and classification. Secondly, we have presented a detailed Risk assessment model for logistics outsourcing risk, and we have established the basic flow for the model. It upgraded the searches speed and efficiency. The last, we have illustrated how to use this model, and more important, how to compensate these differences between searching case and decision problems.

References


