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Designing a Operational Evaluation Model for Outsourcing Decision Making by Effective Outsourcing Factors

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Abstract
Organizations around the world are looking for new approaches to maintain or develop competitive advantage. Outsourcing can be such an approach and one of the strategies that can lead to greater competitiveness.
Maintaining and developing core competences as a way of providing barriers to protect against present and future competitors; make full use of external capabilities, innovation and investment; and finally, provide better service, quality and cost to the customer.
In this study we determined variables and factors involved in maintenance outsourcing process and developed a generic model for the maintenance outsourcing process by three main factors such as characteristics of organization, characteristics of Environment / Industry and characteristics of Contractors. Then the proposed model has been tested in an electric company by the use of gray theory in order to determine that the organization do complete outsourcing or outsourcing with non-decisions.

Key words: Outsourcing, maintenance outsourcing, gray relation analysis.

Introduction

Organizations all around the world are seeking for new approaches to maintain or develop competitive advantage. Outsourcing can be such an approach and one of the strategies that can lead to greater competitiveness [1].

Outsourcing focuses on two strategic ways of developing a competitive advantage: first, concentrating on the organization's resources and investments on what it does best – called core competences; and second, outsourcing all other activities for which the company has neither a strategic need nor a special capability. Outsourcing allows companies to maximize the return on their internal resources and it can be an effective way to reduce costs, free-up capital and improve quality and service [2]

Outsourcing might have operational and/or strategic advantages [3]. Outsourcing can be defined as a "managed process of transferring activities to be performed by others" [4]. It denotes the shift that occurs when a business entity takes work traditionally performed internally and contracts with an external provider for the provision of that work [5].

According to Quinn (1992) and Sharpe (1997), outsourcing is a form of predetermined external provision with another enterprise for the delivery of goods and/or services that could have previously been offered in-house [6],[7].

The outsourcing process includes the following questions:

(1) Does outsourcing make sense?
(2) Are your objectives achievable?
(3) Is the organization ready?
(4) What are the outsourcing alternatives?
(5) How is the request for the outsourcing proposal structured?
(6) What are the negotiating tactics? [2]

Prior to starting the outsourcing program, the company should objectively evaluate its actual situation with respect to some critical issues. In doing so, a significant image of the overall ability to manage the outsourcing program could be drawn and, at the same time, the company's readiness to outsource maintenance activities could be somehow quantified [3]. A company's readiness can be assessed based on a number of factors [2].

Maintaining and developing core competences as a way to provide barriers to protect against present and future competitors; make full use of external capabilities, innovation and investment; and finally, provide better service, quality and cost to the customer[4].

Where capacity and precision of the equipment are critical, companies have begun to look at outsourcing their maintenance activities. Some companies, outsourced all equipment maintenance, achieving a more effective use of the maintenance budget and a reduction of downtime, thus increasing overall efficiency [8].

Overview

Kant Rao and Richard R. Young (1994) examined the attitudes of shippers and service providers towards outsourcing of logistics functions performed within large multinational, manufacturing companies engaged in global trade. Based on case studies, they presented a conceptual model indicating the factors which influence outsourcing or single sourcing decisions [9].

Lieb's (1992) survey indicated that about one-third of large manufacturing companies in the US use third-party logistics services and over 60 per cent of these firms have utilized these services for more than five years. The most widely outsourced services were warehousing, shipment consolidation, and selected logistics information systems. All three activities are important in the context of international logistics as well and their study indicates that, due to its critical role, information systems can also influence on the outsourcing decision itself [10].

Hassanain and Al-Saadi (2005) provided a framework for outsourcing asset management services especially for municipal organizations. Their framework consists of five sequential processes that a number of supporting activities have been defined for each of them. Moreover, they have proposed some main advantage and disadvantages for outsourcing and provided some key strategies for achieving a successful outsourcing in municipal infrastructure [11].

John D. Campbell (1995) determined a six-step approach that provides a framework to outsource in a systematic way, addressing the key issues about objectives, readiness, alternatives, proposals and negotiations. These six steps are as follows:

1. Is outsourcing a viable alternative to self provision?
2. Are the objectives achievable through outsourcing?
3. Is the organization ready to use outsourcing?
4. Evaluate outsourcing alternatives by function.
5. Request for proposal to outsourcing supplier.
6. Vendor selection and agreement negotiation.

He also asserted that those organizations that have embraced outsourcing maintenance activities in a strategic manner have been able to focus their efforts more at providing higher value to their customers [2].

Kant Rao and Richard R. Young (1994) examined the attitudes of shippers and service providers towards outsourcing of logistics functions performed within large multinational, manufacturing companies engaged in global trade. Based on case studies they presented a conceptual model that indicates the factors which influence outsourcing or single sourcing decisions. This factor determined as follow:

- Centrality
- Information technology
- Cost and service
- Risk and control
- Market relations

The research also suggests that the above factors are influenced by drivers: sets of variables from a firm's operating profile. The key drivers are:

- network complexity;
- process complexity;
- Product complexity [9].

Bertolini et al. (2004) experiences dealing with the analysis of maintenance outsourcing by means of multi-criteria decision methods (MCDM). In their study, the proposed methodology has been tested on an industrial case study dealing with important Italian brickwork. This application shows how AHP is capable of supporting the choice of the correct level of theoutsourcing maintenance activities. In particular, the developed hierarchic decisional structure represents an instrument able to give a well balanced synthesis of several different factors that must be taken into account during this type of decision problem.

These factors are consisted of:

- increasing labor productivity;
- reducing maintenance costs;
- focusing on in-house personnel on "core" activities;

- reducing management effort;
- obtaining specialist skills not available in-house;
- fluctuations in workload;
- increasing access to specialist equipment;
- improving equipment uptime/performance;
- reducing risk;
- improving labor productivity;
- improving work quality;
- reducing influence of trade unions;
- improving environmental performance; and
- keeping pace with rapidly changing technology [4].

Rajabzadeh and collegues determine the effective factors involved in outsourcing process and their priorities that was conducted in the Ministry of Economic Affairs and Finance of Iran. The purpose of this paper is to describe the outsourcing process in the public sector. It aimed to develop a generic conceptual model for the outsourcing process in public sectors by conducting binominal and Friedman tests. The model consists of the following steps and components:

- Considering the organization's basic activities,
- Evaluating organizations' existing potentials and analyzing organizational processes,
- Studying general outsourcing patterns,
- implementing and monitoring outsourcing process in terms of some critical success factors,
- Evaluating outsourcing process of the organization and identifying feedbacks.

They found the main components and effective factors involving in the process of outsourcing in public sectors that are as follow:

- Cost reduction
- Improvement of organization focus
- Obtaining world class capabilities
- Resource savings
- Take advantage of reengineering benefits
- Risk sharing
- Increasing service flexibility
- Response to the variety of customers' demands
- Better customization
- Better management of organization's functions
- On time performance
- Quality of services and products
- Accuracy in budgeting
- Responsibility and accountability
- Employees' motivation [3]

In this study we determine variables and factors involved in maintenance outsourcing process and develop a generic model for the maintenance outsourcing process. By using the gray theory, we determined that the organization do complete outsourcing or outsourcing with non-decisions.

Gray system theory

The information that is either incomplete or undetermined is called Gray [14]. The Gray system provides multidisciplinary approaches for analysis and abstract modeling of system for which the information is limited, incomplete and characterized by random uncertainty [15].

In order to pursue the gray system theory,we use gray numbers that are kinds of the interval numbers and the procedures are summarized as follows [16]:

Step 1. Form a committee of decision-maker and identify attribute weights of suppliers. Assume that a decision group has K persons, and then the attribute weight of attribute aj can be calculated as:

$$\otimes Wj = \frac{1}{k}[\otimes Wj1 + \otimes Wj2 + \cdots + \otimes Wjk] \quad (1)$$

Step 2.Using linguistic variables for the ratings to make attribute rating value. Then the rating value can be calculated as:

$$\otimes Vj = \frac{1}{k}[\otimes Vj1 + \otimes Vj2 + \cdots + \otimes Vjk] \quad (2)$$

Step 3.Establishment of gray-decision table. The attribute values of ⊗vij are linguistic variables based on grey number.

Step 4.Normalization grey-decision table. For benefit attribute, ⊗v*ij is expressed as:

$$\otimes^{*}\mathrm{Vij} = [\frac{\underline{v_{ij}}}{\mathrm{vjmax}}, \frac{\overline{v_{ij}}}{\mathrm{vjmax}}] \quad (3)$$

For cost attribute, ⊗v*ij is expressed as:

$$\otimes^{*}\mathrm{Vij} = [\frac{\mathrm{vjmin}}{\overline{v_{ij}}}, \frac{\mathrm{vjmin}}{\underline{v_{ij}}}] \quad (4)$$

Step 5.Establishment of weighted normalized grey-decision table that $\otimes Wj * \otimes Vj$ is shown as below:

$$\otimes_1 * \otimes_2 = [\min(ac, ad, bc, bd), \max(ac, ad, bc, bd)] \quad (5)$$

Step 6. Selection ideal suppliers by grey-based set lower approximation.

Step 7. Calculation of grey relational grade (GRG) between comparative sequences:

$$\mathrm{i(k)} = \frac{\Delta\max - \Delta\mathrm{oi(k)}}{\Delta\max - \Delta\min} \quad (6)$$

$$\Delta\ \max = \max_i \max_k \Delta_i(k)$$

$$\Delta\ \min = \min_i \min_k \Delta_i(k)$$

$$\mathrm{ri} = \frac{1}{n}\sum_{k=1}^{n} \xi\mathrm{i(k)} \qquad \mathrm{i} = 1,2,\ldots,\mathrm{m}.$$

Methodology

In this study we intend to determine the variables and factors involved in maintenance outsourcing process and also seek to develop a generic model for the maintenance outsourcing

process. Using gray theory, we determine whether the organization do complete outsourcing, outsourcing with non-decisions or don't do the outsourcing.

A company's readiness for maintenance outsourcing can be assessed based on a number of factors. These factors are gathered by library study and collecting the opinions of experts in this field that describe as below:

- Control and monitoring: control over supplier, supply chain, risk and outputs [2],[17]
- New technologies: Outsourcing may provide the organization with greater developing new technologies[2] , [18].
- Speed on new problem: Unlike in-house experts, outside sources do not require extended time to come up to speed on a new concept. They are hired because they already possess knowledge and experience. External resources have skills which some companies find difficult to develop themselves internally [2],[19],[4].
- Information Confidentiality: A subcontractor, after building up expertise with the organization's support, may attempt to provide their knowledge to competitors. Clearly, the company must ensure the contractor's reputation is solid[2],[19],[4]
- focus on core business: focus in-house personnel on "core" activities [9],[4],[3],[19].
- Supporting rules of government [9],[4].
- equipment performance[21],[20]
- service flexibility [3],[21],[22]
- maintenance time [4]
- quality of service and productions: Contractors may have superior quality practices than internal suppliers [2],[3],[4],[3],[23]
- Consistent service [9]
- Cost reduction: Contractors may have more specialized equipment for performing theservice. This may allow the contractor to provide better quality and service at a lower price [4]. [24],[25]
- Risk reduction: About risk liability and control [27],[28]
- Cost/service tradeoffs [9]

The results can be listed in three main types such as characteristics of organization, characteristics of Environment / Industry and characteristics of Contractors. In order to classify the effective outsourcing factors, 30 questionnaires are developed. This questionnaire contains the effective factors on maintenance outsourcing. The statistical population of this research includes all managers and experts who are familiar with outsourcing. Accordingly,25 questionnaires were returned. In this research, we used of judgmental sampling method. The result is as follows:

Table 1.effective outsourcing factors

The main criterion	Sub-criteria
characteristics of organization	effective and efficient mechanisms for controlling and monitoring the organization
	Lack of confidentiality associated with outsourcing activities

	Increased focus on key activities
	High cost of repairs
	Instability in Service Repairs
	Shortage of skilled
	Lack of maintenance and test equipment
	Over time of repairs
characteristics of Environment And Industry	Supporting government regulations
	The rapid growth of technology
	High Risk of maintenance
characteristics of Contractors	Diversity of contractors
	enabled Contractors (expertise and financial support equipment)

Now for the purpose of determining the readiness of the organization in different industries, we should define the weight of effective factors. This is followed by rating them in the specified industry with the gray relation analyze method to rank the readiness of the company for complete outsourcing or activity outsourcing.

Case study

The case study presented here deals with electric company.This company has the mission of supplying the safe and suitable electricity power for its users and customers through developing and exploiting its infrastructures. With respect to this company's job mission in terms of producing and transmitting the energy, this company is considered as a public service organization (selling the energy) and also is a project-based organization (constructing and developing projects). In other words, it can be considered as a project-based public service organization.

We have then identified the effective factors in maintenance outsourcing and classified them in the model. In order to identify the priority of our options for complete outsourcing or outsourcing with decision by gray system theory, we determined the importance of each factor in maintenance outsourcing process by a committee of experts in this field and identify attribute weights of options. Complete outsourcing refers to a state in which theorganization makes the selected vendor as the responsible to maintain and decide about what should be repaired and when it should be done. While in the outsourcing with non-decision, the vendor doesn't decide about what activity should be outsourcing and how or when it must be done. In this state the vender only does the determined work. Here our decision group has 25 persons, and then the attribute weight of factors can be calculated based on the following table:

Table2.The scale of attribute weights

⊗W		scale
[0,0.1]	VL	Very low
[0.1,0.3]	L	Low

[0.3,0.4]	ML	Medium low
[0.4,0.5]	M	Medium
[0.5,0.6]	MH	Medium high
[0.6,0.9]	H	High
[0.9,1]	VH	Very high

Table3.weight of effective outsourcing factors

The main criterion	Sub-criteria	wight
characteristics of organization	effective and efficient mechanisms for controlling and monitoring the organization	[0.52,0.61]
	Lack of confidentiality associated with outsourcing activities	[0.92,1]
	Increased focus on key activities	[0.6,0.93]
	High cost of repairs	[0.63,0.91]
	Instability in Service Repairs	[0.63,0.92]
	Poor Quality of Products and Services	[0.65,0.91]
	Shortage of skilled	[0.53,0.64]
	Lack of maintenance and test equipment	[0.51,0.6]
	Over time of repairs	[0.64,0.92]
characteristics of Environment And Industry	Supporting government regulations	[0.91,1]
	The rapid growth of technology	[0.64,0.92]
	High Risk of maintenance	[0.61,0.95]
characteristics of Contractors	Diversity of contractors	[0.42,0.54]
	enabled Contractors (expertise and financial support equipment)	[0.91,1]

Then the rating value of factors in the electric company can be calculated by establishment of gray decision table and the opinion of experts and managements in this company that decision do by . The attribute values of ⊗vij arelinguistic variables based on grey number. Our decision group involves 25 individuals and the attributedvalue of factors can be calculated based on the following table:

Table 4.The scale of attribute Ratings

⊗v		scale
[0,1]	VP	Very poor
[1,3]	P	Poor
[3,4]	MP	Medium poor
[4,5]	F	Fair
[5,6]	MG	Medium good
[6,9]	G	Good
[9,10]	VG	Very good

Table 5.Decision making table

The main criterion	Sub-criteria	Activity outsourcing	Complete outsourcing
characteristics of organization	effective and efficient mechanisms for controlling and monitoring the organization	[6.1,9.2]	[5.3,6.1]
	Lack of confidentiality associated with outsourcing activities	[4.2,5.1]	[1.2,3.5]
	Increased focus on key activities	[5.4,6.1]	[9.1,10]
	High cost of repairs	[5.3,6.1]	[6.3,9.4]
	Poor Quality of Products and Services	[5.2,6.3]	[6.1,9]
	Instability in Service Repairs	[5.3,6.5]	[5.1,6.3]
	Shortage of skilled	[5.4,6]	[6.2,9.1]
	Lack of maintenance and test equipment	[5.4,6.4]	[6.1,9.4]
	Over time of repairs	[5.3,6.1]	[9.2,10]
characteristics of Environment And Industry	Supporting government regulations	[4.2,5.3]	[5.1,6.2]
	The rapid growth of technology	[5.3,6.1]	[6.2,9]
	High Risk of maintenance	[5.1,6.4]	[5.2,6.5]
characteristics of Contractors	Diversity of contractors	[9.1,10]	[3.4,4.6]
	enabled Contractors (expertise and financial support equipment)	[6.1,9]	[3.2,4.5]

Table 6.The Weighted Normalized gray decision table

The main criterion	Sub-criteria	Activity outsourcing	Complete outsourcing
characteristics of organization	effective and efficient mechanisms for controlling and monitoring the organization	[3.172,5.612]	[2.7563, 3.721]
	Lack of confidentiality associated with outsourcing activities	[3.864,5.1]	[1.104, 3.5]
	Increased focus on key activities	[3.24,5.673]	[5.46, 9.3]
	High cost of repairs	[3.339,5.551]	[3.969, 8.554]
	Poor Quality of Products and Services	[3.276,5.796]	[3.843, 8.28]
	Instability in Service Repairs	[3.445,5.915]	[3.315, 5.733]
	Shortage of skilled	[2.862,3.84]	[3.286, 5.824]
	Lack of maintenance and test equipment	[2.754,3.84]	[3.111, 5.64]
	Over time of repairs	[3.392,5.612]	[5.888, 9.2]
characteristics of Environment And Industry	Supporting government regulations	[3.822,5.3]	[4.641, 6.2]
	The rapid growth of technology	[3.392,5.612]	[3.968, 8.28]
	High Risk of maintenance	[3.111,6.08]	[3.172, 6.175]
characteristics of Contractors	Diversity of contractors	[3.822,5.4]	[1.428, 2.484]
	enabled Contractors (expertise and financial support equipment)	[3.111,9]	[2.912, 4.5]

Now the ideal visionis selected based on grey theory. Weuse Rto denote the partition generated by condition attributes.

U0={[0.349,0.561], [0.425,0.51], [0.593, 0.93], [0.431,0.855], [0.418, 0.828], [0.379,0.592], [0.357,
0.582],[0.338,0.564],[0.64,0.92],[0.522,9.2],[0.504,0.62],[0.431,0.828],[0.345,0.618],[0.42,0.54], [0.61,0.9]}

Table 8.compare between ideal vision and alternatives

	$\Delta 1(k)$	$\Delta 2(k)$	$\min_i \min_k \Delta i(k$	$\max_i \max_k \Delta i(k$
effective and efficient mechanisms for controlling and monitoring the organization	0.000	0.189		
Lack of confidentiality associated with outsourcing activities	0.000	0.305		
Increased focus on key activities	0.363	0.363		
High cost of repairs	0.300	0.000		
Poor Quality of Products and Services	0.248	0.000		
Instability in Service Repairs	0.000	0.018		
Shortage of skilled	0.198	0.000		
Lack of maintenance and test equipment	0.180	0.000		
Over time of repairs	0.359	0.000		
Supporting government regulations	0.09	0.000		
The rapid growth of technology	0.267	0.000		
High Risk of maintenance	0.009	0.000		
Diversity of contractors	0.000	0.292		
enabled Contractors (expertise and financial support equipment)	0.000	0.450		
$\min_i \Delta i(k)$	0.000	0.000	0.000	
$\max_k \Delta i(k)$	0.3627	0.45		0.45

Table9. grey relational grade

$\xi i(k)$	$\xi 1(k)$	$\xi 2(k)$
effective and efficient mechanisms for controlling and monitoring the organization	1.000	0.580
Lack of confidentiality associated with outsourcing activities	1.000	0.323
Increased focus on key activities	0.194	1.000
High cost of repairs	0.333	1.000
Poor Quality of Products and Services	0.448	1.000
Instability in Service Repairs	1.000	0.959
Shortage of skilled	0.559	1.000
Lack of maintenance and test equipment	0.600	1.000
Over time of repairs	0.203	1.000
Supporting government regulations	0.8	1.000

The rapid growth of technology	0.407	1.000
High Risk of maintenance	0.979	1.000
Diversity of contractors	1.000	0.352
enabled Contractors (expertise and financial support equipment)	1.000	0.000
r_i	0.680	0.801

Where r_i represents the degree of relationship between each comparative sequence and the reference sequence. The higher degree of relation means that the comparative sequence is more similar to the reference sequence than comparative sequences. Then in this case we can say that the complete outsourcing is the most ideal alternative among other attitude and should be regarded as an important alternative for the company.

Conclusion

The purpose of this study is to develop a generic conceptual model for outsourcing process in maintenance sectors. In addition, it determined the situation about readiness of the organization to use maintenance outsourcing by ranking two levels such as complete outsourcing and activity outsourcing. We determined impacted variables and factors involved in maintenance outsourcing process and developed a generic model for the maintaining outsourcing process. Using gray theory, we have determined the weight of impacted factors in maintenance outsourcing and through the rate of these factors in the Electric Company by gray set approach deal with determine the ready, it concluded that the maintenance sector in this company is ready for doing complete outsourcing.

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