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An integrated framework for outsourcing using balanced score card and ELECTRE III

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A B S T R A C T

During the past few decades, many organizations have attempted to increase their productivity through outsourcing parts of their responsibilities. Outsourcing helps firms reduce their low value added activities and focus on their high value added activities. It also helps organization save their time and energy which leads to more efficient units. The idea of outsourcing is more important for project based organizations where the nature of works is different from a particular project to another one. This paper presents an integrated balanced score card system with an adaptation of ELECTRE III method to select suitable resources for outsourcing. The proposed model of the paper is implemented for a case study of subway system in Iran and the results are discussed.

1. Introduction

Outsourcing has become a necessary tool for many organizations to reduce their size through a decrease on unnecessary activities. There are many specialized firms created when groups of similar activities are outsourced to other organizations. Therefore, specialized people could work for these newly established units, which means economy could create workers who are professional with higher labor productivity. The primary key for the success of any outsourcing project is to find high quality organizations for resource allocation activities. There are different criteria involved when an outsourcing decision-making process is determined. In fact, outsourcing activities are strategic decision-making issues and it plays a key role on the success of companies (Bourne & Wilcox, 1998). One of the most important methods to group various decisions is balanced score card (BSC) (Norton & Kaplan, 1992; Norton & Kaplan, 1996). BSC is a systemic approach, which helps integrating financial and non-financial factors into a comprehensive model and builds a meaningful relationship among different criteria using cause and effect methods. The main mission of BSC is to translate

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mission, vision, values and strategy of an organization into objectives and performance indicators using the following four-way concession interpreting cards,

- Financial perspective: what shareholders expect the company in terms of profitability
- Customer perspective: what the customers expect the company to keep using their services
- Internal processes: Having strong competitive advantage on internal processes could help firms retain more customers and produce more profits
- Learning and growth perspective: Having a good harmony among intangible assets could lead to more productive organization

BSC is looking for the different goals in its implementation. It tries to build a framework for strategic planning through customer and financial perspective, internal, learning and growth perspectives. It creates an insight for both managers and employers to better understanding the company's objectives. BSC helps us assess historical performance and improves outlook. Fig. 1 shows the relationship among various factors of BSC.

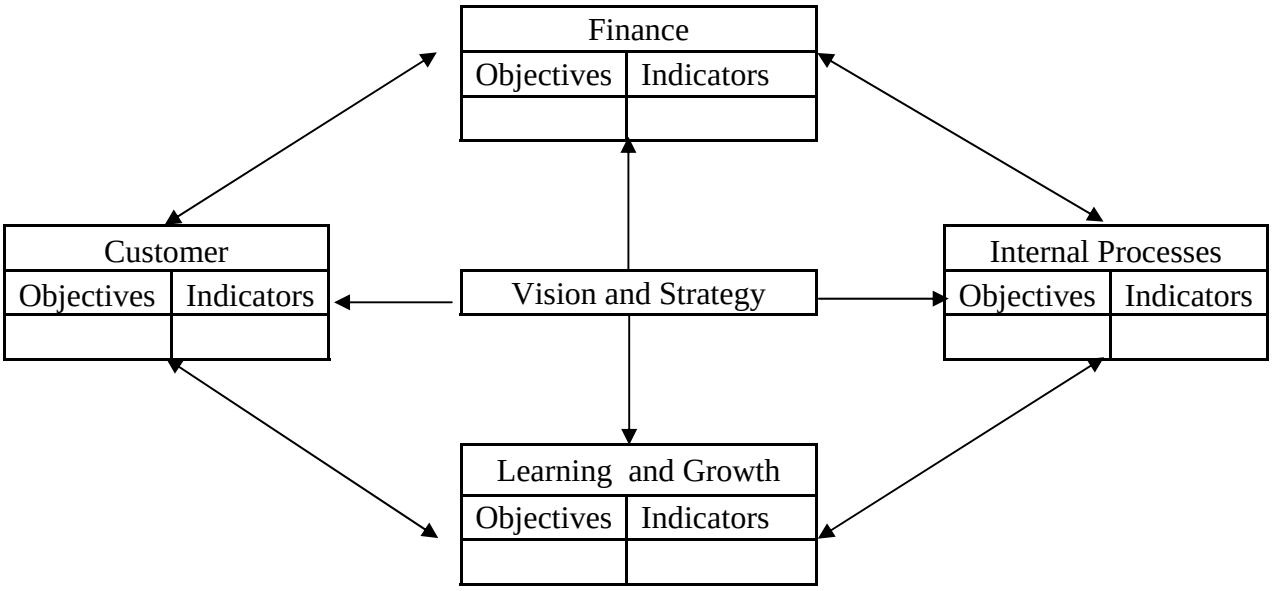

Fig. 1. A simple framework of BSC elements

As we can observe, all BSC components have correlations. As we have already explained, multiple criteria decision -making systems (MCDM) often need to be used for ordering different alternatives. There are literally various types of MCDM techniques such as analytical hierarchy procedure(AHP), TOPSIS, ELECTERE. ELECTERE is one the popular methods, which not only helps us order different alternatives but also it introduces two concepts of threshold and outranking in addition to other ranking methods. In ELECTERE, instead of having two regions of so called *for* and *against* for two alternatives we have three regions where one is the region of uncertainty which is associated with weak preference. ELECTRE has been widely used in different environmental projects such as waste management, environment studies, road and highway constructions, etc (Hokkanen & Salminen, 1997; Karagiannidis & Moussiopoulos, 1997; Wanga & Triantaphyllou, 2000; Srinivasa et al., 2000; Figueira, 2005; Teixeira & Almeida, 2007). Carlos and López (2005) used ELECTRE with an integration of genetic algorithm to rank master students. Dias and Clímaco (2000) proposed an extended ELECTRE method where input parameters are subject to uncertainty. Jaehee et al. (2006) used ELECTRE method for coordination of multi-reservoir planning.

During the last few years, there have been an increasing interest in developing conceptual methods for outsourcing activities. McIvor et al. (1997) introduced a method to select between making or

buying the goods based on three factors of competitive advantage, internal capabilities and the cost of making versus ordering goods. Lordi et al. (1998) studied different reasons for failure of outsourcing maintenance activities and provided some guidance to prevent any failure. AHP has been widely used for ranking different vendors (Yang et al., 2007). Hafeez et al. (2007) used AHP method to rank the outsourcing activities based on different factors such as the amount of knowledge and the assets involved with activities. Chen et al. (2006) used a fuzzy technique for outsourcing the activities based on different factors such as quality, technology, distance, etc. There are many cases where ranking decisions are made in different stages (Kahraman, 2007; Tjader, 2009). Araz et al. (2007) proposed a fuzzy goal programming technique to select suitable criteria and then used fuzzy TOPSIS technique to rank vendors. De Almeida et al. (2007) proposed an integrated model based on utility function and ELECTRE to rank vendors. Weime and Seuring (2009) measured the performance of the outsourcing for four different real-world case studies.

As discussed earlier, there are literally enormous methods to study different factors influencing outsourcing. Table 1 summarizes the details of various issues involved with our proposed model.

Attribute	McIvor et al., 1997	Chen et al, 2006	Yang et al., 2007	Kahraman, 2007	Topcu, 2004	Anderson, 2008	Hsu & Hsu, 2010	Faviel et al., 2008	Burdon, 2004	Menches, 2010
Cash flow				✓					✓	
Security										
Profitability				✓					✓	
Technology		✓					✓	✓	✓	✓
Customer satisfaction				✓					✓	
Quality		✓	✓		✓	✓	✓	✓	✓	
Work experience	✓	✓			✓		✓	✓		✓
Working Capability						✓	✓	✓	✓	
Work Skills	✓		✓		✓	✓	✓	✓	✓	✓
Management					✓	✓			✓	✓
Price	✓		✓	✓	✓	✓	✓	✓	✓	✓
Compatibility		✓	✓				✓			✓

This paper is organized as follows. We first present the proposed methodology of our research in section 2. Section 3 explains the details of our implementation and finally section 4 summarizes the contribution of the paper.

2. The proposed framework

The proposed model of this paper uses an integrated BSC-ELECTRE method to provide a framework for ranking vendors for outsourcing purpose. We first review the literature to find the most important issues on outsourcing procedure. In this phase of study, we also gather decision makers' (DM) opinions. The necessary attributes affecting the outsourcing are categorized into four sections based on BSC requirements and they are also validated using some brain storming sessions. We also determine efficiency matrix, preference and indifference thresholds and the attributes are given appropriate weights. Finally, the ELECTRE III algorithm is applied to the data and the results are analyzed. Next, we implement the proposed model of this paper for a subway project located in Shiraz, Iran.

2.1. Data gathering

In order to gather the necessary information, we chose three university professors and six top project managers who were familiar with the most important issues on outsourcing of the project. We used six members of the management team who were responsible for outsourcing the project activities. Table 2 summarizes the most important issues affecting the outsourcing planning.

Table 2
The most important factors for the success of outsourcing

Attribute	Description
Cash flow	The amount of money injected into the project and its activities
Profitability	The amount of attempts needed to reduce the cost of outsourcing
Cost saving	The amount of efforts dedicated previously to reduce the cost of project through increasing productivity
Capabilities	The availability of a project team to start a task
Customer Satisfaction	The ability to finish the job one time
Technology	The equipments used for accomplishing a task
Experience and expertise	The ranking of a team project to finish particular responsibilities
Quality	The final quality of completed projects to accomplish related responsibilities
Qualification	This item is determined for the ranking of a team project to accomplish unrelated responsibilities
Adaptability to organizational culture	The better a team works under pressure in different weather conditions, the more qualified a team project for outsourcing is

Based on the attributes detected on Table 2 we have divided the most important factors into the following BSC characteristics,

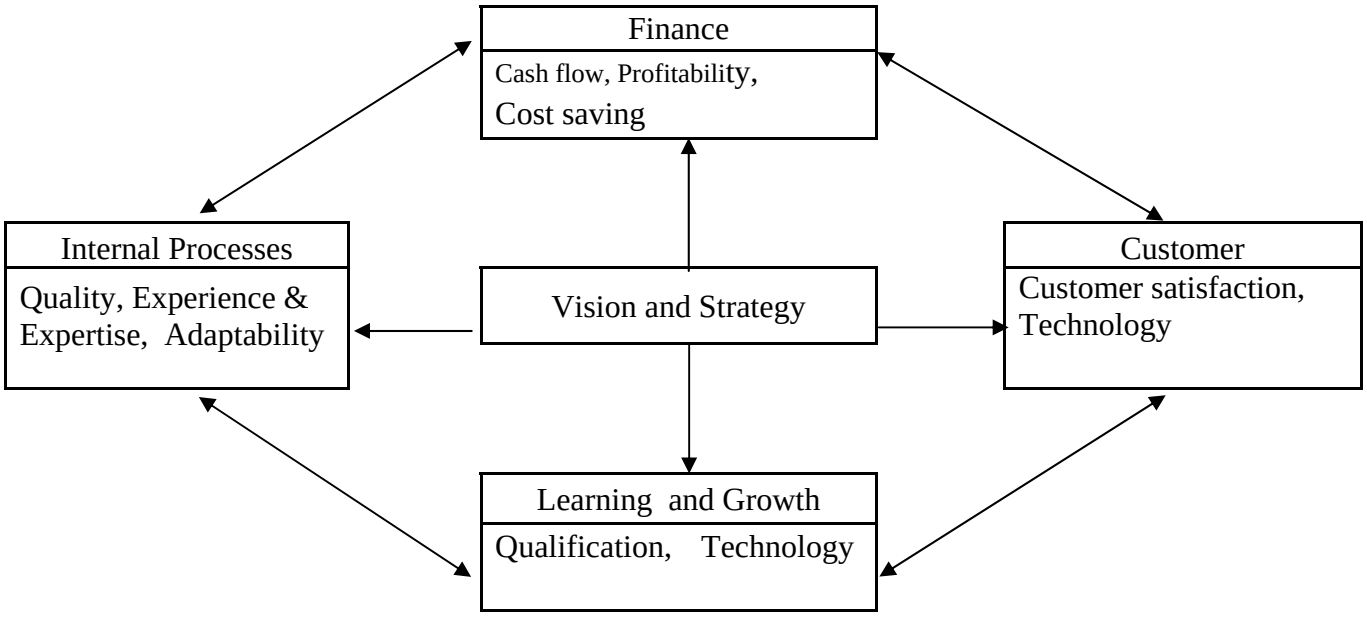

Fig. 2. Framework of BSC components

In order to determine the weight of each attribute, we have used DM's feedback on each factor. When an attribute is extremely important, the attribute receives 100 point and in case it is not important, it will receive zero point. Since there is more than one DM, we use geometric mean to find the average of the point allocated to each attribute. We also determine the preference and the indifference threshold values based on either qualitative or quantitative values and ask DM to assign an

appropriate number to each attribute. For the preference and indifference threshold values, the assigned numbers are varied in different ranges. For instance, for cash flow we chose numbers from 1 to 400 which are proportion with alternatives' cash flow. In other words, for the case of the cash flow, we considered the amount of capital for each outsourcing alternative. In addition, for profitability, we selected the amount of cost reduction in terms of the percentage. Again, we use geometric mean to find an average number for six DMs. Table 3 summarizes the results of the points where columns two and three represent the weight and ranking. Also, columns three and four represent the preference and indifference numbers.

Table 3
The most important factors for the success of outsourcing and their associated weight and rankings

Attribute	Weight	Rank	Preference	Indifference
Quality	98	1	2	1
Experience and expertise	93	2	7	3
Customer satisfaction	86	3	96	45
Technology	81	4	3	1
Cost saving	74	5	9	3
Cash flow	48	6	353	108
Qualification	36	7	4	2
Profitability	11	8	17	5
Adaptability	7	9	3	2
Capability	5	10	4	1

Since there are seven alternatives for outsourcing, we ask six DMs to assign points for each in terms of ten explained attributes. Table 4 which represent the performance matrix summarizes the results of the point assigned for each attribute.

Table 4
The most important factors for the success of outsourcing and their associated weight and rankings

	Seven alternatives for outsourcing						
Attribute	1	2	3	4	5	6	7
Quality	80	85	80	90	95	70	65
Experience and expertise	85	90	70	70	80	68	70
Customer satisfaction	75	70	51	66	82	75	88
Technology	65	75	68	70	85	78	80
Cost saving	65	70	70	65	85	75	65
Cash flow	59	75	64	85	72	65	70
Qualification	70	90	65	85	76	80	70
Profitability	50	80	66	71	82	74	65
Adaptability	90	100	100	100	100	100	95
Capability	100	100	99	100	100	90	95

3. The implementation of ELECTRE III

The proposed model of this paper uses ELECTRE III as a method to prioritize seven existing alternatives. Table 5 is the credibility matrix, which shows the results of the implementation in terms of priority numbers between zero and one where higher numbers represent higher priorities. For instance, the number 0.76 in row 3 of the first column means alternative three is preferred to alternative one. As we can observe from the results of Table 4, alternative five is on top priority, alternatives two; four, six and one come as the next priorities. Alternative three and seven also come

in the last priority compared with other alternatives. Fig. 3 shows the priorities for all the alternatives.

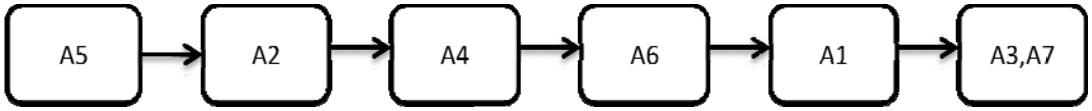

Fig. 3. The priority of seven alternatives

Table 5
The results of the implementation ELECTRE III for seven alternatives

Alternative	1	2	3	4	5	6	7
1	1	0.44	0.79	0.59	0.43	0.62	0.77
2	1	1	1	0.82	0.53	0.80	0.85
3	0.76	0.41	1	0.68	0.27	0.73	0.78
4	0.83	0.56	0.95	1	0.35	0.71	0.85
5	0.92	0.76	1	0.93	1	0.93	0.95
6	0.64	0.57	0.81	0.74	0.35	1	0.92
7	0.64	0.50	0.75	0.73	0.32	0.64	1

3.1. Validation

It is always interesting to validate the results of the implementation of our proposed model on the real-world case study of this paper. There were two main attributes, which were considered to select alternatives: the price and the official ranking of the company. The ranking of a company is normally performed by an independent governmental organization based on the quality and the quantity of employees, work experience and the equipments. The information of the price and the ranking of these seven alternatives are summarized in Table 6.

Table 6
The information of the price and the ranking for seven alternatives

	Rank					
Alternative	Mining	Installation	Road	Construction	Water resources	Price (Rials)
1	_	3	1	1	1	86,100,105,352
2	5	2	2	1	5	76,052,164,128
3	_	5	2	1	1	86,561,285,574
4	_	3	1	2	1	85,619,689,224
5	2	1	1	1	1	75,052,164,128
6	_	5	1	3	1	85,873,359,416
7	5	2	2	1	2	86,205,285,574

As we can see from Table 6, seven alternatives have different ranking points in terms of five criteria of Industry, Hydro, Road, Construction and Water resources. In our study, price is the primary objective for the ranking is considered as the secondary decision making criteria for selecting an alternative. In order to assign subway stations and tunnel project to an appropriate firm, road and construction are more important than other ranking criteria. Therefore, alternative five is on top priority, since it offers the lowest price and it is mostly rank one, for building stations and tunnel construction. Second alternative was also chosen for low price suggestion as well as the number one ranking for construction. Since alternative 4 and 6 suggest relatively close prices for participating in the contract we need to rank these alternative based on their construction ranking which leads us to

choose alternative number 2. Similarly, alternatives 1, 3 and 7 are ordered in the position four to seven of our ranking list.
In summary, the results of ranking alternatives based on two criteria of price and rank are the same as the results of our proposed model, which validates our results.

4. Conclusion

In this paper, we have presented a new framework based on balanced score card and ELECTRE III for ranking alternatives. The proposed model of this paper determined various criteria suggested in the literature as well as the criteria provided by decision makers. The proposed model was implemented for a real-world case study of subway construction and the results were validated using other techniques. The preliminary results of the implementation of our proposed model indicate that it could be used for many other real-world applications, successfully.

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