Inzinerine Ekonomika-Engineering Economics, **2015, 26(3), 239–244**

A New Perspective on Quality Characteristics Determining Supply Chain Management of Coffee Production

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crossref http://dx.doi.org/10.5755/j01.ee.26.3.5462

This paper explores the differences in the quality perception of coffee among different participants in the supply chain management of coffee production. Rather, the aim of this paper was to answer the question of whether a particular level of coffee quality is the same for all participants in the supply chain. Also, we wanted to respond to the issue of whether all participants in the supply chain equally valued its characteristic. As a possible remedy to the problem, two-stage PCA-I-distance approach has been performed. The results have shown that there are indeed differences in the quality perception of coffee among different participants in the supply chain. Also, we proposed framework for emphasizing significant components for respective participant, and within crucial quality characteristics. Therein, we determined the most significant component which encompasses following set of characteristics of the coffee supply chain for distributor: the coffee inventory turnover ratio, producer satisfaction with distributor services, customer satisfaction (retail) with distributor services. Likewise, same procedure was done for producer and analysis pointed out following quality characteristics: the coffee's country of origin, the manufacture date, the expiry date, storage cost of the final product, customs procedures, delays in procurement, and the temperature of at which the coffee is roasted.

Keywords*: product quality, distribution quality, quality perception, PCA-I-distance approach, supply chain management.*

Introduction

The goal of producers is to supply a product to customers that meets the customers' needs, though this need not necessarily mean that they have adequately recognized the needs of the final users (Migliore *et al.*, 2015; Parmigiani & Rivera-Santos, 2015; Wong *et al.*, 2011). In addition, before being consumed, the product must pass through the appropriate distribution chain to reach the user. (Gupta & Singh, 2012) define the service quality in supply chain as how well an organization meets or exceeds the customer expectations in unidirectional or bidirectional way for each element of a supply chain i.e. supplier, manufacturer, distributor, retailer and customer or end consumer. This fact raises the question, whose answer is also the aim of this study, as to whether a particular level of coffee quality is equal for all participants throughout the supply chain, and as to whether certain characteristics rate equally in their importance to all participants. For instance, whereas actually cup quality is the primary criterion in consuming countries, coffee's direct physical quality is mainly assessed through the physical aspects of coffee beans, such as its colour, size, density, and percentage of physical defects in producing countries (Vaast *et al.*, 2006). Numerous factors affect coffee quality (Clifford & Wilson, 1985), including soil water status (Carr, 2001), climatic conditions (Vaast *et al.*, 2002), the maturity of coffee berries at their harvest, bean processing (fermentation, washing, drying, storage, roasting, and beverage preparation), agricultural management (shade, pruning, and fertilisation), and the genetic properties of the cultivars (Bertrand *et al.*, 2003). In this regard of examining overall coffee quality, several quality characteristics of coffee for participants in the coffee supply chain in Serbia are defined and analysed in this study.

(Rosenblom, 1999) distinguishes between title flow, negotiation flow, product flow, finance flow, information flow, and promotion flow. Receiving special attention in this study is the aspect of the flow of the product, namely how members at different stages in the national distribution chain of coffee perceive product quality; i.e., if chain members perceive quality requirements differently, they will pursue different quality characteristics of a product. Quality perception is the cognitive response to a service experience (Petrick, 2004). Although, there has been much research on distribution chains (Stern *et al.*, 1996), few studies in the literature on supply chains have examined how members at different stages in the distribution chain separately perceive the quality of the products offered. (Korneliussen & Gronhaug, 2003) do find that producers and exporters emphasise distribution quality while importers and supermarkets emphasise product quality. These authors believe this difference in preference stems from a division of labour in distribution, where chain stages undertake activities according to their role in the distribution chain. In the case of production and distribution of quality, chain stages' roles and activities influence their perceived quality perceptions. Korneliussen and Gronhaug's findings also reveal that upstream members in the distribution chain stress distribution quality, while firms that are located downstream in the supply process tend to emphasize product quality. (Houston & Sudman's, 1975) research shows that chain stages have different quality perceptions based on their roles in the

distribution chain. The role these perform determines their goals and activities, through whose interaction between adjacent chain stages influences their quality perceptions. For example, suppliers want to know what quality characteristics buyers want and what quality level is expected so that they can arrange their activities accordingly (Zu & Kaynak, 2012).

In this study, our aim is to determine if the differences exist in the quality perception of coffee among different participants in the supply chain. In addition, we wanted to examine the most important component for producers in the coffee supply chain and distributors, as well. Moreover, quality characteristics as integral part of examined components will be scrutinized as well.

Producers have a reason for ensuring large downstream inventories: to provide high distributor service levels to maintain or gain market share (Schwarz & Zhao, 2011). Also, rapid global changes in the environments of industrial markets make distributor commitment more important to producers and in some ways harder to achieve (Goodman & Dion, 2001). Having previously said, the purpose of this study has been to ascertain whether any differences in the quality perception among producers and distributors of coffee in Serbia exist. To achieve this aim, a sample of 16 organizations, 11 distributors, and 5 producers with a major presence (Companies Market, 2014; Balkan Peace, 2014) in the Serbian coffee market have been observed. Accordingly, the following hypotheses have been defined:

H1: A systematic change of quality perceptions through the coffee supply chain is present.

H2: Proposed framework emphasizes significant components for respective participant, and within crucial quality characteristics.

Research Methodology

In order to examine our hypotheses, appropriate questionnaire has been introduced. The quality characteristics, for producers and distributors in the coffee supply chain, were defined by conducting interviews with the managers of coffee manufacturing and distributing organizations in the Serbian market. These characteristics were base on KPI's (Key Performance Indicators) in supply chain (Hugos, 2011; Dubey, 2011). Questionnaire used in the study had first been sent to all organizations that were currently active in the Serbian coffee market; the respondents were managers of coffee manufacturing and distributing organizations. The questionnaire itself consisted of two parts: the first contained questions on the quality characteristics of the coffee supply chain for the producer, and the second included questions on the quality characteristics of the coffee supply chain for the distributor. The quality perception of participants in the coffee supply chain was measured using variable *Significance*, which measures the importance of the quality characteristics participants assigned to the coffee supply chain. For creating this variable, a 5-point Likert scale was used.

With growing need for impartial rankings, one of the devised methodologies, which could answer such a task, was the I-distance methodology developed by (Ivanovic, 1977). Proposed metric solves the issue of incorporating various indicators of different measurement units into a single synthetic indicator (Jeremic *et al.*, 2012). Another important aspect is its ability to overcome the problem of subjectivity in a composite indicator (Dobrota *et al.*, in press). In order to apply the I-distance methodology, it is necessary to fix one entity as a reference in the observed data set. The fixed or referent entity is the entity with the minimal value for each indicator (or a fictive entity with minimal value of each indicator). The ranking of entities in the data set is founded on the calculated distance from the referent entity (Jovanovic *et al.*, 2012). The construction of the I-distance is an iterative process, which can consist of several steps. The first step calculates the amount of discriminate effect of the first variable (the most significant variable that provides the most information on the ranking phenomenon); the second step calculates the value of the discriminate effect of the second variable, not included in the first. This procedure is repeated for all the variables in the observed data set (Seke *et al.*, 2013). Consequently, the procedure calculates the correlations between the I-distance values and input variables. Correlations are used because of the special feature of the I-distance method: It is able to present the relevance of input indicators. The I-distance method defines which of the input indicators are most important for the ranking process by putting them into a specific order of importance according to these correlations.

Let $X^T = (X_1, X_2, ...X_k)$ be a set of variables chosen to characterize the entities. I-distance between two entities $e_r = (x_{1r}, x_{2r}, ...x_{kr})$ and $e_s = (x_{1s}, x_{2s}, ...x_{ks})$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} (1 - r_{ji.12...j-1})$$

where $d_i(r,s)$ is the discriminate effect (distance between the values of the variable X_i for e_r and e_s),

$d_i(r,s) = x_{ir} - x_{is}$ $i \in \{1,...k\}$, σ_i is the standard deviation of X_i and $r_{ji.12...j-1}$ is the partial coefficient of the correlation between X_i and X_j, $(j < i)$ (Jeremic *et al.*, 2011; Radojicic & Jeremic, 2012). In addition, frequently used square I-distance (Jeremic *et al.*, 2013) is given as:

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} (1 - r_{ji.12...j-1}^2)$$

Results

The results of testing the initial assumptions are given below in Table 1 and Table 2. They are broken down into quality characteristics of the coffee supply chain by distributor for Table 1 and quality characteristics of the coffee supply chain by producer for Table 2. After applying PCA method, three components incorporated the most significant characteristics of both producers and distributors. Afterwards, the I-distance method was used to determine which components are the most important for the respective participant in the supply chain. In addition, component loadings as the correlations between quality characteristics and component provide an in-depth overview of the most significant characteristics.

Table 1

Quality Characteristics of the Coffee Supply Chain by Distributor
DISTRIBUTOR

	Component		
	1	2	3
coffee inventory turnover ratio			0,887
producer satisfaction with the distributor's services			0,714
customer satisfaction (retail) with the distributor's services			0,654
documentation of the distributor's medical safety of products		0,921	
accuracy of delivery		0,873	
the completeness and accuracy of transport documentation		0,859	
storage of coffee in the distributor's warehouse		0,854	
storage cost of goods (coffee) in the distributor's warehouse	0,854		
the number of complaints from distributors	0,787		
the number of defective pieces from the distributor	0,739		
quantity and value of wastage, breakage, and write-offs	0,729		
the number of complaints from the final customer	0,707		
order size and frequency of orders	0,687		
the cost of the transportation of the goods	0,672		
waiting time for manufacturers' trucks to unload goods	0,668		
the number of defective pieces at the distributor	0,665		
correlation with the I-distance	0,328	0,639	0,679

Table 2

Quality Characteristics of Coffee Supply Chain by Producer
PRODUCER

	Component		
	1	2	3
the coffee's country of origin	0,973		
the date of manufacture and expiry date	0,973		
the storage cost of the final product	0,973		
customs procedures and delays in procurement	0,886		
the temperature at which the coffee is roasted	0,840		
the unit price of the final product		0,992	
the quantity and value of sale of final products		0,992	
the storage of raw coffee		0,877	
physical properties of the coffee		0,771	
the quality of unit packaging		0,713	
the time needed to cool roasted coffee		0,677	
transport packaging types		0,671	
the chemical properties of unit packaging		0,630	
moisture management of roasted coffee			0,963
the cost of quality in manufacturing			0,963
the internal costs of raw coffee			0,929
milling method			0,644
correlation with the I-distance	0,530	0,506	0,480

The first assumption H1 implies that a systematic change of quality perceptions through the coffee supply chain does exist. The results show that there is indeed a difference in quality perceptions through the coffee supply chain between producers and distributors. Results showed that the correlation with the I-distance of Component 3 for the distributor is 0.679, that essentially proves that this component is the most important for the distributor. This component encompasses following set of quality characteristics: *coffee inventory turnover ratio (an inventory turnover ratio measures the number of units dispensed in relation to the average unit inventory, Sorooshian et al., 2013), producer satisfaction with the distributor's services*, and *customer satisfaction (retail) with the distributor's services.* The correlation with the I-distance for Component 1 for the producer is 0,53, demonstrating the most important component for the producer. This component encompasses *the coffee's country of origin, the date of manufacture and the expiry date, the storage cost of the final product, customs procedures and delays in procurement,* and *the temperature at which the coffee is roasted*. These results all lead to the conclusion that producers and distributors differently evaluate quality characteristics throughout the coffee supply chain. The second assumption H2 is in concordance with suggested framework. It emphasises critical components both for the producer and distributor in the coffee supply chain and within crucial quality characteristics (i.e. for distributor - *coffee inventory turnover ratio, etc.; the coffee's*

country of origin, etc. for producer). The results obtained within do confirm this hypothesis.

The *coffee inventory turnover ratio* characteristic is important to distributors due to the freshness. As the higher inventory turnover there is, the better the shelf life of the products tends to be, which should result in the customer receiving a fresher product. This same characteristic denotes distributor intensities for the sale and flow of the item, which bear a direct impact on sales margins (i.e. the earnings of distributors). A higher turnover ratio, together with desired inventory availability, demonstrates the effective use of resources for distribution of products throughout the supply chain (Bowersox, 2007). Inventories are often rotated during observation periods (for instance, by month or quarter). If the *coffee inventory turnover ratio* is greater, the organization automatically has less stock. A decrease in inventory accompanies a lower occupancy of storage, by that reducing the cost of the holding inventories of the product. In such cases, the free space in storage could be used for other items. This approach would be highly expressive for the sale and distribution of coffee due to the fact that it is a product that necessitates large dimensions (while the unit weight of coffee is light, the boxes in which coffee is packaged demand a large volume of space while stored in a warehouse). In addition, distributors can use the *coffee inventory turnover ratio* as a benchmark to compare the efficiency of their logistics processes with that of competitors. The producer's and user's (retail store) satisfaction with their services are also important for distributors, which could stem from the need for obtaining and maintaining an exclusive agreement for the distribution of coffee, or the opinions of producers and retail distributors in regard to the quality of service and its ability to deliver specific products (accuracy, speed, and precision in delivery).

Based on the data analysis, one of the essential characteristics for the producer is the *coffee's country of origin*. Since the quality of the final product depends on the quality of the raw materials, it is only natural that there would be an interest into where these materials originate. Also, caffeine content of coffee is determined by country of origin of coffee (McCusker *et al.*, 2003). It would appear that the coffee's country of origin is also important due to the price at which the coffee is purchased having a direct impact on the cost of the final product. In addition, the cost and time of delivering the goods depend on the distance of the raw materials from the producer, directly affecting price. The *date of manufacture and expiry date* are both especially important for traceability, arising from the necessity of customer complaints about the quality of coffee which needing to be tested from the end user to the producer, as well as from the quantity of inventory in storage and the management of these stocks. The storage cost of the final product assigns particular importance itself, as stocks of raw materials are made in the season of the production of green coffee and hence heavily influenced by production seasons. Within, the price of coffee varies on the market, commonly being purchased in large quantities when the price of raw coffee is lower, which is after that stored by the producer. The cost of storage for this reason has a direct impact on the final cost of the product and the producer's logistics processes. Customs procedures and delays are also important due to the availability of raw coffee for the producer. The temperature of the coffee itself directly affects the taste of coffee and the customers' perception of the brand of coffee. Finally, the temperature at which the coffee is roasted is a critical operation as the quality of the coffee depends most on this characteristic.

Conclusion

The results of this study prove to be useful in the analysis of coffee supply chains since they examine the most important quality components for both producers and distributors in such supply chains. The additional analysis has established that the most important component for distributors encompasses following quality characteristics: (1) *coffee inventory turnover ratio*, (2) *producer satisfaction with the distributor's services* and (3) *customer satisfaction (retail) with the distributor's services*, and those for producers have been found as: (1) *the coffee's country of origin*, (2) *the date of manufacture and expiry date*, (3) *the storage cost of the final product*, (4) *customs procedures and delays in procurement* and (5) *the temperature at which the coffee is roasted*. This implies that a systematic change of quality perceptions through the coffee supply chain does exist. The results show that there is indeed a difference in quality perceptions through the coffee supply chain between different participants, which advocates in favour of hypothesis H1. The results also imply that the most important components in the coffee supply chain for producer encompass crucial quality characteristics such as: *the coffee's country of origin, the date of manufacture and the expiry date,* etc. In addition, the same approach is used for distributors and several prominent quality characteristics have been singled out; thus confirming our hypothesis H2.

The results have shown that distributors recognize the need to take into account producers' and users' (retail stores) satisfaction with their services due to the benefits of maintaining a high level of user satisfaction. The subsequent recommendation would within be for distributors to monitor the satisfaction level of their users (producers and retail stores) in order to improve their service. The results could prove useful in improving the quality of the product (coffee) to the final consumer and enhance the quality of the supply chain. Based on the results obtained in the study, a system of KPI (Key Performance Indicators) could be formed, one in which indicators would be followed to improve the coffee supply chain. Recognition of the most important components of the supply chain according to customers and other stakeholders should lead to a better understanding of customer requirements. Future research should extend to the improvement of coffee packages (eco-cheaper packs), a KPI system for the supply chain management of coffee, customer satisfaction, and cost reduction in the distribution chain (reducing inventory and distribution costs).

Acknowledgement

We are grateful for reviewers' comments and suggestions that helped us reshape and improve our paper.

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The article has been reviewed.

Received in October, 2013; accepted in June, 2015.