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THE IMPLEMENTATION OF ANALYTIC HIERARCHY PROCESS IN PHARMACEUTICAL INDUSTRY FOR SELECTION PROCESS OF 3RD PARTY LOGISTICS SERVICE PROVIDER*

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Abstract

Deciding to outsource a company's warehousing and distribution is never easy. Although cost is certainly one of the major considerations, there are many other criteria such as quality, reputation and service level that are part of the decision making process. Many companies from different industries prefer to outsource logistics activities by evaluating different information when choosing the right logistics partner. Through this, companies also gain experience about working with a strategic partner for outsourcing. Also, the experience/former performance of the potential partner is one of the most important performance indicator and decision criteria for the logistics provider selection. Therefore, experience is one of the key driver in decision making process. Since pharmaceutical industry has its own priorities due to stricter quality standards, the experience related to the former performance is a more relevant factor in the decision criteria. In this study, the analytic hierarchy process (AHP) was applied to evaluate selection process of 3PL service providers in pharmaceutical industry. Also, the relative weights of the four criteria and twelve sub-criteria were determined to select the most important criteria in pharmaceutical industry which was experience with its factor weight of 32.40%.

Keywords: 3rd Party Logistics, Logistics Outsourcing, Pharmaceutical Industry, Pharmaceutical Logistics, Health Care Logistics

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ANALİTİK HİYERARŞİ SÜRECİNİN İLAÇ ENDÜSTRİSİNDE 3. PARTİ LOJİSTİK HİZMET SAĞLAYICI SEÇİM SÜRECİNE UYGULANMASI

Öz

Bir işletmenin depolama ve dağıtımında dış kaynak kullanımına karar vermek asla kolay değildir. Maliyet en önemli unsurlardan biri olmasına rağmen, karar mekanizmasının parçası olan kalite, itibar ve hizmet seviyesi gibi birçok ölçüt de söz konusudur. Farklı endüstrilerden birçok işletme lojistik faaliyetlerinde dış kaynak kullanımında doğru lojistik ortağını seçerken farklı bilgileri değerlendirmeyi tercih ederler. Bu sayede işletmeler dış kaynak kullanımı için stratejik ortak ile çalışma konusunda tecrübe edinirler. Ayrıca, potansiyel ortağın tecrübesi / eski performansı en önemli performans göstergelerinden biridir ve lojistik hizmet sağlayıcı seçiminde karar ölçütleridir. Bu nedenle, karar verme sürecinde tecrübe temel ölçütlerden biridir. İlaç endüstrisinin daha sıkı kalite standartları sebebiyle kendi öncelikleri olduğundan, geçmiş tecrübeye ilişkin deneyim karar mekanizmasında daha uygun bir faktördür. Bu çalışmada, ilaç endüstrisinde 3. Parti lojistik hizmet sağlayıcı seçimini değerlendirmek için analitik hiyerarşi süreci (AHS) uygulandı. Aynı zamanda, 4 ana ve 12 alt ölçütün ağırlıkları belirlenerek ilaç sektöründeki en önemli ölçüt %32.40 faktör ağırlığı ile tecrübe olarak belirlenmiştir.

Anahtar Kelimeler: 3. Parti Lojistik, Lojistikte Dış Kaynak Kullanımı, İlaç Endüstrisi, İlaç Lojistiği, Sağlık Ürünleri Lojistiği

I.INTRODUCTION

Since the competition in the market is getting though it is becoming more challenging for the companies to design / redesign their processes more effectively and efficiently in order to reach the competitive cost level in their industry. In order to be able to reach that competitive level, more companies are trying to focus on their core competencies.

With 3rd Party Logistics (3PL), the function logistics, which is not a core function of the company and traditionally performed within the company, is partially or totally shifted to a service provider experienced in this function (Ashenbaum et al., 2005). The companies want to concentrate more in decreasing logistics costs, improvement of the processes, being more flexible, avoiding new investments and improving their customer service levels. Therefore, companies pay too much attention in selection process of 3PL service provider.

Although outsourcing is commonly used in the last two decades, there are still some grey areas for the selection process of the third party logistics (3PL) service provider. Actually, there is enough literature on this subject and the necessary information is given in basic form in this literature. But depending on the industry the company is operating the criteria's have different priorities.

Especially for the industries, where the core business requires stricter quality standards, like the Good Manufacturing Practices (GMP) rules in the pharmaceutical industry, it is more efficient, to concentrate on core functions. Therefore, outsourcing some of

the activities, which are out of the main scope of the company, is one of the favorite ways of reaching competitive advantage.

Therefore, companies in the pharmaceutical industry act in such cases with a harmony since their ways of working based on GMP regulations needs more attention on some specific issues. For that reason, it is useful for the pharmaceutical companies, to decide based on some specific criteria's based on other companies' experiences in the same industry.

In this paper, the core idea is to set a model which can be used easily by the management of pharmaceutical companies by their 3 PL service provider selections. The study starts with a literature review, followed by explanation of Analytical Hierarchy Process (AHP) which is a method of Multi Criteria Decision Making (MCDM). Since there are several criterions by the selection of 3 PL service provider which can be categorized as MCDM problem, and the literature review reflects that AHP is the most used and easiest method to imply, the implementation of AHP for 3 PL service provider selection process is given with this paper. Also, due to different criteria's of pharmaceutical industry, this industry is chosen as implementation area. By the way, since most of the multinational pharmaceutical companies operating in Turkey prefer to work with 3PL and there are a few examples in the literature, this study aims to help a specific industry, pharmaceutical industry.

II.LITERATURE REVIEW

Companies are looking for further alternatives to achieve success in today's competitive environment. In order to get hold of competition, the main aim is to create efficiency and focus more on core competencies through using outsourcing alternatives (Embleton and Wright, 1998; Lambert et al., 1999). With outsourcing, some business activities are assigned to another company with special expertise and investment on that area. For all countries and industries, the most exciting side of outsourcing is these economic, strategic, and environmental factors (Lau and Zhang, 2006).

Multinational companies should adapt their strategies and supply chain operations according to the socio-economical changes, market dynamics they are operating in and customer/supplier relations (Kusaba et al., 2011, Lorentz e al., 2013). Therefore, especially for the multinationals, since economical changes are creating big risks for the company, the main aim is the use of limited resources for core competencies and reduce the amount of investment for a non-core functions.

With the compelling competition environment in all industries and rising financial risks, outsourcing became popular since end of 90's. Especially for the logistics operations, since logistics hosts special expertise and high amount of investments in the nature of its operations, the most preferred operation to be outsourced is logistics operations.

Logistics outsourcing industry is growing almost 5-10 % every year and further studies based on the findings of 2.000 surveys performed to industry executives indicated that about 54% spend for transportation purposes and 39 % spend for warehousing purposes are being outsourced (Langley, 2012).

Although there are a lot of studies about third party logistics in the recent years, there is still need for academic researches and publications (Selviaridis and Spring, 2007). Quite a few number of researchers worked on the topic but there is still need for theoretical background information and sharing of expertise. There is still room for improvement for the knowledge on this topic (Chen et al., 2009).

In many studies, it is concluded that logistics outsourcing is generating competitive advantage through focusing on core activities, increase efficiency, improve customer services and creating cost advantages especially by reducing transportation costs and investments for logistics (Aguezzoul, 2014; Bathnagar et al., 1999; Boyson et al., 1999; Hertz and Alfredsson, 2003; Hsu et al., 2012; Vaidyanathan, 2005).

3PL creates value both from economies of scale (fleets, warehouses) and economies of scope (increasing net value) point of view. Investing in logistics activities like information transfer based equipment's and distribution centers also requires a high amount of investment. Reducing capital investments through logistics outsourcing enables the companies to reduce their financial risks (Vasiliauskas and Jakubauskas, 2007).

Since end of 90's, several studies are performed by the researchers in order to define some criteria for logistics service provider (LSP) selection and to define some performance criteria for LSP (Chiu, 1995; Kahn and Mentzer, 1998; Larson and Kulchitsky, 1999).

After these studies, which paved the way of increasing the awareness for logistics service outsourcing further studies are performed to present the effect of the relations between performance and resources of a logistics company (Lai et al., 2008; Karia and Wong, 2013; Ryoo and Kim, 2015).

The potential benefits for logistics outsourcing can be summarized as focusing on core competencies, cost and time saving, reduction by investments, increase of flexibility by management capabilities, efficiency increase, service diversification, inventory visibility, economies of scale and sharing expertise and knowledge, where the potential problems can be summarized as lack of control, lack of workforce quality, decreased service levels, lack of proper information flow, management problems and environmental problems (Alkhatib et al., 2015).

There are also some risks, which should be examined before the outsourcing decision and logistics provider selection since it can cause some displeasure with the performance (Baghalian et al., 2013; Lieb and Bentz, 2005; Wang et al., 2014).

An approach to eliminate the risk for building a reliable and effective workflow with the LSP is to pay attention by the selection of the LSP and contracting process **(Vasiliauskas and Jakubauskas, 2007).**

Many companies use former performance information in the selection process (Liu and Lyons, 2011; Moghaddam, 2015).

The outsourcing relations with third party service providers are not easy to manage due to the loose nature of relationships but is very important for success (Yang and Zhao, 2016). In order to ensure the outcome of the outsourced activities, the most used techniques are contracts, audits, key performance indicator settings and insider information. The recent studies showed integration by means of collaboration and relationship management can also serve for the same purpose. This enhances cost reduction and supply chain responsiveness (Chen et al., 2009; Flynn et al., 2010; Kannan and Tan, 2010; Prajogo and Olhager, 2012; Soosay et al., 2008; Swafford et al., 2008; Thun, 2010; Zhao et al., 2011).

The company and the third party logistics provider should establish a risk sharing matrix so that both parties can build a reliable partnership. Demand, inventory and financial risk is examples of risks which service provider carries (Vasiliauskas and Jakubauskas, 2007).

In the pharmaceutical industry, 80% of the companies experienced outsourcing are satisfied with the result. The most outsourced efforts are as listed in Figure 1 (Sponheimer, 2013).

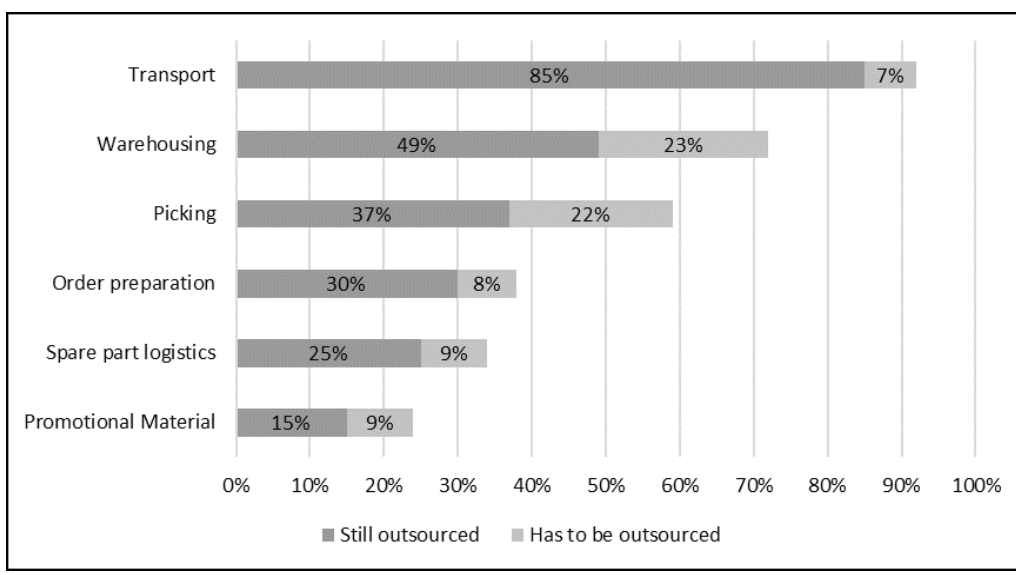

Figure 1. Activities to Outsource (Sponheimer, 2013)

III.METHODOLOGY

In this study, Analytic Hierarchy Process (AHP), one of the MCDM methods, is used for evaluating the criteria used for 3PL service provider selection. AHP, proposed by Saaty (1977, 1980), is one of the most preferred MCDM methods which is used to solve complicated problems in a hierarchical system. With AHP, the priorities among the decision criteria which are extracted from the several criteria are available. This is an easy to use method which evaluates multiple criteria either qualitative or quantitative linked to each other where the importance of the criteria is set by judgment of the decision makers. So, the contribution of the decision makers with their preferences, experiences, knowledge, perception and opinion can also be achieved through this method AHP.

For AHP, the steps are defined as:

Step 1 - Establishing of hierarchical structure: For decision making, the goal, the criteria, sub-criteria and the alternatives are given (Saaty, 2008). In Figure 2, the structure is given accordingly:

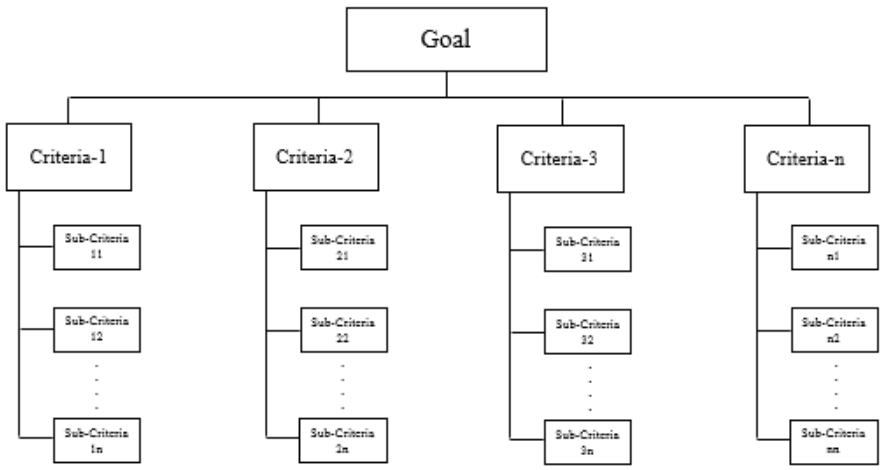

Figure 2. The Hierarchical Structure for AHP Process

Step 2 - Comparison of reciprocal matrix: After establishing hierarchical structure, the most important phase of AHP is creating the reciprocal matrix. By this matrix, the criteria or alternatives are compared reciprocally.

$$A = \begin{bmatrix} 1 & a_{21} & a_{31} & \dots & a_{n1} \\ 1/a_{21} & 1 & a_{32} & \dots & a_{n2} \\ 1/a_{31} & 1/a_{32} & 1 & \dots & a_{n3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1/a_{n1} & 1/a_{n2} & 1/a_{n3} & \dots & 1 \end{bmatrix}_{nxn}$$

For each criterion in the matrix above, according to the contribution to the goal and the priority of each target in name of criteria, with respect of the opinion from the decision makers, is defined reciprocally. Here, a fundamental scale is given in Table 1 (Saaty, 1990).

Table 1. The Fundamental Scale in AHP

Scale	Implication
1	The importance of two factors is the same
3	A factor is moderate than another factor
5	A factor is strongly important than the other
7	A factor is demonstrate importance than the other
9	A factor is extremely important than the other
2,4,6,8	Intermediate value

Step3 - Definition of Eigenvector: After establishing the reciprocal matrix, the next step is to calculate the Eigenvector, which shows the priority of each criteria among the other criteria in the matrix.

Step 4 – Calculating of Consistency Index & Ratio

Consistency Index (CI):

$$CI = \frac{\lambda max - n}{n-1}$$

RI: In order to evaluate the consistency, the random consistency index should be given as shown in the Table 2:

Table 2. RI Values for Matrix

# of elements	1	2	3	4	5	6	7	8	9	10	11	12
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.53

Consistency Ratio (CR):

$$CR = \frac{\lambda max - n}{(n-1)*RI}$$

If CR is less than 0.10, the decision is that the matrix is consistent.

IV.SWITCHING TO 3PL LOGISTIC PROVIDER: BE READY FOR A WRESTLE

To save, having a better customer service level, more improved Information Technologies investment should not cozen companies by switching to 3PL logistic provider. This is a complicated and by the way very didactic experience. Almost every company had difficulties by switching to third party logistics. Especially pharmaceutical industry has also some difficulties due to industrial dynamics. In order to learn from experiences, it is better to review the methodology that the multinationals use for projecting this process and the difficulties or problem areas of this process.

Outsourcing project starts with the strategy and planning phase including the internal evaluation with the management in order to develop a plan. The plan should include the information about which services of supply chain to outsource, the portfolio to be outsourced, user requirements, Information Technology (IT) requirements for interfaces and project schedule for the coming years. This detailed project plan and also phasing of the project plan will give the company the flexibility about the outputs of each phase of the project. According to this outputs companies are able to accelerate the process or postpone some phases due to the results of each phase from quality of outputs point of view.

Outsourcing projects have generally a flow like given in Figure 3:

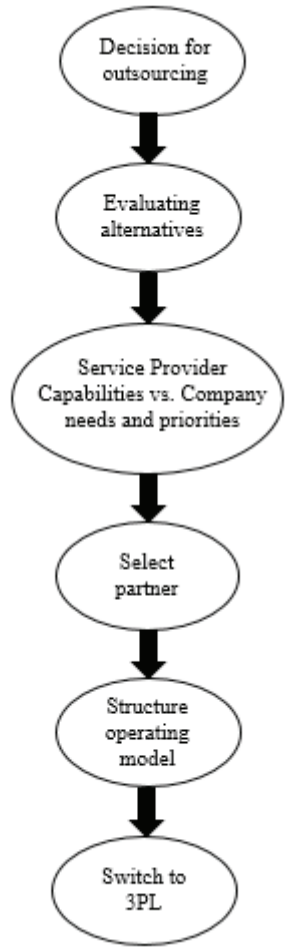

Figure 3. Flow of 3 PL Service Provider Selection Process

By defining the user requirement specifications, all detailed information about the operations to be outsourced should be defined as procedures and recorded. The trends by the processes, campaign periods, inbound and outbound dynamics should be determined. That means all the experience about the process should be documented. This step is very critical for both parties, company and logistic partner, since in order to be on the same page, company should inform the service provider with the documented experience about its processes. What the company wants as target, what the company expects from the service provider, the volume of the operation should be documented and explained to the provider to the very tiny extend. The strengths, weaknesses, threads and opportunities of the process

and even some confidential details which will be shared after selection with the service provider should be prepared with protection of a confidentiality agreement.

A further step before starting the project is master data maintenance. Together with the operation information, all the information about in-house master data should be checked and updated. It should be guaranteed that the material master data and also customer master data definitions should reflect the present situation. Master data with mistakes can cause big accidents by project go-live period. In order to avoid the questions like "What is the actual address of the customer A?" at the last minute, companies should perform master data maintenance accordingly.

This process plan also enables the company to build the contractual conditions. According to the special contractual conditions, key performance indicators and also penalty conditions are easier to define. The contract should be prepared as detailed as possible in order to cover all the conditions which will be a matter afterwards when the process has started.

Before starting with the selection criteria's, which are extracted from the experiences of the leading companies in the industry, there are some essential topics which should be considered during the selection process.

Since personalized services are prominent, alignment of cultural sense and company infrastructures become more critical. The needs from operation and cultural point of view should be satisfied with this partnering. Both parties should be ready for sharing their capabilities and resources. Also, both sides should have common sense about ethics and responsibility. Therefore, on top of the other objective criteria, this organic aspect should be considered.

After announcing the tender for 3PL outsourcing the next phase is evaluating the offers from candidates. By this evaluation project, there are several topics to be considered which are also forming the process design of outsourcing. The first and very important topic is about costs which also is a trigger for outsourcing projects. The costs of the service provider should be evaluated from competitiveness point of view. The company should evaluate the saving potential from their costs which also should affect the decision process a lot.

The next critical issue with the outsourcing is IT both the company and service provider is using. It is not always the case that the company and the provider are using the same Warehouse Management System (WMS). The WMS should be linked with the related interfaces to the companies Enterprise Resource Planning (ERP) system, so that the data flow is guaranteed and also secured. The interface structures to the existing software system of the company and the service provider should be defined very clearly. The programmers should work with the experienced team members in the operations matter for these interfaces. This will avoid having changes in short time periods. Nothing is permanent but change; that is true,

but changes should not be so quick in such new formations. If frequency of changes and the adaptation speed of the organization to those changes are not regulated, there will be big gaps by the ERP structure (inventory management). After having the interfaces completed validations should be performed accordingly.

The location of the service provider is important. It is related to cost and presence issues. The 3P should be located in the correct location and should be present in several locations to serve the customers with high responsiveness.

The order processing standards should be clearly defined and a fall back scenario should be submitted. The company wants to be able to control the orders being worked on. The ability of having representatives at service provider's site is an advantage for the companies.

The company should be evaluated from reliability perspective/point of view. Here, the service provider's track records are important where also the guarantees for the company should be examined. Also stability from financial side and financial risks should be discussed.

Last but not the least, the environmental awareness should also be taken in to account since creating environmentally safer processes is matter for all business aspects.

After evaluating the proposals and providers the next step should be the preparation for the start-up phase.

Before start-up, aforementioned criteria should be considered from contract perspective/ point of view. Additionally, to monitor the service provider's performance, some Key Performance Indicators for the above mentioned criteria's should be defined. These criteria can be listed as cycle time for response capacity of the 3PL, Cost of Goods Sold for saving potentials, on-time response, right quality and right quantity metrics for reliability and inventory days/ capacity utilization rates for asset management efficiency.

A group of experienced professionals should be organized in order to deal with the regulatory issues and related authorizations. It can be also the case that on the very last minute there will be some regulatory changes. This group of professionals should be in case to react to this last minute changes. Also this group has to inform the Project team about the regulations and rules about the licenses so that any bottleneck about these issues can be eliminated.

Training about the operations, especially by dealing with a logistic service provider where the provider has limited experience on pharmaceutical industry, is one of the important success factors of the Project. Since pharmaceutical industry is dealing with Good Manufacturing Practices (GMP). The service provider should also be familiar with the GMP procedures. The team should be educated about GMP regulations at first and then about the potential problems and results of this problems during Go-Live phase.

Sales team and all the sales channels should be informed about the project. By the roll out phase, it will be better if the sales team is not organizing any tender, launch of a new product or campaign on the Go-Live, Day 1. On the Go-Live day, it is obtained to work with the minimum operations volume. The team should not hurry for operations since the result of almost all possible steps should be checked by Day 1.

A team for Customer Complaint Management should be arranged. Whether you planned all the details of the process or not, there will be some complaints coming from the customers. In order to complete the process with minimum loss, complaints management is an important process. An unsuccessful Complaint Management system is one of the important triggers for market share loss and bad reputation. It also minimizes gossips about the company's processes.

V.IMPLEMENTATION OF THE METHODOLOGY

There are several studies in the literature which used different techniques to evaluate the 3 PL service providers. Aguezzoul (2014) reviewed the literature in order to find out what are the most used criteria and methods for service provider selection in logistics services. As also mentioned in this article, the most used techniques for evaluation are Multi-criteria decision-making (MCDM), statistical approaches, artificial intelligence, mathematical programming models and integrated approaches.

First, it should be evaluated whether this problem can be solved with AHP. Since mentioned above, this kind of problems are easy to overcome with AHP like also mentioned in the literature (So et al., 2006; Göl and Çatay, 2007; Efendigil et al., 2008).

The criteria's used for Figure 4 were defined with the light of mentioned criteria's (Aguezzoul, 2014) and also experienced based information support from 3 leading multinational pharmaceutical companies operating in Turkey. The structure given in Figure 2 is implemented with the selected criteria's mentioned in the literature to 3PL service provider selection.

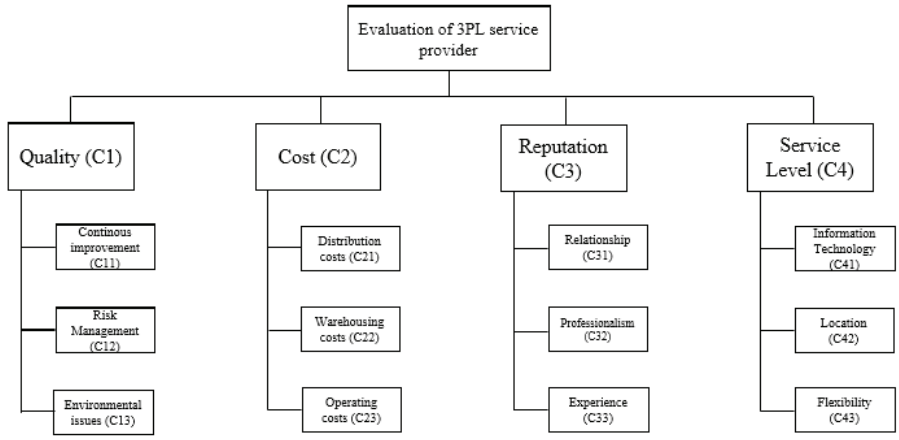

Figure 4. Hierarchical Structure for 3PL Service Provider Selection Criteria's

By creating the matrix, the fundamental scale given in Table 1 is used. The data entered into the matrix is calculated with the geometric mean values obtained from the answers of experts of the three international companies mentioned above (Dyer, 1992).

Below the comparison matrix of criteria's and sub-criteria's are given with the related calculated λ, CI, RI and CR is given with the below tables:

Table 3. Comparison Matrix of Evaluation from 3 PL Service Providers Criteria's

Evaluation 3PL SP	Q	C	R	SL	W	λ_{max}	CI	RI	CR
Q	0.207	0.333	0.160	0.273	0.243	4.003	0.001	0.900	0.001
C	0.069	0.111	0.240	0.045	0.116				
R	0.621	0.222	0.481	0.546	0.467				
SL	0.104	0.333	0.120	0.136	0.173				

Table 4. Comparison Matrix Sub-Criteria Quality

Quality (C1)	C11	C12	C13	W	λ_{max}	CI	RI	CR
C11	0.100	0.118	0.063	0.094	3.005	0.003	0.580	0.005
C12	0.600	0.709	0.750	0.687				
C13	0.300	0.177	0.188	0.222				

Table 5. Comparison Matrix Sub-Criteria Cost

Cost (C2)	C21	C22	C23	W	λ_{max}	CI	RI	CR
C21	0.091	0.107	0.045	0.081	3.002	0.001	0.580	0.002
C22	0.636	0.765	0.818	0.740				
C23	0.273	0.130	0.136	0.180				

Table 6. Comparison Matrix Sub-Criteria Reputation

Reputation (C3)	C31	C32	C33	W	λ_{max}	CI	RI	CR
C31	0.091	0.040	0.122	0.084	3.006	0.003	0.580	0.005
C32	0.364	0.161	0.146	0.224				
C33	0.545	0.806	0.730	0.694				

Table 7. Comparison Matrix Sub-Criteria Service Level

Service Level (C4)	C41	C42	C43	W	λ max	CI	RI	CR
C41	0.746	0.824	0.625	0.732	3.002	0.001	0.580	0.002
C42	0.107	0.118	0.250	0.158				
C43	0.149	0.059	0.125	0.111				

Table 8. Contribution of The Weights to The Evaluation of 3 PL Service Provider Selection

Criteria	Wi	Sub-Criteria	Wi	Wf
Quality	0.243	C11	0.094	2.274
		C12	0.687	16.685
		C13	0.222	5.385
Cost	0.116	C21	0.081	0.940
		C22	0.740	8.582
		C23	0.180	2.084
Reputation	0.467	C31	0.084	3.940
		C32	0.224	10.430
		C33	0.694	32.400
Service Level	0.173	C41	0.732	12.650
		C42	0.158	2.730
		C43	0.111	1.920
SUM				100.000

VI.CONCLUSION

Since two decades, especially in the pharmaceutical industry overall, working with 3rd party service provider for the logistic services is very popular and there is still room for enlargement and improvement. In this article, it is presented which criteria are being emphasized for the third party logistics provider selection in the literature and also experienced based information support from 3 leading multinational pharmaceutical companies operating in Turkey about this issue.

According to the outputs of the AHP method with support of information from the above mentioned companies, it came out that experience is the most important criteria in pharmaceutical industry (32.40%). In the literature, cost is given as one of the most important factors for 3PL outsourcing decisions. For sure cost is an important aspect by selection process. But since pharmaceutical industry has its own regulations, GMP, it brings to the processes a different approach where experience plays a significant important role.

Experience is followed by risk management (16.69%). For quality related issues, fallback scenarios and also Customer Complaint Management, having a risk management under tight control will also help service providers to meet the GMP rules pharmaceutical companies are looking for.

Information technology, the next important criteria (12.65%), helps to build bridge between service providers, the mother company and to Ministry of Health (MoH) in pharmaceutical industry since this industry needs a 2 dimensional matrix barcode information (e.g. batch number, expiry date, serial number etc.) received and sent to MoH.

Relationship, which refers to reliability, compatibility and trust is the next important criteria (10.43%). The service provider should be compatible so that the part of the process running by the provider meets all the strict regulations of MoH and GMP which the mother company must follow.

Therefore, it will be useful for the companies which have an outsourcing project for logistics services in the pipeline in the pharmaceutical industry, to get benefitted from the experiences / failures from the others in the same industry.

References

Aguezzoul, A. (2014). "Third-party logistics problem: A literature review on criteria and methods". Omega: International Journal of Management Science 49: 69–78.

Alkhatib, S.F, Darlington, R., Yang, Z. and Nguyen, T.T. (2015). "A novel technique for evaluating and selection logistics service providers based on the logistics resource view". Expert Systems with Applications 42: 6976–6989

Ashenbaum, B., Maltz, A. and Rabinovich, E. (2005). "Studies of Trends in Third-Party Logistics Usage: What Can We Conclude?". Transportation Journal 44(3): 44

Baghalian, A., Rezapour, S. and Farahani, R. Z. (2013). "Robust supply chain network design with service level against disruptions and demand uncertainties: A real-life case". European Journal of Operational Research 227: 199–215

Bhatnagar, R., Sohal, A. S. and Millen, R. (1999). "Third party logistics services: a Singapore perspective". International Journal of Physical Distribution and Logistics Management 29 (9): 569–587

Boyson, S., Corsi, T., Dresner, M. and Rabinovich, E. (1999). "Managing effective third party logistics partnership: What does it take?". Journal of Business Logistics 20(1): 73–100

Chen, H., Daugherty, P.J. and Roath A.S. (2009). "Defining and operationalizing supply chain process integration" Journal of Business Logistics 30.1: 63-84.

Chiu, H. N. (1995). "The integrated logistics management system: A framework and case study". International Journal of Physical Distribution and Logistics Management 25: 4–19

Dyer, R. F. and Forman, E. H. (1992). "Group decision support with the analytic hierarchy process". Decision Support Systems 8 (2): 99-124

Efendigil, T., Önüt, S. and Kongar, E. (2008). "A holistic approach for selecting a third-party reverse logistics provider in the presence of vagueness". Computers and Industrial Engineering 54 (2): 269–87

Embleton, P. R. and Wright, A. (1998). "A practical guide to successful outsourcing". Empowerment in Organizations 6 (3): 94 –106

Flynn, B.B., Huo, B. and Zhao, X. (2010). "The impact of supply chain integration on performance: a contingency and configuration approach". Journal of Operations Management 28 (1): 58–71

Göl H. and Çatay, B. (2007). "Third-party logistics provider selection: insights from a Turkish automotive company". Supply Chain Management: An International Journal 12 (6): 379–84

Hertz, S. and Alfredsson, M. (2003). "Strategic development of third party logistics providers". Industrial Marketing Management 32 (2): 139–149

Hsu, C. H., Wang, F.-K. and Tzeng, G.H. (2012). "The best vendor selection for conducting the recycled material based on a hybrid MCDM model combining DANP with VIKOR. Resources". Conservation and Recycling 66: 95–111

Kahn, K. B. and Mentzer, J. T. (1998). "Marketing's integration with other departments". Journal of Business Research 42: 53–62

Kannan, J. and Tan, K. (2010). "Supply chain integration with third-party logistics providers". International Journal of Production Economics 125 (2): 262–271

Karia, N. and Wong, C. Y. (2013). "The impact of logistics resources on the performance of Malaysian logistics service providers". The Management of Perations 24 (7): 589–606

Kusaba, K., Moser, R. and Rodrigues, A. M. (2011). "Low-cost country sourcing competence: A conceptual framework and empirical analysis". Journal of Supply Chain Management 47 (4): 73–93

Lai, F., Li, D., Wang, Q. and Zhao, X. (2008). "The information technology capability of third-party logistics providers: A resource-based view and empirical evidence from China". Journal of Supply Chain Management 44: 22–38

Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. (1999). "Building Successful Logistics Partnerships". Journal of Business Logistics 20 (1): 161–181

Langley, J. "Third Party Logistics Study 2012". (Accessed October 27, 2012).

Larson, P. D. and Kulchitsky, J. D. (1999). "Logistics improvement programs: The dynamics between people and performance". International Journal of Physical Distribution and Logistics Management 29: 88–102

Lau K. H. and Zhang J. (2006). "Drivers and Obstacles of Outsourcing Practices in China". International Journal of Physical Distribution and Logistics Management 36 (10): 776-792

Lieb, R.C. and Bentz B.A. (2005). "The Use of Third-Party Logistics Services by Large Manufacturers: The 2004 Survey". Transportation Journal 44 (2): 5-15

Liu, C.-L. and Lyons, A. C. (2011), "An analysis of third-party logistics performance and service provision"; Transportation Research Part E: Logistics and Transportation Review 47 (4): 547–570

Lorentz, H., Kittipanyangam, P. and Srai, J.S. (2013). "Emerging market characteristics and supply network adjustments in internationalizing food supply chains". International Journal of Production Economics 145 (1): 220-232

Moghaddam, K. S. (2015). "Fuzzy multi-objective model for supplier selection and order allocation in reverse logistics systems under supply and demand uncertainty". Expert Systems with Applications 42: 6237–6254

Prajogo, D. and Olhager, J. (2012). "Supply chain integration and performance: the effects of long-term relationships, information technology and sharing, and logistics integration". International Journal of Production Economics 135 (1): 514–522

Ryoo, S., and Kim, K. (2015). "The impact of knowledge complementarities on supply chain performance through knowledge Exchange". Expert Systems with Applications 42: 3029–3040

Selviaridis, K. and Spring, M. (2007). "Third party logistics: a literature review and research agenda." The International Journal of Logistics Management 18 (1): 125-150

So, S.H., Kim, J.J., Cheong, K.J. and Cho, G. (2006). "Evaluating the service quality of third-party logistics service providers using the analytic hierarchy process". Journal of Information Systems and Technology Management 3 (3): 261–70

Soosay, C.A., Hyland, P.W. and Ferrer, M. (2008). "Supply chain collaboration: capabilities for continuous innovation". International Journal of Supply Chain Management 13 (2): 160–169

Sponheimer, A. (2013). "Supply-Chain-Trends und Regularien in der Pharmalogistik". Pharmind Pharm. Ind. 75 (9): 1422-1428

Swafford, P.M., Ghosh, S. and Murthy N. (2008). "Achieving supply chain agility through IT integration and flexibility". International Journal of Production Economics 116 (2): 288–297

Thun, J. H. (2010). "Angles of integration: an empirical analysis of the alignment of internet-based information technology and global supply chain integration". Journal of Supply Chain Management 46 (2): 30–44

Vaidyanathan, G. (2005). "A framework for evaluating third-party logistics". Communications of the ACM 48 (1): 89–94

Vaziliauskas, A. V. and Jakubauskas G. (2007). "Principle and Benefits of Third Party Logistics Approach When Managing Logistics Supply Chain". Transport XXII (2): 68-72

Wang, Y., Ma, X., Lao, Y. and Wang, Y. (2014). "A fuzzy-based customer clustering approach with hierarchical structure for logistics network optimization". Expert Systems with Applications 41: 521–534

Yang, Q. and Zhao, X. (2016). "Are logistics outsourcing partners more integrated in a more volatile environment?". International Journal of Production Economics 171 (2): 211-220

Zhao, X., Huo, B., Selen, W. and Yeung, J.H. (2011). "The impact of internal integration and relationship commitment on external integration". Journal of Operations Management 29 (1–2): 17–32

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