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Evaluation of the Performance Attributes of Retailers Using the Scor Model and AHP: A Case Study in the Turkish Clothing Industry

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Abstract
Today global firms in distant places are trying to find ways of controlling larger networks of production and distribution. The competitive nature of the field has increased dramatically in the retail sector in recent years. Today retailers must have some competitive strategies like having more price competitiveness, higher service levels as well as utilising advances in computing capabilities and information technologies to improve their supply chain efficiency. In this paper, a methodology was developed to compare three successful textile retailers. First the Supply Chain Operation Reference (SCOR) model was used to determine the performance criteria and then a case study was conducted involving Turkish clothing manufacturers. The Analytical Hierarchy Process (AHP), which is a multi-criteria decision making technique to solve complex and unstructured problems with multiple attributes, was used to evaluate results. As a result of the study, three successful retailers were compared according to the performance attributes.

Key words: *analytical hierarchy process (AHP), supply chain operation reference (SCOR), supply chain process.*

Introduction

The goal of a supply chain should be to increase the overall supply chain profitability. Supply chain profitability is the difference between the revenue generated from the customer and the total cost gathered across all stages of the supply chain. Supply chain decisions influence both the revenue generated as well as the cost incurred, thus they have a large impact on the success or failure of a firm. A successful supply chain structure manages product flows, information, and funds to provide a high level of product availability to the customer while keeping costs low [1].

The supply chain of the clothing sector has very distinctive processes. The sector includes a variety of sizes, colours, and cuts of a collection that requires very efficient and optimised logistics. Moreover different supply methods and the fast fashion sector affect processes in the supply chain. Furthermore time efficiency is one of the key factors for this industry in providing a competitive advantage [2]. Kocaoğlu et. al. stated that due to the increasing complexity and size of the supply chain of the manufacturing industry, a large and complex supply chain usually makes it difficult to coordinate and thus degrades its performance [3]. Chen et al. considered the planning of a multi-product, multi-period, and multiechelon supply chain network and constructed a supply chain planning model as a multi-objective mixed-integer linear program (MILP) to satisfy several objectives, such as minimising the total cost, increasing decision robustness in various product demand scenarios, lifting local incentives, and reducing the total transport time [4]. Kayalı examined the technical, pure technical and scale efficiencies of the profitability of textile companies in Turkey for 2007. They gave some information about the situation of the textile sector inside the Turkish economy and they used Data Envelopment Efficiency. The efficiency score of the textile sector was found to be low [5].

Schniederjans and Garvin indicated that strategic objectives (cost, quality, delivery, etc.) were too highly aggregated to direct decision making [6]. They are broad and generic categories with a multitude of possible interpretations, for example, "quality" can mean reliability, durability, or aesthetic appeal. Palladino analysed how two companies, Zara and Benetton, have achieved their success through various business strategies and how they have influenced each other [7]. Huan and Sheoran criticised the SCOR model, analysed its strengths and weaknesses. They stated that the model can be used as a common model for evaluating, positioning and implementing supply-chain application software [8]. Rangone explained the use of non-financial performance measures in terms of support provided for the achievement of the strategy. For this aim they stated that it was necessary for performance measures to be expressed in heterogeneous measurement units and they showed the potential of the AHP for assessing and comparing the overall manufacturing performance of different departments [9]. Suwignjo et al. used a cognitive map, cause and effect diagram, and analytic hierarchy process (AHP) to build a hierarchical model and determine the priorities of performance metrics [10]. Varma et al. suggested a combination of the Analytical Hierarchy Process and Balanced Scorecard to evaluate the performance of the petroleum supply chain. The AHP technique has been applied to determine the relative weights of various perspectives as well as the factors relating to them [11].

In this paper a methodology was developed to compare three successful textile retailers (which have been renamed Retailer A, Retailer B and Retailer C to protect confidentiality). The companies selected are well-known brands in

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the market for their irregular supply chain, variety of product ranges and retail speed. The companies were compared from the perspective of Turkish clothing suppliers. A method was used to compare three successful textile retailers using the Supply Chain Operation Reference 10 (SCOR 10) model. After determination of the performance criteria, a case study involving Turkish clothing manufacturers was conducted. The Analytical Hierarchy Process (AHP), which is a multi-criteria decision making technique to solve complex and unstructured problems with multiple attributes, was used to evaluate results.

Methodology

SCOR model

The Supply Chain Operations Reference-model (SCOR) is a process reference model that has been developed and endorsed by the Supply Chain Council (SCC) as the cross-industry standard diagnostic tool for supply chain management. SCOR enables users to address, improve and communicate supply chain management practices within and between all interested parties. The SCOR framework makes it possible for organisations to quickly determine and compare the performance of the supply chain and related operations within their organisation as well as against other organisations [12].

SCOR is a hierarchical model with specific boundaries in regard to scope. There are at least four hierarchical levels in the model. SCC focuses on three process levels and does not attempt to prescribe how a particular organisation should tailor its systems. These hierarchical levels are as follows: Level 1: Top Level (Process Types), Level 2: Configuration Level (Process Categories), Level 3: Process Element Level (Decompose Processes), and Level 4: Implementation Level (Decompose Process Elements). Level 1 defines the scope and content of the SCOR Model. In addition, the basis of competition performance targets is set in this level. In Level 2, a company's supply chain can be "configured-to-order" from 26 core process categories. Companies also implement their operation strategy at this level. Companies fine-tune their operation strategy at Level 3, which defines a company's ability to compete successfully in its chosen markets. Level 3 also consists of the process element definition, process element information inputs and outputs, process performance metrics, best practices -where applicable-, and system capabilities required to support best practices. At Level 4, companies implement specific SCM practices to achieve competitive advantage [13]. In this study the research scope was concentrated on Level 1 performance attributes and metrics specifically.

Table 1. *Fundamental nine-point scale and its description [6].*

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak	Experience and judgement slightly favor one activity over another
3	Moderate Importance	
4	Modarate Plus	Experience and judgement strongly favor one activity over another
5	Strong Importance	
6	Strong Plus	An activity is favored very strongly over another, its dominance demonstrated in practice
7	Very Strong Importance	
8	Very very strong	An evidence favoring one activity over another is of the highest possible order of affirmation
9	Extreme Importance	
Reciprocal of above	If activity I has one of the above nonzero numbers assigned to it when compared with activity j. then j has the reciprocal value when compared with i.	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to spun the matrix

Table 2. *General information about the experts.*

Manufacturer type	Number of employees	Business position
Fabric	1000	Customer representative
Knitting	370	Customer representative
Denim	317	Denim production director
Accessory	100	Sale and marketing management
Knitting & weaving	250	Customer representative
Knitting & weaving	120	Merchandiser
Fabric	1000	Customer representative
Accessory	105	Sale management
Knitting & weaving	50	Marketing management
Knitting & weaving	194	Customer representative
Knitting & weaving	550	Customer representative
Knitting	46	Production coordinator
Knitting & weaving	205	Merchandiser assistant
Knitting & weaving	200	Customer representative
Knitting & weaving	130	Merchandiser assistant
Weaving	98	Merchandiser
Knitting	150	Merchandiser assistant
Denim	770	Senior merchandiser
Weaving	1000	Merchandiser
Weaving	85	General manager

Analytical hierarchy process (AHP)

The importance of decision making in human judgement has increased. The Analytic Hierarchy Process (AHP) is a powerful and flexible decision making process to help people to set priorities and make the best decision when both qualitative and quantitative aspects of a decision need to be considered [14]. Saaty's 1-9 scale was utilised to gauge answers, which are shown in ***Table 1***.

AHP comprises eight major steps [15]:

1. State the problem.
2. Identify the criteria that influence the behaviour of the problem.
3. Structure a hierarchy of the criteria, sub-criteria, properties of the alternatives, and the alternatives themselves.
4. Prioritise the primary criteria with respect to their impact on the overall objective, called 'the focus'.

Table 3. *Adaptation of the criteria to the SCOR model.*

Performance attribute	Definition	Adaptation of SCOR model to apparel industry
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include being on-time, and the right quantity and quality.	PRODUCTION & QUALITY 1. Defective production ratio 2. Percentage of quantity that can be delivered on time/ customer order 3. Green production 4. Quality relative to competitors(material and accessory quality) 5. Variety of the goods (Colour and product variety)
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides products to the customer. Examples include cycle-time metrics.	SPEED 1. Lead time 2. Number of collections per year 3. Percentage on-time for rush orders
Agility	The ability to respond to external influences and to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include flexibility and adaptability	MARKETING & INNOVATION 1. Number of fairs attended (frequcency) 2. Flexibility and Adaptability 3. Strong market image and good marketing techniques 4. Ability to offer new and innovative products 5. Fashion follow-up speed
Costs	The cost of operating the supply chain processes. This includes labour, material, management and transportation costs. A typical cost metric is the cost of goods sold.	COST 1. The ability to achieve the target price of the customer 2. The cost of operations and supply chain processes
Asset management	The ability to efficiently utilise assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs. outsourcing. Metrics include inventory days of supply and capacity utilisation.	ASSET MANAGEMENT 1. Inventory days of supply 2. Capacity utilisation

5. Prioritise the sub-criteria with respect to their criteria.
6. Consistency test.
7. Selection of the best alternatives: At the end of the study, the alternative with the highest overall priority should be selected.
8. Sensitivity analysis.

Questionnaire

The research design for this study includes a case study involving 20 Turkish clothing manufacturers. Qualitative data were gathered via a questionnaire which was distributed to members of the top-level management teams of each of the selected clothing firms in Turkey. Because AHP evaluation is based on expert opinions, the number of questionnaires conducted depends on the study content. In this study efforts were especially focused on getting information from the right experts who were capable of answering comprehensive questions and who also had experience of all three retailers currently or previously to obtain reliable information. It was very difficult

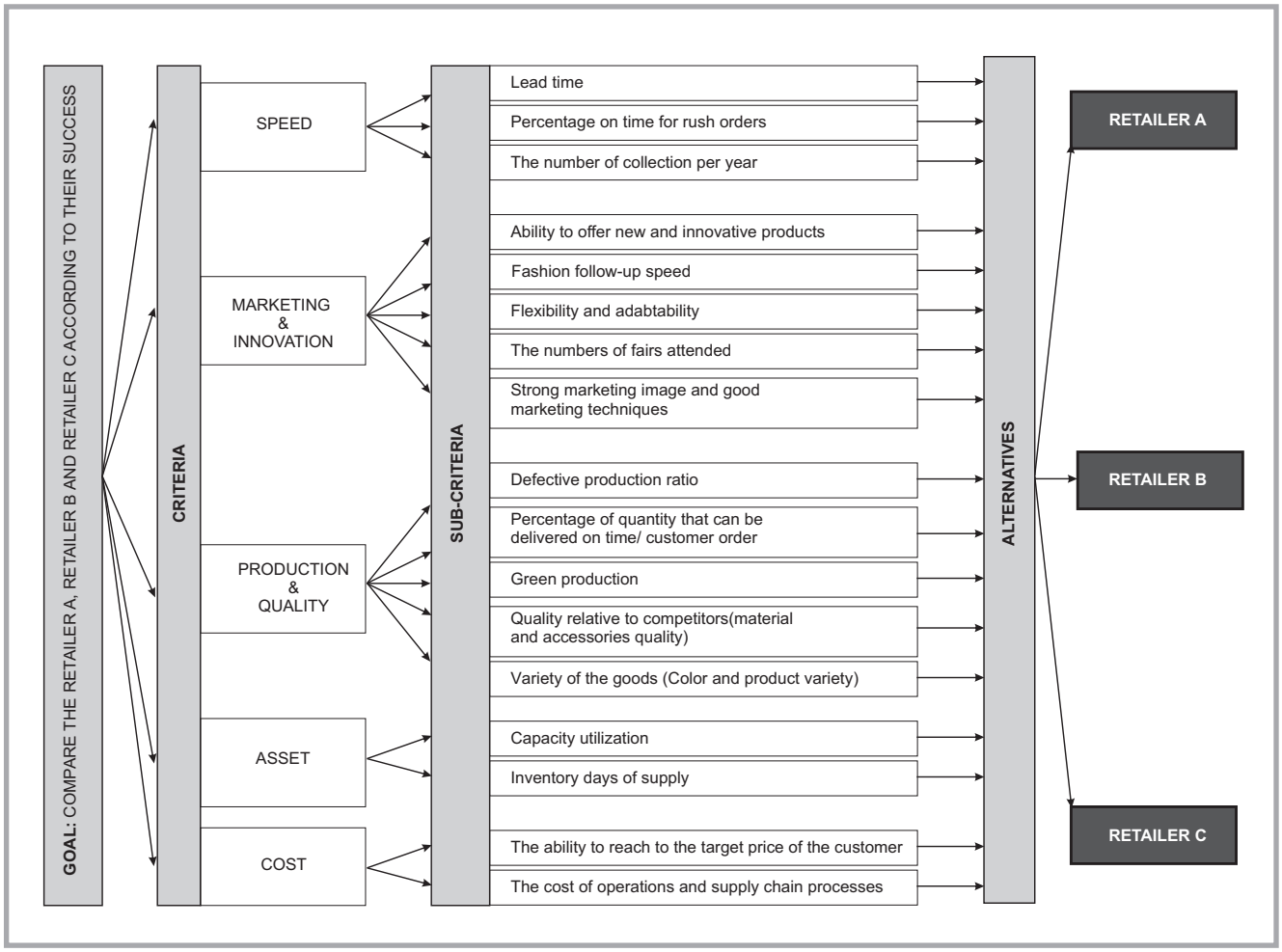

Figure 1. *Hierarchical design.*

to achieve this because especially Retailer C does not have manufacturers in common with Retailer A and Retailer B. ***Table 2*** (see page 15) gives general information about the experts and companies. Also, as is seen from ***Table 2***, all the interviewers were selected from different types of manufacturers, which was important to achieve an unbiased approach during performance criteria evaluation.

The application part of the study is as below.

a. Determine criteria in order to evaluate retailers' performance.
b. Adaptation of the criteria to the SCOR model in terms of the model's limitation and stipulate the criteria for the final shape.
c. Structure the hierarchy, which is one of the most important steps as it makes the complex problem more comprehensible.
d. Performance evaluation of pair-wise comparisons. Each element in a particular level is compared with another in the same level and they are evaluated on a numerical scale.
e. Checking the consistency index
f. Obtain the results and decide which alternative is preferable.

Results

Determining the criteria and adaptation of the criteria to the SCOR model

It is obvious that defining the right criteria is very important for achieving the main goal. Therefore a sensitive study had to be made to determine the criteria accordingly. After identification of the criteria, some modifications are needed in order to adapt to the SCOR model. The main criteria can be listed as production & quality, speed, marketing & innovation, asset management and cost, which can also be seen in ***Table 3***. All three retailers selected are known in the market for their speed, variety of product range, low cost, and irregular supply chain. Therefore the criteria were selected in order to be able to show the weak and strong points of the retailers mentioned.

Structuring the hierarchical design

The problem was hierarchically structured into different levels: the goal, main criteria, sub-criteria and alternatives, and a four level hierarchical model was devised**.** The whole hierarchy of the assessment can be easily visualised and is shown in ***Figure 1***. The goal is to compare the retailers mentioned according to their performance attributes, which were located at the top level of the hierarchy. The criteria and sub-criteria contributing to the decision were represented at the intermediate levels, which were followed by the alternatives or selection choices at the bottom of the hierarchy.

Pairwise comparison

After forming the hierarchical structure the next step is to make a pair-wise comparison matrix of the relative criteria. Taking the basis of the geometric mean of 20 expert views of the binary comparisons, the comparison matrixes were calculated. Once the components were compared pairwise, the whole pairwise comparisons were collected into a matrix called a pairwise comparison matrix. Another point that should be considered was the inconsistency index, which is useful for identifying possible errors in judgments. In general, the inconsistency index should be less than 0.1. In the study, this ratio never exceeded 0.1.

Figure 2 (see page 18) shows the relative importance of the five main (speed, marketing & innovation, production & quality, cost and asset management) criteria. According to the data obtained from the questionnaire, the most important three criteria were marketing & innovation, cost and production

Table 4. *Weights of sub-criteria*

SPEED	Weights
Lead time	**0.390**
Percentage on time for rush orders	**0.505**
The number of collections per year	**0.103**
MARKETING & INNOVATION	
Ability to offer new and innovative products	**0.208**
Fashion follow- up speed	**0.186**
Flexibility and adaptability	**0.243**
The numbers of fairs attended	**0.071**
Strong marketing image and good marketing techniques	**0.289**
ASSET MANAGEMENT	
Capacity utilisation	**0.653**
Inventory days of supply	**0.346**
PRODUCTION & QUALITY	
Defective production ratio	**0.217**
Percentage of quantity that can be delivered on time/ customer order	**0.317**
Green production	**0.100**
Quality relative to competitors (material and accessory quality)	**0.181**
Variety of goods (Colour and product variety)	**0.183**
COST	
The ability to achieve the target price of the customer.	**0.741**
The cost of operations and supply chain processes.	**0.258**

Table 5. *Calculation of the priorities of the alternatives under the sub-criterion 'marketing & innovation'.*

Criterion	Weight	C.I.	Sub-criteria	Weight	C.I.	Alternatives	Weight
Marketing & innovation	0.262	0.0068	Strong marketing image and good marketing techniques	0.289	0.0060	RETAILER A	0.335
						RETAILER B	0.374
						RETAILER C	0.289
			Flexibility and adabtability	0.243	0.0061	RETAILER A	0.433
						RETAILER B	0.344
						RETAILER C	0.222
			Ability to offer new and innovative products	0.208	0.0000	RETAILER A	0.550
						RETAILER B	0.266
						RETAILER C	0.183
			Fashion follow- up speed	0.186	0.0344	RETAILER A	0.596
						RETAILER B	0.295
						RETAILER C	0.108
			The numbers of fairs attended	0.071	0.0007	RETAILER A	0.362
						RETAILER B	0.356
						RETAILER C	0.280

Table 6. *Calculation of the priorities of alternatives under the sub-criterion 'cost'*

Criterion	Weight	C.I.	Sub-criteria	Weight	C.I.	Alternatives	Weight
COST	0.257	0.0000	The ability to achieve to the target price of the customer	0.741	0.0020	RETAILER A	0.475
						RETAILER B	0.357
						RETAILER C	0.167
			The cost of operations and supply chain processes	0.258	0.0004	RETAILER A	0.440
						RETAILER B	0.227
						RETAILER C	0.332

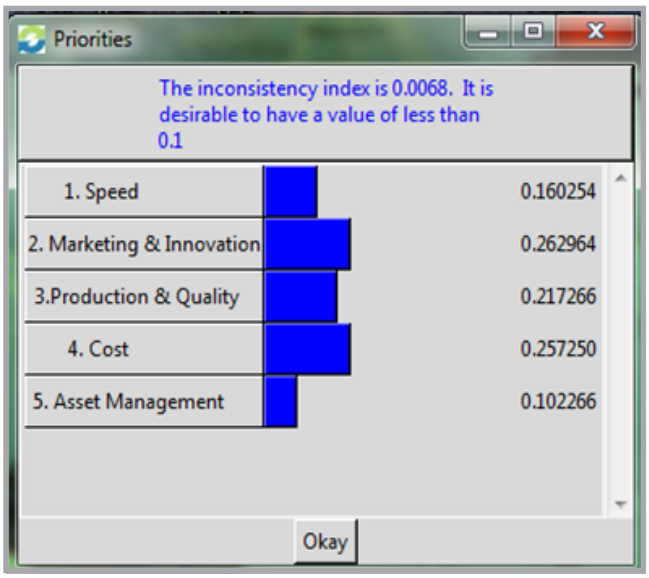

Figure 2. *Priorities of the main criteria.*

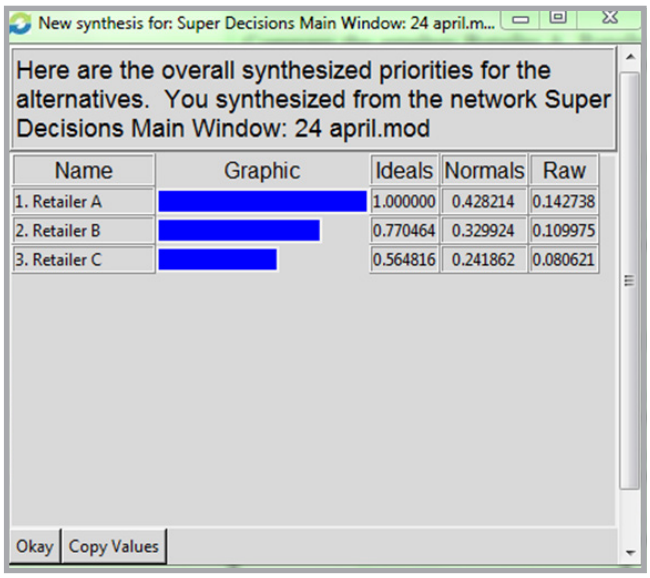

Figure 3. *Results of the most preferable brands.*

& quality, which were extremely close to each other. Marketing innovation had a value of 0.262, whereas the cost was 0.257, and production & quality 0.217. On the other hand, the other two criteria, speed and asset management, achieved lower significance levels of 0.160 and 0.102, respectively.

Table 4 presents the overall weighting information for each sub-criteria related to the main criteria.

According to the results, marketing & innovation was found as the most important main criterion, for which the most important sub-criterion was 'strong market image and good marketing techniques', followed by 'flexibility and adaptability'.

Table 5 shows the priorities of the alternatives with respect to the sub-criterion of **marketing & innovation**. According to the most important sub-criterion, Retailer A was the second preferred brand, while Retailer B was the most-preferred one. For the 'ability to offer new and innovative products', 'fashion follow-up speed' and 'flexibility and adaptability', Retailer A was well ahead of Retailer B.

The next criterion was **cost,** as shown in ***Table 6***. It was found that 'the ability to achieve the target price of the customer' had more weight than the other sub criteria, which means that the interviewers believe that achieving the target cost is very critical in their firm and will try their best to shape their supply chain to improve this ability. Like marketing & innovation, for the cost sub-criterion Retailer A was the most preferred brand.

Another type of measure evaluated was the **production & quality,** which was the third most important one among the main criteria. When the sub-criteria of production & quality were investigated, it was found that the most important criterion is the 'percentage of quantity delivered on time', while the least important was 'green production', surprisingly. Although the importance of green production has been increasing over the past few decades, both the interviewers that participated in the questionnaire and the suppliers mentioned did not give high scores to this criterion. On the other hand, more and more consumers are taking into account a company's social and environmental policies when making purchasing decisions.

Another point that should be evaluated was the quality relative to other competitors. Because Retailer C attaches importance to that point, it was ranked first for the three sub-criteria, as seen in ***Table 7***.

When the sub-criterion for the **speed** were examined it was found that the most important was 'percentage on-time for rush orders', which was followed by 'lead time'(***Table 8***).

The last criterion was under the name of **asset management**. Capacity utilisation was selected as the first criterion, for which Retailer B came first, Retailer C second, and Retailer A was last.

After pairwise comparisons, the next step of the application is evaluating the performance of suppliers regarding relative criteria and classifying the suppliers according to their performance.

The *Normals* column in ***Figure 3*** presents the results in the form of priorities, which is the usual way to report results. The *Ideals* column is obtained from the *Normals* column by dividing each of its entries by the largest value in the column. These results showed that Retailer A was selected as the best choice considering the multi-criteria decision making process.

These results present that Retailer A, with 43%, became the primary brand among its competitors, followed by Retailer B with 33%. The third preferable brand was Retailer C, with a proportion of 24%.

Conclusion

The purpose of this paper was to compare three successful brands according to their performance attributes. Initially the criteria were determined and adapted to the SCOR model, which contains standard metrics to measure process performance. The AHP approach was applied to construct the hierarchical structure of the model and determine the priorities of the criteria. The findings of this study present that Retailer A came first for most of the criteria as well as sub-criteria. Especially for the criteria 'Marketing & Innovation' and 'Cost & Speed', the company was easily the leading brand among its competitors. On the other hand, for the sub-criteria 'quality relative to its competi-

Table 7. *Calculation of the priorities of the alternatives under the sub-criterion production & quality.*

Criterion	Weight	C.I.	Sub-criteria	Weight	C.I.	Alternatives	Weight
Production & quality	0.217	0.0401	Percentage of quantity that can be delivered on time/ customer order	0.317	0.0014	RETAILER A	0.410
						RETAILER B	0.336
						RETAILER C	0.253
			Defective production ratio	0.217	0.0014	RETAILER A	0.198
						RETAILER B	0.257
						RETAILER C	0.544
			Variety of goods (Color and product variety)	0.183	0.0127	RETAILER A	0.466
						RETAILER B	0.335
						RETAILER C	0.198
			Quality relative to competitors (material and accessory quality)	0.181	0.0057	RETAILER A	0.183
						RETAILER B	0.345
						RETAILER C	0.470
			Green production	0.100	0.0000	RETAILER A	0.139
						RETAILER B	0.399
						RETAILER C	0.461

Table 8. *Calculation of the priorities of alternatives under the sub-criterion 'production & quality'.*

Criterion	Weight	C.I.	Sub-criteria	Weight	C.I.	Alternatives	Weight
Speed	0.160	0.0245	Percentage on time for rush orders	0.505	0.0361	RETAILER A	0.547
						RETAILER B	0.322
						RETAILER C	0.130
			Lead time	0.390	0.0241	RETAILER A	0.577
						RETAILER B	0.284
						RETAILER C	0.138
			Number of collection per year	0.103	0.0010	RETAILER A	0.534
						RETAILER B	0.271
						RETAILER C	0.194

Table 9. *Calculation of the priorities of alternatives under the sub-criteria 'asset management'.*

Criterion	Weight	C.I.	Sub-criteria	Weight	C.I.	Alternatives	Weight
Asset management	0.102	0.0000	Capacity Utilization	0.653	0.0082	RETAILER A	0.262
						RETAILER B	0.427
						RETAILER C	0.309
			Inventory days of supply	0.346	0.0010	RETAILER A	0.429
						RETAILER B	0.341
						RETAILER C	0.228

tors', 'green production' and 'defective production ratio', Retailer C was first.

The importance of Turkish suppliers in the textile and clothing industry among its competitors cannot be denied; however, the role of Far East suppliers has increased over the past decade. This study aimed to provide textile scientists and academics with a comprehensive and valuable database for comparing some successful retailers according to their performance attributes in relation to the retailers' suppliers in Turkey. Nevertheless the results presented in this paper are only a preliminary study using the views of Turkish suppliers of the retailers mentioned. Therefore the views of such as Chinese, Thai and Vietnamese experts that work with the retailers mentioned can also be received and the results evaluated according to their views. On the other hand, the retailers chosen for this paper are well-known brands in the market for their high-fashion product range with affordable prices as well as for their irregular supply chains. In the future, authors from different countries will compare their own successful retailers in their countries to specify their successful and weak points.

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