Outsource Evaluation and Selection in Software Outsourcing Risk Management

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Abstract: Outsourcing software development has many advantages as well as inevitable risks. Of these risks, outsourcee selection is one of the most important. A wrong outsourcee selection may have severe negative influence on the expected outcome of the project. Within the framework of software development project risk management, we analysed the risks involved in outsourcee selection and also provided methods to identify these risks. Using the principles of Analytical Hierarchy Process (AHP) and Cluster Analysis based on Group Decision Making, we established an index evaluation system to evaluate and select outsourcees. Real world applications of this system demonstrated its effectiveness in evaluating and selecting qualified outsourcees.

Keywords: software outsourcing; outsourcee; risk management; Group Decision Making

1. Introduction

With the rapid advances of economic globalization and the computer technology, software customers have higher and higher requirements. More and more software enterprises have selected the software project outsourcing strategy in order to keep their competitiveness. According to the analysis of IDC’s (Information Data Corporation), global application software market increases at a rate of 29.2% annually, hopefully reaching the scale of 38.9 billion US dollars in 2005. The statistics from Business Week shows that one third of the global software industry value is achieved through outsourcing. Software outsourcing is becoming an important trend in world wide software industry, in which China and India have become the major players. There will be more than three million jobs shifted outside the United States according to data provided by Forrester Research Inc (McCartney, 2003). An interactive survey by Gartner also tells that 5% of the IT jobs will be transferred into other countries (Hoffman, 2003).

Outsourcing offers several advantages, such as enabling existing staff to concentrate on core competencies, focusing on achieving key strategic objectives, lowering or stabilizing overhead costs, obtaining cost competitiveness over the competition, providing flexibility in responding to market conditions, and reducing investments in high technology. Thus software outsourcing is becoming increasingly popular. However, the difference between outsourcers and outsourcees in terms of geography, culture, law, view of value and management methods, there are also disadvantages to outsourcing agreements. These include becoming dependent on an outside supplier for services, failing to realize the purported cost savings from outsourcing, locking into a negative relationship, losing control over critical functions, and lowering the morale of permanent employees (Kliem, 1999). The largest risk comes form the choice of the outsourcees. A wrong choice may make the outsourcer fail to achieve the development scale, time, cost, and quality and benefit goals. The purpose of outsourcing is to pursue potential benefits, but this can’t guarantee a outsourcing will come successfully. Some of the challenges and risks associated with outsourcing are similar to those existing in in-house development, but a lot more risks are different and much higher in intensity. Outsourcers will have much more failure chances then in-house developer unless risks associated with outsourcing are under control and proper management.

Though much research have been done about outsourcing risks, there are few research reports about the evaluation and selection of outsourcees. This paper started off from software outsourcing risk management, analysed various risks resulting from outsourcee selection failure, built up a set of outsourcee evaluation index system using analytic hierarchy process, group decision and cluster analysis method . Practical computation results have been provided.

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2. Outsourcing risk management

The nature of project outsourcing is a management strategy which subcontracts what can’t be done or what can’t be done properly in-house to others who can do it better. Software project outsourcing refers to a software company (called outsourcer) subcontracts some software projects which would be done inside the company to other professional, more efficient software companies (outsourcees) through contracts. (Meng GuoBao et al., 2004)

Software project outsourcing is essentially composed of seven phases (Kliem, 1999):

1. Determine the business case for or against outsourcing, what is to be outsourced?
2. Search for outsourcees, where and how to search?
3. Evaluate and select outsourcees, decide on methods and standards to evaluate and select outsourcees;
4. Conduct negotiations with outsourcees on project range, time, costs, quality;
5. Consummate an outsourcing agreement and legalize what have been negotiated and agreed on;
6. Execute and manage the agreement: set up outsourcing management organization structure, sign management agreements, monitor and trace outsourcees;
7. Determine the business case to decide whether to renew, renegotiate, or terminate a contract.

A risk refers to the resulted negative effects of an event or action onto an organization’s ability to achieve its commercial goals or strategies. Risk is a kind of uncertainty in nature. (Yang Ying et al., 2001). Risks exist veritably in outsourcing; hence it is necessary to manage risks before making outsourcing decisions. Outsourcing risk management involves the controlling process of preventing, checking, and correcting risky events with negative consequences. This process includes identifying, analyzing and sorting risks according to their priorities, considering how to eliminate or reducing risks, while taking into account management costs during the outsourcing agreement effective period. Risk management consists of four closely interrelated steps: risk identification, risk analysis, risk sorting and risk control (Sun Qiang et al., 2004). Risk identification is to identify and evaluate potential risky aspects, which is the most important step in risk management. Risk analysis is to analyze and to decompose the causes or deeper reasons for known risks. Risk sorting is to quantify the risk probabilities and possible outcomes, and then to sort risks. Risk control is to manage and control the recognized risks; it consists mainly of risk control planning, risk avoidance, risk reducing and risk monitoring.

Researchers have conducted analysis on the origins of outsourcing from different perspectives:

Kleim (2004) proposed that the outsourcing risks come usually from finance, technology, management, behavior, and law. Financial risks deal with budget and cost; technological risks deal with tools, techniques and standards; management risks deal with decision making and reporting; behavioral risks deal with managing and leading people; legal risks deal with governmental laws and regulatory considerations.

Kleim (1999) put potential risks confronting outsourcing agreements into of three categories: legal, operational, and financial. (1) Legal risks involve litigious issues prior to and after negotiating an agreement, such as including unclear clauses in the agreement, locking into an unrealistic long-term contract, not having the right to renegotiate the contract, omitting the issue of outsourcee management; (2) Operational risks involve ongoing management of an agreement, such as becoming too dependent on a vendor for mission-critical services, being unable to determine the quality of the services being delivered, not having accurate or meaningful reporting requirements, selecting a vendor that has a short life expectancy, being unable to assess the level of services provided by a vendor, having a vendor fail to provide an adequate level of services; (3) Financial risks involve the costs of negotiating, maintaining, and concluding agreements, such as not receiving sufficient sums for penalties and damages, paying large sums to terminate agreements, paying noncompetitive fees for services.

Leavy (2004) thought that the two major risks in outsourcing are the risk of mortgaging the future: losing key skills and capabilities, and the risk of choosing to outsource at the wrong time in a market’s evolution.
Jiang et al. (2002) proposed that software development risks include poor technological acquisition, limited application size, lack of team’s general expertise, lack of team’s expertise with the task, lack of user support, intensity of conflicts, extent of changes brought, resources insufficient, lack of clarity of role definitions, application complexity and lack of user experience.

Meng GuoBao et al. (2004) are convinced that the project outsourcing in essentially a kind of transaction relation between the software company and the outsourcees. From the view point of transaction cost theory and agent theory, software companies will encounter unexpected transaction and management cost risks, lock-in risks, expensive agreement settling cost risks, dispute and lawsuit risks, risks of lowered quality of the products delivered by outsourcees, risks of losing competitiveness, and risks of backward selection, moral risks.

Ling ZeFu et al. (2004) proposed that there are three types of risks in information technology outsourcing, the risk of losing information technology investment flexibility, the risk of outsourcee selection failure, the risk of reduced internal learning and innovation ability.

3. Risk resulted from outsourcee selection failure

Software companies have to set up an expert group to evaluate the outsourcee candidate’s capacity before making the choice. An inappropriate evaluation process or unsuitable results may bring about the outsourcee selection failure, along with following possible risks (Meng GuoBao et al., 2004):

1) The risk of reduced quality of the products delivered by the outsourcees. The outsourcee don’t commit seriously to carrying out of the signed contract because of immorality or opportunism; or the outsourcee can’t deliver the assigned tasks within the deadline, thus influencing the progress of the whole project; the outsourcee deliver software products whose quality is far from the expected; the outsourcee can’t keep the after-sale-service promises after the products being accepted by the users; the outsourcees are slow in responding to customers, shifting and upgrading products to meet new requirements.

2) The risks of backward selection. Essentially, the software project outsourcing is a transaction relationship between the outsourcer and the outsourcee, there exists an entrust-agent relationship between them. Backward selection means that both parties in the business purposely conceal related risk information, which are often asymmetric; to procure interests unworthy of their risks they take. With a better knowledge of their own abilities, the outsourcees may hide their ability deficiencies and exaggerate their advantages before signing contracts in order to procure their own interests. Even though the outsourcees can obtain their wanted economic interests in this way, they may not provide qualified products required by the customers. Backward selection makes it easy to be taken advantage by lousy outsourcees, hindering the enterprises from selecting optimum cooperation partners.

3) Morality risks. Morality risks are the possibilities that the agents take secret actions which are out of trustee’s control or just don’t act, losing the possibility of making profits on both sides of trustees or agents. During outsourcing, the outsourcees’s lack of commitment to implement the contract and their concealing the project progress, costs and quality prevent the software enterprises to manage them. Leading to dramatic reduction of product quality.

4. Establish outsourcee ability evaluation item systems

In order to avoid failure in outsourcees selection before making outsourcing decisions, it is necessary to have a risk prevention mindset, to identify various risks from outsourcee during each phase of outsourcing decision, and to establish a scientific efficient outsourcee ability evaluation index system and to select outsourcee scientifically, efficiently. Researchers have proposed following outsourcee ability evaluation items as listed in Table 1.
Table 1 Outsource ability evaluation items

<table>
<thead>
<tr>
<th>Integral Items</th>
<th>Items in the Literature</th>
<th>Origin of Items</th>
</tr>
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<tbody>
<tr>
<td>Management and business professionalism</td>
<td>Professionalism of outsourcing staff, specialized outsourcing manager, experts and team, knowledge and ability, employee training plan</td>
<td>Barki et al. (2001), Bahli et al. (2005), Lin ZeFu et al.(2004), Meng GuoBao et al. (2004)</td>
</tr>
<tr>
<td>Enterprise environment, understanding of pertinent law, regulations</td>
<td>Financial status, cost level, cost and progress plan</td>
<td>Barki et al. (2001), Jennex et al. (2003), Lin ZeFu et al.(2004)</td>
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</table>

In accordance with the project outsourcing management requirements and the principle of outsourcing evaluation index system (system completeness, scientifically conciseness, stability and comparability, flexibility and operability), we summarize the following major five indices for evaluating outsourcing ability after literature research and expert discussion: technology and production ability, management and business ability, reputation, financial operation ability, enterprise environment and understanding of pertinent law and regulations.

Technology and production ability is an item evaluating the outsourcee’s integrated ability in terms of hardware, including outsourcee’s technology level, specialized technology investment willingness and ability, IT and telecommunication infrastructure, quality system, enterprise scale.

Management and business ability is an item to evaluate the outsourcee in terms of software, including outsourcee’s positioning in the industry sector, knowledge and professionalism of their staffs and managers, and employee training plan.

Reputation is an item used by other customers and consultant agencies to check the outsourcee’s reputation, performance, e.g. ability to implement a contract, commercial reputation and verbal recommendation.

Financial operation ability information is obtained through analyzing the audited financial reports and annual audit reports provided by outsourcees. This item is to check the amount of time the outsourcees have involved in the related business, their market share and fluctuations, and also to evaluate the outsourcee’s affordability in specialized technology investments.

Enterprise environment, understanding of pertinent law and regulations is to examine the outsourcees’ organization environment, their understanding of pertinent laws, regulations, outsourcing business and intellectual property protection practices. The outsourcees’ environment influences the establishment of strategic partnership. Particularly with the economic globalization trend, when selecting an abroad outsourcing that has a far different political, legal, economical, technical and social culture environments, once the supply chain established, many unexpected problems may turn up during practical operations. Therefore, this item has a greater influence. The enterprise environment evaluation includes mainly enterprise culture, geographical location, political, legal and tax policies, macro-economic policies.

5. Methods to evaluate outsourcing's ability

Currently there are several methods to evaluate and select the outsourcing either qualitatively or quantitatively. Qualitative methods are suitable for comparison and selection of non-numeric items, while quantitative methods are for understanding the outsourcing’s operation system with large amount of data available. For software enterprises, particularly for first time partners, the limitation of
information and data makes it necessary to combine both methods. The currently prevalent methods are listed as follows (Peng YongXing, 2003):

(1) Analytic Hierarchy Process (AHP). AHP is a multi-goal decision method combining qualitative and quantitative analysis which can effectively analyses goal and decision criterion systems, non-sequential relations among hierarchies and comprehensively test the decision maker’s judgment and comparison. However, it is impossible to take into account each expert’s decision preference or bias when several experts are involved in decision making.

(2) Data Envelopment Analysis (DEA). DEA is a new integral method to evaluate the relative validities of similar departments with multi goal input/output. This method is also a strong tool to investigate multi items input/output production functions. However DEA focuses too much on quantitative analysis to deal with non-quantitative items.

(3) Fuzzy Synthesis Evaluation. This method is an integral method to evaluate suppliers using fuzzy sets theory. This method effectively combines outsourcees’ performance and evaluators’ subjective judgments, qualitative analysis and quantitative analysis. It is particularly suitable for occasions where it’s required to do qualitative and quantitative analysis on outsourcee with insufficient data.

(4) Cluster Analysis. This method falls into the category of group decision, a multi-variable quantitative analysis method which divides data into several groups with a maximum inter-group difference and a minimum inner-group difference or a maximum inner-group similarity.

The above mention methods all have their advantages and limits. In practice, two or more than more methods are used together such that the methods can complement one another and give out evaluation procedures and results as scientific, reasonable, and operable as possible. For example Trlluri and Baker (1996) proposed a two-step partner selection model in which the first step the DEA is used to distinguish efficient business flow procedures, followed by obtaining solutions using (0-1) integer goal programming and final selection of qualified outsourcee. Meng GuoBao et al. (2004) recommended an AHP based DEA outsourcee selection model with bias consideration.

There are multi-solutions and uncertainties in evaluating software project outsourcee’s abilities, because each item evaluates the outsourcee from different perspective. There are also differences in contribution of each item in evaluating outsourcee’s ability. Therefore, a set of objective and fair item’s weights is essential in evaluating outsourcees. In practice several pertinent experts form a expert decision group to decide on important problems. Experts come from different technical fields, possessing different bias, knowledge background and understanding views for a specific item, they may have large inconsistency on a same decision problem In order to eliminate this inconsistency as much as possible and to have a fair, justified, efficient evaluation item system, the paper suggests a integrated outsourcees’ ability evaluation method which incorporates AHP and cluster analysis.

6. The outsourcee ability evaluation process
The principle of this evaluation method is:
1) first to obtain each single decision make’s evaluation item weight using AHP;
2) to calculate the vector angles among any two decision makers’ decision vectors using group cluster analysis;
3) combine and group decision vectors with angle less than the selected critical angle value, giving higher weights to the groups that have higher similarity of judgments among experts, while lower weights to the groups with lower similarity among experts;
4) To determine from these results the expert evaluation integrated weight coefficient to scientifically represent the opinions of majority people (Johnson et al., 2001).
6.1 Determine single expert evaluation item weight using AHP
Suppose m experts are evaluating n evaluating items, where $E = \{E_1, E_2, ..., E_m\}$ is specialist decision groups. The evaluation results of kth experts is subjected AHP calculation and consistency test. The resulted eigenvectors of decision criterion layer is $W^{(k)} = (w_1, w_2, ..., w_n)^T$. Repeat this process until all m expert’s eigenvectors are obtained, which is the evaluating item weight of a single expert. See Wang MeiYuan(2004) for details on this method.
6.2 Group experts using group decision Cluster Analysis Method

Take each expert’s evaluation result as a vector, the constancy value of two experts’ results are calculated as the cosine of the angle between two result vectors:

\[ d_{ij} = \cos \theta_{ij} = \frac{\vec{W}_i \cdot \vec{W}_j}{|\vec{W}_i||\vec{W}_j|} \]  

(1)

where, \( d_{ij} = d_{ji} \)

In expression (1), when consistency value \( d_{ij} \) approaches 1, experts i and j have higher similarity in all aspects. These two experts can be grouped into one group if their consistency value approaches a certain level.

Cluster Analysis is carried out as following:

(1) Let each cluster represent a single expert, i.e. \( G_1 = \{E_1\}, G_2 = \{E_2\}, G_3 = \{E_3\}, \ldots, G_m = \{E_m\} \), with totally m clusters. Let \( q = m \);

(2) Calculate consistency value \( d_{ij} \) between m clusters using expression (1);

(3) Choose the maximum \( d_{xy} \), and let the respected cluster \( G_x \) and \( G_y \) form a new cluster \( G_{q+1} = \{G_x, G_y\} \);

(4) if \( q = 2 \) (m-1), go to step (7), otherwise continue to step (5);

(5) Remove \( G_x \) and \( G_y \) from cluster sets and add new cluster \( G_{q+1} \);

(6) Calculate the consistency value \( d_{ij} \) among the clusters in the new cluster set, where \( d_{i,q+1} = \max\{d_{ix}, d_{iy}\} \) (Johnson et al., 2001), i≠x or y, i=1,2,…,m. Let \( q = q+1 \), go to (3) and continue to merge the rest clusters;

(7) Draw cluster plot and determine clusters and cluster numbers.

6.3 Integral evaluation of outsourcees’ ability

In cluster analysis, m experts are grouped into t clusters, the evaluation information of experts from the same cluster have high similarity, hence similar weight scores; otherwise the evaluation information of experts from the different clusters have different weight scores. Clusters with larger number of experts represent the evaluation information of majority of experts, hence receive greater weight score, otherwise lower weight score. (Wu YunYan et al., 2003).

Assume there are \( \Phi_k \) experts in the cluster containing the kth expert, and the weight of the kth expert is \( a_k \), \( a_k \) is proportional to \( \Phi_k \) from expression \( \sum_{k=1}^{m} a_k = 1 \) and \( a_1 : a_2 : \cdots : a_m = \Phi_1 : \Phi_2 : \cdots : \Phi_m \), we have the weighty coefficient of the kth expert:

\[ a_k = \frac{\Phi_k}{\sum_{j=1}^{m} \Phi_j} \]

The software project outsourcee integral weighted evaluation system \( W = (w_1, w_2, \ldots, w_n)^T \) can be obtained from the weighted average of each single expert’s evaluation result eigenvector \( W^{(k)} = (w_{1k}, w_{2k}, \ldots, w_{nk})^T \), using weight coefficient \( a_k \).

After getting the weight coefficient of each evaluation vector, experts start to evaluate outsourcees using 100 percent scale. The final grade of the software outsourcee is determined by calculating the weighted average of integral evaluation weighted item system \( W = (w_1, w_2, \ldots, w_n)^T \).

7. Calculation Example

Software enterprises are looking for ways to outsource software project to improve core competitiveness and to reduce cost. It is necessary to build up an integrated outsourcee ability evaluation item system to choose the most competitive outsourcees from a larger number of similarly qualified candidates. The process of establishing integral evaluation item system is described as follows.
7.1 Calculate each expert’s evaluation item weight using AHP

The above mention outsourcee’s ability evaluation item falls into goal layer, decision criterion layer, sub-decision criterion layer, goal layer \(A\) represent outsourcee’s ability and goal; decision criterion layer is \(B_1\): technology and production ability, \(B_2\): management and business professionalism, \(B_3\): reputation, \(B_4\): financial operation ability, \(B_5\): enterprise environment and legal regulation understanding. They are the practical representation of the general goal, and the sub-goals needed to consider in decision making, they are also the concrete criteria in decision making; sub-decision criterion layer are detailed roll out of the decision criterion layer.

The importances of outsourcee evaluation item are determined on the basis of extensive investigations by pertinent experts and personals within the industry using Delphi method. The Pairwise Comparisons Matrix between each pair of decision criterion layer \(B_j\) is obtained based on large amount of statistical investigation data. For the purpose of convenience, we just list the experts’ evaluation results into 5 clusters and only carry out analysis and calculation for goal layer and criterion layer.

\[
A_1^{(1)} = \begin{bmatrix}
1 & 3 & 4 & 5 & 8 \\
1/3 & 1 & 3 & 4 & 7 \\
1/4 & 1/3 & 1 & 5 & 6 \\
1/5 & 1/4 & 1/5 & 1 & 5 \\
1/8 & 1/7 & 1/6 & 1/5 & 1
\end{bmatrix} ;
A_2^{(2)} = \begin{bmatrix}
1 & 1/3 & 3 & 4 & 8 \\
3 & 1 & 3 & 5 & 8 \\
1/3 & 1 & 4/5 & 1 & 5 \\
1/4 & 1/5 & 1/5 & 1 & 5 \\
1/7 & 1/5 & 1/5 & 1/5 & 1
\end{bmatrix} ;
A_3^{(3)} = \begin{bmatrix}
1 & 2 & 1/3 & 4 & 7 \\
1/3 & 1 & 4/5 & 1 & 5 \\
1/4 & 1/4 & 1 & 5 & 6 \\
1/5 & 1/5 & 1/5 & 1 & 5 \\
1/5 & 1/5 & 1/5 & 1/5 & 1
\end{bmatrix} ;
A_4^{(4)} = \begin{bmatrix}
1 & 5 & 1/4 & 4 & 1/3 \\
1/5 & 1 & 1/5 & 4 & 1/4 \\
1 & 3 & 1/3 & 3 & 7 \\
1/4 & 1/5 & 1/5 & 1/7 & 1 \\
1/8 & 1/5 & 1/7 & 1/6 & 1
\end{bmatrix} ;
A_5^{(5)} = \begin{bmatrix}
1 & 6 & 3 & 4 & 8 \\
1/5 & 1/4 & 1/5 & 1 & 4 \\
1/3 & 4 & 1 & 3 & 7 \\
1/4 & 5 & 1/3 & 1 & 6 \\
1/8 & 1/5 & 1/7 & 1/6 & 1
\end{bmatrix} ;
\]

Five expert cluster eigenvectors \(W^{(i)}\) and eigenvalues \(\lambda_{max}^{(i)}\) can be obtained from the above PCM using hierarchy analysis and calculate:

\[
W^{(1)} = (0.4524,0.2534,0.1744,0.0865,0.0332)^T, \lambda_{max}^{(1)} = 5.5507
\]
\[
W^{(2)} = (0.2672,0.4322,0.1834,0.0850,0.0332)^T, \lambda_{max}^{(2)} = 5.5009
\]
\[
W^{(3)} = (0.2403,0.1923,0.4339,0.1005,0.0330)^T, \lambda_{max}^{(3)} = 5.5462
\]
\[
W^{(4)} = (0.4646,0.0762,0.2527,0.1724,0.0341)^T, \lambda_{max}^{(4)} = 5.4616
\]
\[
W^{(5)} = (0.1722,0.0892,0.4377,0.0359,0.2650)^T, \lambda_{max}^{(5)} = 5.5296
\]

The average random consistency ratio CR of the five PCM are all verified to be less than 0.1, therefore these five PCM \(A_1^{(i)}\) have satisfactory consistency.

7.2 Calculate expert evaluation item weight using Cluster Analysis

Let \(E_1, E_2, E_3, E_4, E_5\) represent opinions of five expert clusters, dividing five expert groups into five clusters, i.e \(G_1=\{E_1\}, G_2=\{E_2\}, G_3=\{E_3\}, G_4=\{E_4\}, G_5=\{E_5\}\), Let q=5.

Calculate consistency value between two expert clusters using expression (1) and have

\[
d_{12} = 0.8990, d_{13} = 0.8071, d_{14} = 0.9279, d_{15} = 0.6204, \\
d_{23} = 0.7960, d_{24} = 0.7113, d_{25} = 0.5873, \\
d_{34} = 0.8338, d_{35} = 0.8770, \\
d_{45} = 0.6894.
\]

Since \(d_{14} = 0.9279\) has the maximum value, merge \(G_1\) and \(G_4\) to a new cluster \(G_6=\{G_1, G_4\}=\{E_1, E_4\}\), and the cluster sets becomes \(G_2, G_3, G_5, G_6\).

Calculate the consistency value of the new cluster set and obtain

\[
d_{23} = 0.7960, d_{25} = 0.5873, d_{26} = 0.8770,
\]
\[
d_{35} = \max\{d_{31}, d_{32}\} = 0.9279, d_{36} = \max\{d_{31}, d_{32}\} = 0.8338, d_{56} = \max\{d_{51}, d_{52}\} = 0.6894, \text{ and } q = q+1 = 6.
\]

Previously, \(d_{26} = 0.890\) is the greatest, so merge \(G_2\) and \(G_6\) into a new cluster \(G_7 = \{G_2, G_6\}=\{E_2, E_6\}\), and the new cluster combination becomes \(G_3, G_5, G_7\).
Following the steps of agglomerative clustering, we group the rest clusters and obtain the final new cluster $G_8 = \{G_3, G_5\}$ and $G_9 = \{G_7, G_8\} = \{E_3, E_5\}$.

The results are shown in Cluster Plot as in Figure 1.

![Figure 1 Cluster Plot](image)

From cluster plot, $E_1, E_4, E_2$ have high similarity. So we group these three expert groups into one cluster, $E_3$ and $E_5$ have high similarity. They also fall into one cluster.

Since the expert numbers of each cluster $\Phi_1 = \Phi_2 = \Phi_4 = 3, \Phi_3 = \Phi_5 = 2$, the weight coefficient of each expert cluster is calculated as:

$$a_1 = a_2 = a_4 = \frac{\Phi_1}{\sum_{i=1}^{4} \Phi_i} = \frac{3}{3 + 3 + 2 + 2} = \frac{3}{13}, \quad a_3 = a_5 = \frac{2}{13}.$$

Finally, the integrated weight of each evaluation item is obtained from the weighted average of expert clusters evaluation results' eigenvectors:

$$w_1 = \sum_{k=1}^{4} a_k \cdot w_{1(k)} = \frac{3}{13} \times 0.4524 + \frac{3}{13} \times 0.2534 + \frac{2}{13} \times 0.2534 + \frac{3}{13} \times 0.4524 + \frac{2}{13} \times 0.1744 = 0.3331,
\quad w_2 = 0.2191, \quad w_3 = 0.2750, \quad w_4 = 0.1003, \quad w_5 = 0.0688.$$

Final integrated weights of five evaluation items of expert cluster is $W = (0.3331, 0.2191, 0.2750, 0.1003, 0.0688)^T$. That is to say that, when evaluating outsourcee’s abilities, the integrated evaluation item weights are: Technology and production ability 0.3331, management and business professionalism 0.2191, reputation 0.2750, financial operation ability 0.1003, enterprise environment and legal regulation understanding 0.0688. We see that in software outsourcee evaluation, people put the highest requirement in outsourcee’s technology and production ability, reputation and management/business ability, then goes the financial operation ability and enterprise environment and legal regulation understanding.

8. Conclusion

Outsourcing software development project has many advantages as well as inevitable risks. Of these risks, outsourcee selection is one of the most important. A wrong outsourcee selection may have severe negative influence on the expected outcome of the project in terms of development scale, time, cost, quality, interest and contract lock-in.

In order to avoid failure in outsourcee selection before making outsourcing decisions, it is necessary to have a risk prevention mindset, and to establish a scientific efficient outsourcee ability evaluation item system and to select outsourcees scientifically, efficiently.

From research we discover that in software outsourcee evaluation, people put the highest requirement in outsourcee’s technology and production ability, reputation and management / business ability, followed by financial operation ability and enterprise environment and legal regulation understanding.

However, the evaluation item weight system isn’t fixed throughout the evaluation process, it is necessary to make adjustment according to different software projects, countries where outsourcee locates (domestic or abroad), the relationship between the software company and the outsourcee.
Throughout the process of establishing the outsourcee evaluation weight system establishing process, like choosing the item system, evaluate the importance of each item, adjustment of consistency, the evaluation results are to some extent influenced by the subjective opinions of decision makes, experts and users, particularly when we assign the same weight to the expert clusters with more tendency consistency hence neglect the practical existent subtle difference among expert clusters. The influence of this factor on the reliability of evaluation results still awaits further investigation.

References

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