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SELECTING A THIRD-PARTY LOGISTICS PROVIDER FOR AN AUTOMOTIVE COMPANY: AN ANALYTIC HIEARARCHY PROCESS MODEL

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Summary: *In this paper, a multi-criterion decision making (MCDM) model for outsourcing logistics services in the Turkish automotive industry is presented. In the paper, the logistics requirements of the automotive companies and the role of the third-party logistics (3PL) services in the automotive industry are reviewed. The concept of milk run and its benefits are explained. The current situation of the Turkish automotive industry and agricultural tractors segment is analyzed. An argument for outsourcing 3PL services for Turk Traktor Fabrikası (TTF: Turkish Tractor Plant) is developed. An analytic hierarchy process (AHP) model is created to select the best 3PL provider among four candidates. The model is used to evaluate the alternatives. Finally, the outcome and the implications of the model for implementation are discussed.*

1. Introduction

Globalization has played a very important role on the developments that affected the Turkish automotive industry throughout the country. Especially within last fifteen years, Turkey has became the investment base of the World's biggest automotive companies and their subsidiaries. The total vehicle production of the domestic automotive sector is around one million vehicles and the exports have reached to nearly fifteen billion US dollars.

In order to survive in this constantly growing market, it is inevitable for the Turkish automotive companies to remain competitive. Today, it is not possible to remain competitive for automotive companies by just launching new models into market on time. These companies should strive for competitiveness by keeping their costs as low as possible while developing more advanced products through improved processes. This is especially true for agricultural tractors that became more of a commodity unless differentiated otherwise through speed, dependability, or flexibility of the operations.

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[1] This paper is a condensed and updated version of Mr. Hasan Karagul's submission for EMBAT 600 Personal Project during his final semester at the Electronic MBA Program of Istanbul Bilgi University, Istanbul, Turkey. The original submission was in Turkish. Mr. M. Murat Albayrakoglu, MS/MBA/MSITM, was his project supervisor.

There are many production management philosophies aiming to gain profitability and cost advantages for manufacturing companies. The lean production philosophy is one of them; it covers all the activities on supply chain management and proposes tools to reach cost and profit targets. With lean production philosophy, the 3PL (third-party logistics) services and practice of milk run emerge at the intersection of the material supply activities from the suppliers.

This paper draws the attention to the importance of outsourcing logistics services. Although logistics covers the procurement of transportation, storage, ordering, and material handling services (Razzeque and Sheng , 1998), the paper focuses only on the transportation of the inbound materials. Moreover, this paper investigates the possible competitive advantages for Turk Traktor Fabrikası (TTF: Turkish Tractor Plant) if it outsources the inbound material supply services from its vendors and partners through a milk-run system. The paper will propose a model based on the analytic hierarchy process (AHP) to select a 3PL provider acting as the lead logistics provider (LLP) for TTF. An application of the model will be presented and discussed at the end.

2. Logistics Problems and Opportunities for TTF

TTF is located in Ankara in central Anatolia region of Turkey, and has annually spent about 110 million Euros on purchased materials from its suppliers over the last three years. There are a total of 128 suppliers that supply from 195 plants in 16 cities in western and central Turkey. The geographical distribution of these companies is shown in Table 1. Every month, TTF's Production Planning and Control Department, that employs 13 personnel, places firm orders from these suppliers and passes a 3-month material-requirement estimate to them. The department also monitors the inbound deliveries and therefore is under considerable workload.

City	No. of Suppliers	City	No. of Suppliers	City	No. of Suppliers	City	No. of Suppliers
Ankara	37	Aydin	1	Balikesir	1	Bursa	16
Denizli	2	Eskisehir	3	Iskenderun	1	Istanbul	46
Izmir	9	Kirsehir	2	Kocaeli	4	Konya	1
Manisa	2	Nigde	1	Sivas	1	Tekirdag	1

Table 1. Geographical Distribution of TTF's Suppliers

2.1. Problems

At an average, 75 shipments are delivered to TTF during each shift and four employees are responsible for unloading and restocking the materials arrived. Frequency and size of the deliveries place the personnel under considerable strain to provide a smooth service to the rest of TTF. Besides this, the inventory turnover has been realized as 3.2 times per year in 2006. This rate is very low: it is within the lowest 25% among Turkish automotive companies whereas the average for the top 25% is 14.4. As it can be seen from these figures, TTF manages it inventory considerably poorly as compared to the most of the sector (Central Bank, 2004; Istanbul Stock Exchange, 2006).

2.2. Opportunities

Under these circumstances, the best way of reducing the workload and managing the inbound logistics more efficiently is to outsource the entire service to a 3PL provider by combining shipments from multiple vendors in close geographic proximity into one shipment received by the client, normally done for a defined route on a recurring basis known as milk run. In fact, if the inbound logistics activities are outsourced to a specialist LLP, the following benefits can be gained:

1. The costs for supply of materials can reduce approximately 0.2% of the total purchasing cost. This, in turn, means a saving of 18,000-20,000 Euros per month when the current situation is taken into account.
2. Due to the standardization and simplification that may occur during the material supply process and afterwards by implementing Kanban and just-in-time (JIT) production, an initial reduction of 25 % in raw material stock can be realized. Additional reduction in work-in-process (WIP) inventory is also possible. This would certainly help the inventory turnover to rise to the top half or even the top quarter of the automotive sector.
3. In addition to a reduction in the number of personnel and associated costs, communication and control costs will be decreased significantly.
4. A reduction in both the warehouse and production space will be realized. This space will be available for alternative purposes such as creating additional capacity for manufacturing.
5. Simplified yet more accurate shipments will also decrease the requirements for materials handling that will push the material costs further down, and reduce the possibilities for reverse logistics.

3. Solution Alternatives for the Pilot Implementation

TTF should simplify the material supply processes by co-operating with an LLP company to initiate a milk run implementation in a manner to move over a total of four geographical regions for its 128 supplier companies grouped in 16 cities from which it conducts material supply. These geographical routes are recommended as follows.

Route 1: Aegean Route – İzmir / Manisa / Balikesir / Aydin / Denizli
Route 2: South Marmara Route – Bursa / Eskisehir
Route 3: North Marmara Route – Istanbul / Kocaeli / Tekirdag
Route 4: Mid Anatolia Route – Ankara / Nigde / Kırsehir / Konya / Sivas / Iskenderun

TTF plant must grant the priority to the companies on Route 1 because it experiences supply problems. Route 1 can be chosen for the pilot implementation of milk-run system. During the implementation period for the pilot, it can be benefited from the knowledge, experience and consultancy capabilities of the LLP company which will be selected for cooperation. In the mean time, material-packaging standards must be developed and implemented for easier and more uniform handling during milk runs, and, therefore, the implementation can be spread to all geographical routes over time. At this point, the selection of an LLP company with which a business partnership will be established and criterion to be utilized for this selection have vital importance.

4. A Model for LLP Company Assessment

Four LLP specialist companies—Borusan Lojistik, Reysas Lojistik, Horoz Lojistik and TNT Lojistik[2]—have been identified as candidates among the possible companies to be cooperated for the project of implementing milk runs for supply activities of TTF from its vendors. This selection has been made after examining the experience and capabilities of all possible companies. These four companies which are well known to the automotive and logistics sectors in Turkey are assessed with the help of a multi-criterion decision-making model which is used for organizing criteria determined by TTF's management, and evaluating alternatives under the hierarchy of criteria using the AHP. The AHP is a very suitable multi-criterion decision-making method for such a selection decision because of the nature and complexity of the problem that would be discussed further in the upcoming sections.

[2] Then CEVA Lojistik.

4.1. The Analytical Hierarchy Process (AHP)

The AHP which was developed by Thomas L. Saaty, is widely used to assist decision makers to solve complex problems consisting of multiple criteria. The process covers the selection a set of decision criteria, evaluating the relative importance of each criterion, and determination of the relative decision by the decision maker (Saaty, 2000, 2001). The decision maker has the opportunity for prioritizing the decision alternatives on the basis of their relative importance by utilizing the AHP method. The significant superiority of this approach is its ability to include subjective factors in the decision making process for reaching a recommended way of action (Saricicek, Dagdeviren and Yuzugullu, 2001).

Recently, the utilization of human provisions into decision making problems has been significantly increased. By combining human judgment and factual information, AHP enables decision makers to make more efficient decisions. In AHP, at first an objective must be determined to achieve. A hierarchy is constructed based on the primary criteria with respect to the objective of the decision maker, the subcriteria with respect to the primary criteria, and finally the decision alternatives. The decision alternative that dominates the rest is implemented in order to achieve the initial objective. (Dagdeviren, Akay and Kurt, 2004).

The AHP method requires three steps to be taken: 1) hierarchy development; 2) pairwise comparisons; and 3) synthesis (Saricicek, Dagdeviren and Yuzugullu, 2001).

Step 1. Hierarchy Development
The first step in AHP is the construction of a tree-like hierarchy to achieve the objective. The hierarchy is represented graphically to display the objective, primary criteria, subcriteria, and decision alternatives. Such a graphical representation is useful for understanding and discussing the problem. After constructing the hierarchy, the next step is the determination of the relative importance, and, hence, the priority of each criterion by making pairwise comparisons (Roper-Lowe and Sharp, 1990; as reported by Saricicek, Dagdeviren and Yuzugullu, 2001).

Step 2. Pairwise Comparisons
The basic idea for analytic hierarchy process is adding objectivity to the highly subjective process for which "weights" are assigned to each criterion for decision making with multiple criteria (Tadisina, Troutt and Bhasin, 1991; as reported by Saricicek, Dagdeviren and Yuzugullu, 2001). AHP utilizes a scale for the degrees of importance varying between 1 to 9 for grading the relative priorities of two criteria (or alternatives). The 9-point scale gives the opportunity to make qualitative and quantitative comparisons easily (Dagdeviren, Akay and Kurt, 2004).

After developing the pairwise comparison matrix according to the given degrees of importance, the local priority of each criterion should be calculated. The following algorithm is used to determine the local priorities:

> Step 1: Add values on each column on the pairwise comparison matrix.
> Step 2: Divide each element by the total of this column in the pairwise comparison matrix. As a result of this, the "normalized comparison matrix" is obtained.
> Step 3: Calculate the average of the elements on each row of the normalized matrix in order to establish the local priority of each element with respect to the component immediately above it.

The key step of AHP is the establishment of local priorities based on pairwise comparisons. The quality of final decision depends on the soundness and consistency of these comparisons. Here consistency means, in case, if Element A is m times important than Element B, and Element B is n times more important than Element C, then Element A is $m \times n$ times more important than Element C. The calculation of consistency index for the AHP is based on the consistencies among pairwise comparisons. The AHP allows for some inconsistency in making pairwise comparisons. If the degree of consistency is acceptable, the decision process should continue. If the degree of consistency is not acceptable, the decision maker should reevaluate his or her judgment and redo the pairwise comparisons.

Step 3. Synthesis
After making consistency checks for all pairwise comparison matrices, the priority sequence of decision alternatives are found by following the steps below:

> Step 1: Form the priority matrix by combining the priority vectors obtained by the basis of decision alternatives for each criterion.
> Step 2: Calculate the importance of the decision alternatives by multiplying the priority vector and priority matrix for the criterion. As a result, the decision alternatives are prioritized according to the degrees of importance, and preferences of the decision maker or decision makers.

4.2. Development of the Model to Select the 3PL Provider

The companies subject to assessment in order to make milk runs are investigated according to the criteria given in Table 2. These criteria are used as a basis for the AHP model. In order to construct the model for assessing the LLPs, a Web-based decision support tool called *Web-HIPRE* is utilized. This software has been designed to support hierarchy design, construction, and implementation for decision making models and problem solving. It is based on the software called HIPRE +3 developed at Helsinki University of Technology (Mustajoki and Hamalainen, 2000).

1. Technical Capabilities	**2. Provider Characteristics**	**3. Financial Criteria**
1.1. Information technology (IT) infrastructure [IT INFRASTRUCTURE]	2.1. Viability [VIABILITY]	3.1. Initial capital outlay [ICO]
1.2. Communication infrastructure [COMMUNICATION INFRASTRUCTURE]	2.2. Consultancy services [CONSULTANCY SERVICES]	3.2. Total costs of partnership [TOP]
1.3. Vehicles [VEHICLES]	2.3. References [REFERENCES]	3.3. Return on investment [ROI]
1.4. Equipment infrastructure [EQUIPMENT INFRASTRUCTURE]	2.4. Quality of service [QUALITY OF SERVICE]	3.4. Payback period [PBP]
1.5. Facilities [FACILITIES]	2.5. Service performance [SERVICE PERFORMANCE]	
4. Organizational Criteria	**5. Operational Impact**	**6. Impact on TTF**
4.1. Internal controls [INTERNAL CONTROLS]	5.1. Impact on costs [COST]	6.1. Revenue [REVENUE]
4.2. Compatibility with the current processes [CURRENT PROCESSES]	5.2. Impact on quality [QUALITY]	6.2. Market share [MARKET SHARE]
4.3. Adaptation with the current organization structure [CURRENT STRUCTURE]	5.3. Impact on dependability [DEPENDABILITY]	6.3. Market structure [MARKET STRUCTURE]
4.4. Compliance with organization culture and traditions [CULTURE AND TRADITIONS]	5.4. Impact on speed [SPEED]	
	5.5. Impact on flexibility [FLEXIBILITY]	

Table 2. Criteria for LLP Assessment

In order to design a model to evaluate the logistics companies that can provide the milk-run service, the hierarchy seen in Figure 1 was developed. The model consists of four layers, beginning with the objective of selecting the best 3PL provider. The primary criteria include technical capabilities, provider characteristics, financial factors, organizational factors, impact of partnership on operational performance, and impact on TTF. Secondary criteria provide further details to the primary criteria. Finally, the decision alternatives are Borusan Lojistik, Reysas Lojistik, Horoz Lojistik and TNT Lojistik. The criteria and subcriteria shown in Table 2 as headings have been determined through discussions with the TTF managers responsible for materials management.

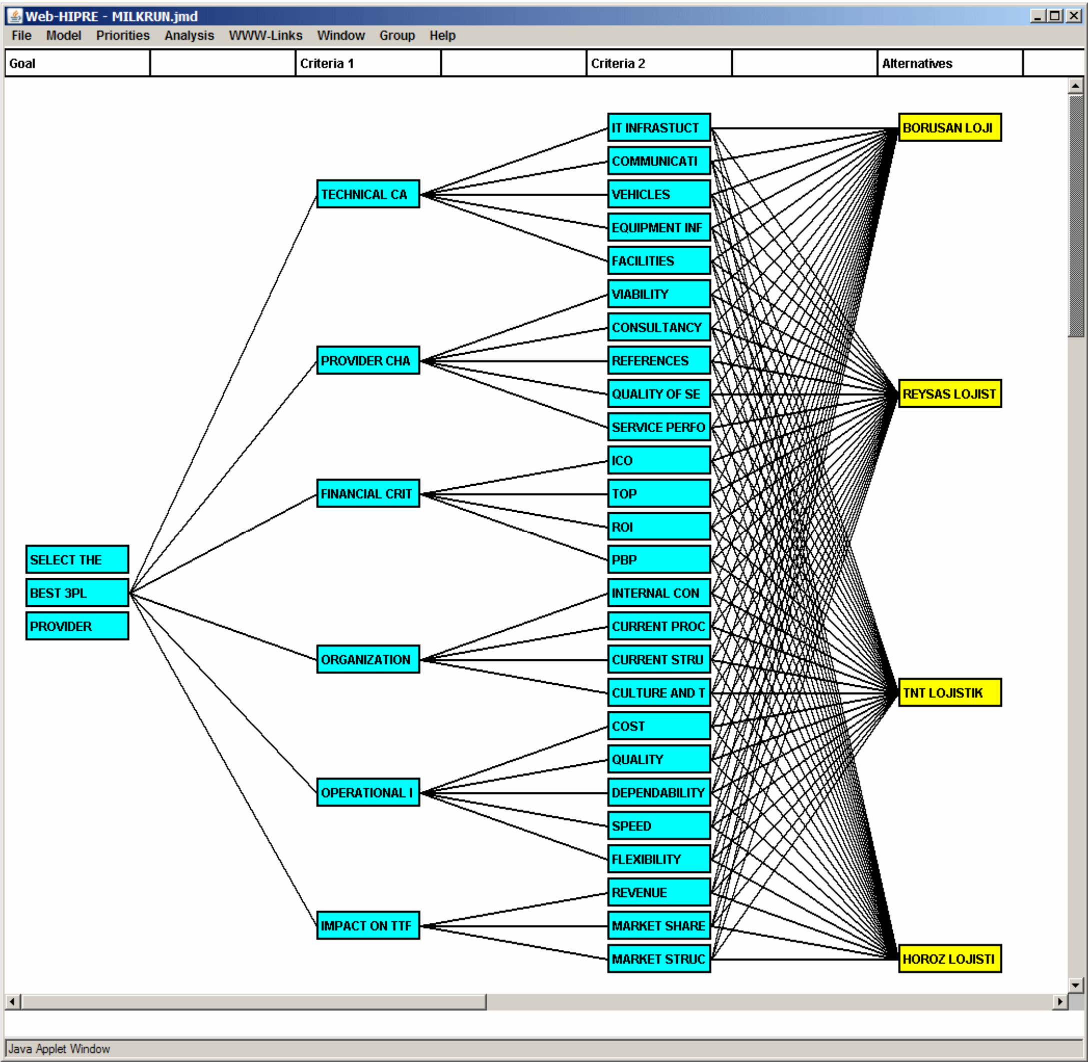

Figure 1. The Decision Hierarchy as Implemented on *Web-HIPRE*

4.4. The Application of the AHP Model

Pairwise comparisons were made after collecting information about each of the four 3PL providers followed by visits to their headquarters and interviews with their representatives. Pairwise comparisons were made based on the information collected through the Web, company documents, and interviews with the company representatives. After the pairwise comparisons, the results shown in Figure 2 are found. As a result of an overall assessment, Reysas Lojistik became the first company to be preferred since it gets the highest global priority of 0.301 among the four. TNT Lojistik got the second place with a global priority value of 0.267. Horoz Lojistik turned to be the third with an overall priority of 0.240, and Borusan Lojistik was the fourth with 0.192. Figure 2 graphically depicts the overall priorities for the decision alternatives as implemented on *Web-HIPRE*.

The LLP company recommended to carry out milk runs between TTF and its suppliers is Reysas Lojistik. The most significant factor that contributed to Reysas Lojistik's position in provider characteristics was found to be its two strong references from the Turkish automotive industry: TOFAS and Toyota. Reysas is the LLP of these two companies in Turkey. Equally significant are the technical capabilities and the extent of operational impact from partnership with Reysas.

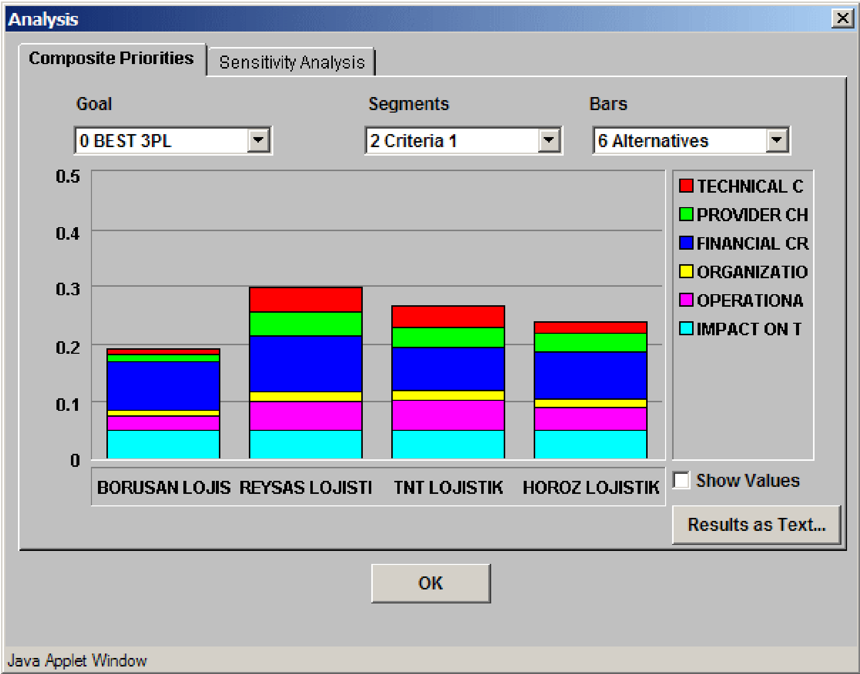

Figure 2. Results of the AHP Model as Implemented on *Web-HIPRE*

Reysas's uses a computer program *Oplog* for all of its milk run clients and their suppliers in transporting required materials based on the client's schedule. Moreover client companies can monitor the locations of milk-run vehicles via Internet with a system called SVTS (Satellite Vehicle Tracking System). All vehicles are monitored by this way via satellite. In order to monitor the entry and exit of the vehicles into and from the supplier plants, a program called *Poliroute* is utilized. Reysas seems to be a company that has people and other resources to transfer their knowledge and experiences by cooperating with its client and its client's suppliers at the beginning of this project and they are capable of orienting the suppliers to participate in the milk-run project in a short period.

5. Conclusion

At present, competition conditions get harder throughout the World. Companies that try to compete on the basis of price apply many new techniques and wish to reduce their costs and increase their profitability. One of the areas in cost reduction for the manufacturing companies is material costs. This study recommends implementing a milk-run system in order to reduce materials management and logistic costs and presents a model based on the AHP method to select a logistics company that would act as the LLP for TTF.

Most of the problems faced by the manufacturing management require complex and sophisticated assessments for solution. The criteria used in making these decisions are diverse and sometimes incommensurable. For this reason, a multi-criterion decision making method, such as the AHP, is needed to design and construct a model for selecting a 3PL provider to act as the LLP.

Such a model would not only yield a solution to be implemented, but provides a deeper understanding of the problem by rendering structure to a seemingly unstructured problem. The size of the model allows for a rapid yet thorough evaluation of the decision alternatives and is expected to yield better and more efficient decisions. The model provided in this paper is flexible to include new elements in the future according to new developments.

Beyond a better understanding of the problem and its flexibility, the model allows for participation by a group of decision makers rather than just one. As a group decision-making tool, the model takes advantage of being implemented on *Web-HIPRE* so that contributions to the model by the decision makers are independent of location. The model is capable of facilitating consensus among a diverse group of decision makers having different interests, and promotes ownership of the decision to increase the chance of a successful implementation of the project.

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