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ScienceDirect

Procedia Computer Science 55 (2015) 715 – 724

Procedia Computer Science

Information Technology and Quantitative Management (ITQM 2015)

Proposal for using AHP method to evaluate the quality of services provided by outsourced companies

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Abstract

This work aims to describe the development stages of a decision support system for evaluating the quality of services provided by outsourced companies that serve organisations in the Brazilian retail sector. It used applied research, implemented through a case study conducted with the outsourced service providers of one of the 158 subsidiaries of a retail company. Using the Analytic Hierarchy Process (AHP), it was possible to develop an evaluation model capable of measuring the performance of the quality indicators and evaluating the performance of the outsourced services provided to the company under study.

Peer-review under responsibility of the Organizing Committee of ITQM 2015

Keywords: Multiple-Criteria Analysis; Analytic Hierarchy Process; Performance Indicators.

1. Introduction

The services sector has acquired immense importance for the Brazilian economy. Its growth is seen as a promise for the country's development. If, on the one hand, the services sector presents itself as a labour market alternative, on the other, it is also necessary to be prepared to participate in it, which is accomplished through continuous improvement and adaptation to the characteristics of each sector.

With regard to the services provided in retail stores, there are a large number of services and an increasingly greater supply of them, which leads one to assume that to be able to compete, companies need to sell a quality product or service or they will be unable to obtain a share of the market, without which companies cannot survive. Similar to other sectors, the quality of the services provided by the retail sector is continuously sought after, and the challenges to attain it are equally high.

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Peer-review under responsibility of the Organizing Committee of ITQM 2015
doi:10.1016/j.procs.2015.07.083

Faced with increasingly aware, discerning, and demanding consumers, who choose the organisations that best meet their needs and which propose services that add value to what is offered, the demand for improvements in the quality of services provided is an objective that is continuously sought by companies; once achieved, it can become an important competitive advantage. However, the constant demand for quality is no longer a competitive advantage; it has instead become a survival criterion for companies in recent years.
In this context of fierce competition among companies and given the continuous need for improving the quality of services offered, companies providing outsourced services have emerged; depending on the way these services are provided, these companies may directly, and negatively, affect the image and revenue of the company receiving these services. Thus, the objective of this work is to propose the measurement of the performance indicators of a retail company's outsourced services through the implementation of an evaluation model.

This article is organised into five sections. After establishing the introductory points, section 2 discusses the literature that theoretically grounds the work. Section 3 presents the methodological design of the research. Section 4 details the case study illustrating the application of the Analytic Hierarchy Process (AHP) for creating the instrument evaluating the quality of the third-party services provided to the organisation under study. Lastly, section 5 analyses the reach of the objectives proposed in the research, the study limitations, and contributions for future works.

2. Theoretical Foundation

The AHP method was developed by Thomas Saaty [1-2-3] to support decision-making problems with multiple criteria. Amongst the existing methods, the analytic hierarchy process (AHP), is possibly the most well known and used in multiple-criteria decision making [4].

The benefit of this method is that since judgment values from equal comparisons are based on experience, intuition, and also on physical data, the AHP may deal with the qualitative and quantitative aspects of a decision-making problem [5]. This model's main feature is the hierarchical decomposition of the problem, creating a criteria hierarchy and converting subjective evaluations of relative importance into a set of general scores or weights [1]. There are three main phases in the AHP model methodology, which consist of: structuring the problem; comparative judgments, and priority analysis. The structuring phase is based on obtaining the decision-making model, presented in the form of a hierarchy in the AHP [5-6]. In the judgment phase, the global performance of each alternative is obtained, weighing the alternative's performance in each criterion according to the criterion's weight.

The hierarchy is important because it tries to represent reality in a faithful way presenting its most important elements and their relations [1-2]. A hierarchy is an abstraction from the structure of a system to study the functional interactions of its components and their impact on the total system [4]. These hierarchies are basic for the human way of thinking in terms of separating reality into sets and subsets. Moreover, once the hierarchy has been established, the relative weights can be determined in order to rate the decision-making alternatives. The peer-to-peer comparison is carried out with the help of a judgment scale [1], which enables the assignment of weights ranging from 1, when the criteria have the same importance, to 9, for the absolute importance of a criterion over another. These represent the intensity of a certain element over another [6].

The AHP method is not a model for finding the correct answer, but a process that helps decision makers find the best answer [7]. This method's importance has been proven for academic studies and organisations. The AHP method is a powerful instrument for organizations in prospecting their own strategies and those of their competitors [4]. This methodology, applied to groups of decision makers within a cooperative environment, occurs more rapidly, especially if the members have common objectives, long-lasting contacts, and the same status within the group [3-4].

3. Method

This work is based on the methodological structure which is organised as follows: project aims, method (design), data collection techniques, and data analysis techniques [8]. With regard to the aims, the research is considered applied. As for the method used in the work, this is a case study, since it seeks improvement opportunities for a medium-sized company, more specifically in the retail sector. As for scope, it is a company located in a southern Brazilian city that provides furniture assembly services.

Regarding the collection techniques, group interviews were performed, including the participation of the retail organisation's management core, with collection of primary data and references that helped to identify the main questions for the research. In addition, documents, such as the organisation's total quality manuals, were made available as an alternative survey and these secondary data were used to support the interviews developed.

With regard to the analysis techniques, the study adopted a qualitative and quantitative approach. This type of research can be demonstrated by the use of group interviews, documents, and mathematical methods. Thus, this work intends to operationalise a method for evaluating the services of the outsourced company that are provided to a retail organisation, using both research types.

4. Developing the case study

To develop the case study, the stages proposed by Saaty [1-2-3-4] for using the AHP method were followed. There are three main phases in the AHP model methodology, namely: structuring the problem, comparative judgments, and priority analysis.

4.1. Structuring the problem

The unit of analysis under study is a large Brazilian company, with 158 subsidiaries strategically located throughout the country, which operates in the retail segment and seeks opportunities for improving the quality of its services. Retail companies are making increased use of outsourced services in order to make their services faster and more efficient, thus providing clients with a better service. It is, therefore, necessary for organisations to pay special attention to these services, since once their performance is considered satisfactory, it may lead to financial benefits.

The retail company in question does not have a model for evaluating the criteria for these services; hence, it is performed empirically by managers who, because they have a considerable length of service time leading the organisation, have the autonomy to act according to the knowledge they have acquired, seeking a better decision. Thus, the AHP is presented so that it can be used as an efficient method for the decision-making process, identifying the best option amongst the proposed alternatives. Thus, according to the above, the hierarchical structure of the criteria [9] is presented in Figure 1.

At the top of the hierarchy, considered Level 1, is the objective of the model's decision-making process. Immediately below, in Level 2, the criteria directly related to Level 1 are highlighted and their relative priorities are stipulated. It is possible to observe that, in Level 2, there are important criteria to consider in the furniture assembly process. They are as follows: Time, Cost, Quality, Training, Relationship, Competence, and Monitoring. In order to evaluate them, and to clarify all the criteria, the decision makers considered some of the more important criteria.

Then, in Level 3, the sub-criteria used as a direct reference for evaluating the decision alternatives are described, keeping in mind that these sub-criteria are quantifiable. It is important to note that the sub-criteria in Level 3 will serve as a foundation for evaluating each of the decision alternatives, as presented in Figure 1, which in turn presents the set of criteria that will help in the decision-making process.

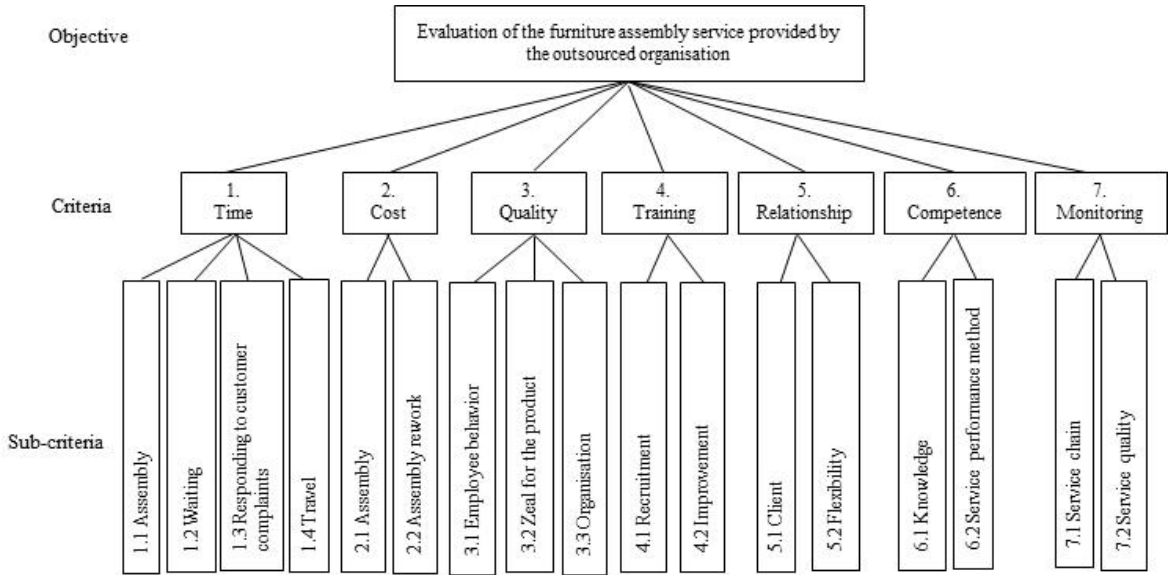

Fig. 1. Hierarchical structure of the criteria

Once all the criteria have been considered and presented in the hierarchical tree in a structured way, in order to achieve the objective proposed in the model, it is time for the next phase of the AHP.

4.2. Comparative Judgement

For the next phase of the AHP model, paired comparisons were made between the sub-criteria on the same level. The Pair Judgment Scale was used for these comparisons and the preferences for each element were, therefore, determined. Having obtained these values, comparison matrixes were generated for the sub-criteria - Time, Costs, Quality, Training, Relationship, Competence, and Monitoring, as shown in Tables 1, 2, 3, 4, 5, 6, and 7.

Table1. Paired comparison matrix for the Time sub-criteria

Criterion	Assembly	Waiting	Responding to customer complaints	Travel
Assembly	**1.00**	0.20	0.50	4.00
Waiting	5.00	**1.00**	5.00	8.00
Responding to customer complaints	2.00	0.20	**1.00**	3.00
Travel	0.25	0.13	0.33	**1.00**

As can be seen in Table 1, we took as a reference that the intensity of importance of the Waiting criterion importance is 8 (high degree of importance) when related to the criterion Travel; this type of relationship is observed with the other comparison matrices. The comparison matrix is reciprocal, where all aij judgments correspond to aji = 1/aik and all aii = 1, i.e., all the alternatives or criteria compared against themselves will always have the same importance in the scale.

Table 2. Paired comparison matrix for the Cost sub-criteria

Criterion	Assembly	Assembly rework
Assembly	**1**	0.14
Assembly rework	7.00	**1**

Table 3. Paired comparison matrix for the Quality sub-criteria

Criterion	Employee behaviour	Zeal for the product	Organisation
Employee behaviour	**1**	2.00	5.00
Zeal for the product	0.50	**1**	3.00
Organisation	0.20	0.33	**1**

Table 4. Paired comparison matrix for the Training sub-criteria

Criterion	Recruitment	Improvement
Recruitment	**1**	3.00
Improvement	0.33	**1**

Table 5. Paired comparison matrix for the Relationship sub-criteria

Criterion	Client	Flexibility
Client	**1**	0.33
Flexibility	3.00	**1**

Table 6. Paired comparison matrix for the Competence sub-criteria

Criterion	Knowledge	Service performance method
Knowledge	**1**	2.00
Service performance method	0.50	**1**

Table 7. Paired comparison matrix for the Monitoring sub-criteria

Criterion	Service chain	Service quality
Service chain	**1**	4.00
Service quality	0.25	**1**

4.3. Priority Analysis

In this stage, once the comparison matrices have been constructed, they are standardised. One of the most frequently used standardisation procedures is to divide each number of a column in the paired comparison matrix by the total sum of the columns. Subsequently, the arithmetic mean is computed for each line of the standardised matrix and the relative priorities (auto-vectors) for each of the criteria are thus determined. Table 8 provides a matrix for the Time sub-criteria in %.

Table 8. Paired comparison matrix for the Time sub-criteria in %

Criterion	Assembly	Waiting	Responding to customer complaints	Travel	**Relative priority**
Assembly	0.1212	0.1307	0.0732	0.2500	**14.37%**
Waiting	0.6061	0.6536	0.7321	0.5000	**62.30%**
Responding to customer complaints	0.2424	0.1307	0.1464	0.1875	**17.68%**
Travel	0.0303	0.0850	0.0483	0.0625	**5.65%**
Sum	1	1	1	1	**100%**

Thus, as an example, the assembly x assembly relationship according Table 3 is calculated as: 1/(1.00+5.00+2.00+0.25). Below, Tables 9 through 14 present the matrices for the Cost, Quality, Training, Relationship, Competence, and Monitoring sub-criteria in %, where the same processes described above were used.

Table 9. Paired comparison matrix for the Cost sub-criteria in %

Criterion	Assembly	Assembly rework	**Relative priority**
Assembly	0.1250	0.1228	**12.39%**
Assembly rework	0.8750	0.8772	**87.61%**
Sum	1	1	**100%**

Table 10. Paired comparison matrix for the Quality sub-criteria in %

Criterion	Employee behaviour	Care with the product	Organisation	**Relative priority**
Employee behaviour	0.5882	0.6006	0.5556	**58.15%**
Care with the product	0.2942	0.3003	0.3333	**30.93%**
Organisation	0.1176	0.0990	0.1111	**10.92%**
Sum	1	1	1	**100%**

Table 11. Paired comparison matrix for the Training sub-criteria in %

Criterion	Recruitment	Improvement	**Relative priority**
Recruitment	0.7519	0.7500	**75.09%**
Improvement	0.2481	0.2500	**24.91%**
Sum	1	1	**100%**

Table 12. Paired comparison matrix for the Relationship sub-criteria in %

Criterion	Client	Flexibility	**Relative priority**
Client	0.2500	0.2481	**24.91%**
Flexibility	0.7500	0.7519	**75.09%**
Sum	1	1	**100%**

Table 13. Paired comparison matrix for the Competence sub-criteria in %

Criterion	Knowledge	Service performance method	**Relative priority**
Knowledge	0.6667	0.6667	**66.67%**
Service performance method	0.3333	0.3333	**33.33%**
Sum	1	1	**100%**

Table 14. Paired comparison matrix for the Monitoring sub-criteria in %

Criterion	Service chain	Service quality	**Relative priority**
Service chain	0.8000	0.8000	**80%**
Service quality	0.2000	0.2000	**20%**
Sum	1	1	**100%**

Then, an analysis of the consistency of the translated opinions was performed, since the decision makers may be uncertain or make negative judgments when comparing some of the elements.
For each line of the comparison matrix, the weighted sum is determined based on the sum of the product of each value of the same by the priority of the corresponding alternative (which derives from the priority vector), and the weighted sum obtained for each line is divided by the priority of the corresponding alternative. Based on tables 3 and 10, the λ_{max} of the Time criterion is computed according to Eq. (1) to (4):

$$V\ Assembly = \frac{(1\ x\ \ 0.1437)+(0.20\ x\ 0.6230)+(0.50\ x\ \ 0.1768)+(4\ x\ 0.0565)}{0{,}1437} = 4.05 \quad (1)$$

$$V\ Wait = \frac{(5\ x\ \ 0.1437)+(1\ x\ 0.6230)+(5\ x\ \ 0.1768)+(8\ x\ 0.0565)}{0{,}6230} = 4.30 \quad (2)$$

$$V\ Responding\ to\ customer\ complaints = \frac{(2\ x\ 0.1437)+(0.20\ x\ 0.6230)+(1\ x\ 0.1768)+(3\ x\ 0.0565)}{0.1768} = 4.29 \quad (3)$$

$$V\ Travel = \frac{(0.25\ x\ 0.1437)+(0.13\ x\ 0.6230)+(0.33\ x\ 0.1768)+(1\ x\ 0.0565)}{0.0565} = 4.10 \quad (4)$$

Therefore, when averaging the results of each line, the maximum value is obtained. In this case, the value for the Time criterion follows, as shown in Eq. (5):

$$\lambda_{max}\ of\ the\ time\ criterion = \frac{4.05+4.30+4.29+4.10}{4} = 4.19 \quad (5)$$

Using the result obtained as the maximum auto-value above, the analysis of the consistency (CI) of the paired comparison matrix is performed [10], thus assessing the coherence ratio (CR) of the judgments. For the randomised index value, the default table proposed by Saaty [1-2] was used. The calculations were performed according to Eq. (6) and Eq. (7) below.

$$CI = \frac{(4.19-4)}{(4-1)} = 0.063 \quad (6)$$

$$CR = \frac{0.063}{0.90} = 0.07 \quad (7)$$

For the Costs, Quality, Training, Relationship, Competence, and Monitoring sub-criteria, the same processes for determining the CR above were used. As example, the matrix to Quality sub criteria (see Table 3) has CR = 0.07, which is considered a good level of consistency, with an index below the recommended. The same applies to the other matrices of order 2; therefore, it was possible to conclude that all the matrices have judgments with a high level of consistency. For Level 2, there is a need to explain the highest criteria. In this regard, the paired comparisons were presented for this Level using the following matrix form presented in Table 15.

Table 15. Paired comparison matrix for Level 2

Criterion	Time	Cost	Quality	Train.	Relationship	Competence	Monitoring	**Relative priority**
Time	0.1828	0.2667	0.4282	0.4707	0.1936	0.3083	0.1980	**23.12%**
Cost	0.0256	0.0381	0.0300	0.4932	0.0160	0.0339	0.0099	**9.24%**
Quality	0.0914	0.2667	0.2141	0.2466	0.2420	0.2055	0.1485	**20.21%**
Training	0.5484	0.0095	0.1071	0.1233	0.2420	0.3083	0.1980	**21.95%**
Relationship	0.0457	0.1143	0.0428	0.0247	0.0484	0.0206	0.1485	**6.36%**
Competence	0.0603	0.1143	0.1071	0.0407	0.2420	0.1028	0.2475	**13.07%**
Monitoring	0.0457	0.1905	0.0707	0.0308	0.0160	0.0206	0.0495	**6.05%**
Sum	1	1	1	1	1	1	1	**100%**

Having prepared the paired comparison steps and calculated the relative priorities, it was possible to create the final decision structure of the AHP model for evaluating the services performed by the outsourced organisation.

Thus, in order to aggregate all the criteria with the respective relative priorities, an objective function was generated according to Eq. (8), where Vx is the final value of each x decision alternative [10-11].

$$V_x = \sum_{i \in N} w_i \,.\, v_i(x) \quad (8)$$

Where:

V_x is the value function of each x decision alternative;
N is the set of second level criteria;
w_i is the weight of each $i \in N$ second level criterion;
$v_i(x)$ is the value function of each $i \in N$ second level criterion, for each x decision alternative.

In eq. (9) to (15), the $v_i(x)$ value functions for each second level criterion are presented.

$$v_1(x) = 0.1437.(1.1) + 0.6230.(1.2) + 0.1768.(1.3) + 0.0565.(1.4) \quad (9)$$
$$v_2(x) = 0.1239.(2.1) + 0.8761.(2.2) \quad (10)$$
$$v_3(x) = 0.5815.(3.1) + 0.3093.(3.2) + 0.1092.(3.3) \quad (11)$$
$$v_4(x) = 0.7509.(4.1) + 0.2491.(4.2) \quad (12)$$
$$v_5(x) = 0.2491.(5.1) + 0.7509.(5.2) \quad (13)$$
$$v_6(x) = 0.6667.(6.1) + 0.3333.(6.2) \quad (14)$$
$$v_7(x) = 0.8000.(7.1) + 0.2000\,.(7.2) \quad (15)$$

Based on the model's equations, according to Eq. (8) to (15), and the structure of the hierarchical decision tree of Figure 1, a model simulation with three scenarios for evaluating outsourced services was created: scenario A, B, and C, where a medium-sized wardrobe assembly was taken as a model. To do so, scores on a 1-5 scale were established with an increasing degree of importance for each sub-criterion, and thus each scenario was measured. Table 16 shows the detailed simulation of scenario A.

Table 16. Simulation of scenario A

Criterion	Score	Note	Weighted score
1.1	**2**	It took ½ days to complete the assembly	0.0664
1.2	**3**	It took 15 days to start the assembly	0.4321
1.3	**2**	It took 30 days to resolve, because a part was requested from technical support	0.0818
1.4	**4**	The assembler arrived within the expected time	0.0523
2.1	**3**	Average costs were incurred with the furniture assembly because the assembler had to go to the client's home several times because of problems with the furniture	0.0343
2.2	**4**	The assembler came back once to adjust the furniture	0.0328
3.1	**2**	He introduced himself to the client impolitely, although he was careful about his physical appearance	0.2350
3.2	**3**	The furniture was not carefully handled, resulting in damage	0.1875
3.3	**2**	There was no punctuality nor previous scheduling of tasks	0.0441
4.1	**4**	The recruitment staff searches for trained assemblers	0.6593
4.2	**5**	There is a continuous search for new techniques that make it possible to improve the general services provided	0.2734
5.1	**3**	The client is heard, gets attention, but there are delays in solving the problem	0.0475
5.2	**3**	The clients' needs are frequently met	0.1433
6.1	**4**	There is know-how about the furniture assembly and its features	0.3486
6.2	**3**	The furniture assembly is correctly performed, but there is no special dexterity	0.1307
7.1	**2**	The company studies the implementation of an efficient monitoring for the chain in the long term	0.0968
7.2	**3**	The company aims at implementing an efficient monitoring in the short term	0.0363
		Final score	**3.1932**

The same procedure was performed to simulate the scenarios B and C. Table 17 shows the final classification obtained by the AHP model for evaluating the assembly service provided by the outsourced company, in descending order.

Table 17. Final classification of the AHP model

Scenario	Score
C	3.8697
A	3.1932
B	2.9333

Scenario C has the highest score, thus making it the scenario with the best evaluation according to the objective of achieving the maximum value in the objective function. Therefore, according to the established criteria, scenario C has the best conditions for providing assembly services, with reduced waiting times, constantly seeking to improve its services through training, and with employees qualified for the work.

5. Summary

This research sought to evaluate the performance of outsourced services for furniture assembly provided to the company under study, using the AHP multi-criteria method. This model was specifically created for serving the retail organisation, highlighting the importance of obtaining performance metrics of these services, thus enabling an investigation of improvement opportunities for the company. The case study was developed in a retail company located in a southern Brazilian city, where the data collection began; through semi-structured group interviews, the information required to begin developing the proposed model was obtained, and the most important criteria and sub-criteria for the problem assessment process were identified.

Thereafter, a hierarchical tree was prepared with the decision makers' participation, followed by the paired comparison of the sub-criteria and criteria. Shortly after, the consistency of the sub-criteria paired matrices was verified. In each of the criteria of the two levels, priority analysis was used to obtain their relative priorities from the comparison matrices, and they were standardised in order for them to have the same magnitude. It was, therefore, possible to define the objective function that aggregated all the criteria and their relative priorities, thus enabling the simulation of the proposed model for the three scenarios evaluating outsourced services. By developing equations (9) to (15), representing the value functions, and equation (8), representing the objective function, the work's general objective was achieved: a model evaluating the furniture assembly services provided to the retail organisation was constructed. Similarly, when all the criteria from all the levels were identified, their relative priority was determined, identifying the most relevant ones. Having developed the objective function and constructed an evaluation model, the specified objectives were also achieved.

Regarding limitations of this work, it is important to note the use of the case study, since the model cannot be used in a generalised way for other situations and segments beyond the one it was applied to. In addition, it was difficult to gather all the interview participants together at the same time; since it was a semi-structured group interview, there were many cases where the participants were not all available simultaneously. Another limitation was the need for all of the research participants involved in the process to be committed to it. As contributions, this study highlights the use of multi-criteria methodology applied to the services sector, more specifically in the retail sector, demonstrating the possibility of applying this tool not only for evaluating the quality of services, but also in many different management areas. To continue this research, we suggest applying the model to all the subsidiaries of the retail company, providing managers with an efficient tool in the decision-making process.

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