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Effects of Knowledge Management on Supply Chain Management in the Clothing Sector: Turkish Case

Abstract

The clothing sector, which has a significant place in the Turkish economy due to its export potential, procurement of income and employment, is undergoing a restructuring process. True and effective management of the steps during this restructuring process is very important in terms of efficiency, productivity, speed and flexibility. Enterprises have to manage their supply chains and all of their flows effectively in order to be able to meet the desires and expectations of customers as well as to enrich their customer portfolio. At this point, knowledge management, which contributes to the effective usage of knowledge and knowledge flows, has been represented as a valuable parameter affecting the supply chain management of enterprises. The study aims to present the effects of knowledge management on supply chain management in the clothing sector. Data were obtained from a survey conducted in clothing enterprises that are listed as amongst the 500 biggest in Turkey. Then these data were evaluated by the analytic network process. According to the research results, effective knowledge management elements have positive effects on the performance of the clothing supply chain. Also knowledge creation is the most significant criterion for clothing enterprises.

Key words: clothing sector, supply chain management, knowledge management, analytic network process.

Introduction

The clothing sector, which has a significant place in the Turkish economy due to its export potential, procurement of income and employment, is going through a restructuring process. True and effective management of the steps during this restructuring process is very important in terms of efficiency, productivity, speed and flexibility.

Enterprises have to manage their supply chains and all of their flows effectively in order to be able to meet the desires and expectations of customers as well as to enrich their customer portfolio. The reason is that rivalry commonly occurs among the supply chains rather than between enterprises.

The clothing sector is characterised by short product life cycles, high variability, unpredictable and variable demand, many inventory items, low predictability, impulse buying, high product range, long and inelastic procurement processes and a complicated supply chain [14 - 16]. Therefore the sector can be defined in lean retailing terms, which indicates the agility of retailers against demands [16]. The rapid renewal of products and satisfying the needs (delivery times, accurate and exact orders) are the absolute requirements of lean retailers within the clothing industry [15]. In this environment, efficient supply chain management means the difference between success and failure [14].

The clothing supply chain is complicated [17, 15] due to its unpredictability and uncertainty. It is also characterised by temporary markets, short product life cycles and high product range [17]. The clothing supply chain, generally, is a relatively long chain which includes lots of members, which is why careful supply chain management is required so that the delivery time can be shortened and a quick response made [15]. Impressive and agile communication is an inseparable part of clothing supply chain management when the characteristic properties of clothing products and agile retailing activities are considered [16].

At this point, knowledge management, which contributes to the effective usage of knowledge and knowledge flows, has been represented as a valuable parameter affecting the supply chain management of clothing enterprises.

Although there are several studies in literature about the effects of information management on supply chain management, only a few concern the effects of knowledge management, which includes experiences and unwritten knowledge. Besides there are no studies about the effects of knowledge management on supply chain management in the clothing sector. Therefore the present investigation aims to contribute to the literature by determining the effects of knowledge management on supply chain management in the clothing sector.

In accordance with the study protocol, a survey was conducted within clothing enterprises listed amongst the 500 biggest industry enterprises in Turkey. The data obtained were evaluated by the analytic network process, which is a type of mathematical modelling. Evaluation with the analytic network process is usually made by specialists and bilateral comparison matrices are acquired during it. Within the scope of the research a different method was used, an evaluation made by the managers of the clothing enterprises, and new matrices were formed by the transfer of data acquired with an original method. Thus the significance of theoretical knowledge can be examined in terms of implementation.

Effects of knowledge management on supply chain management

Knowledge is the most important and critical factor of all sources that an enterprise manages for strategic supply chain management implementation [1]. Knowledge is a glue between the other supply chain groups which work together in order to maintain an integrated and coordinated supply chain. Therefore it is a significant performance factor of the supply chain. Knowledge should have some properties for making successful supply chain decisions [2]:

1. Knowledge should be accurate.

2. Knowledge should be accessible when it is needed. The knowledge obtained after it is needed becomes invalid.
3. Information should be in the manner that it is needed. Useless and invalid knowledge should be eliminated.
4. The cost of knowledge should be of an acceptable level.

It is clear that knowledge management, which is a knowledge intensive activity, is significantly active in supply chain management. Knowledge is considered as the source of rivalry advantage because it provides a share of business data in a controlled manner. Also it helps to maintain an integrated and coordinated supply chain. Knowledge is the foundation stone of managerial decisions [3]. Despite the fact that sharing knowledge is important, its effect on supply chain performance depends on which information is shared, when and how it is shared and with whom it is shared [4].

Knowledge share throughout the supply chain is a significant factor in today's global economy in terms of supply chain performance [5]. Knowledge also becomes the most important element for matching the supply and demand better

so that the supply chain performance can be improved [6]. Moreover knowledge share is used as an important integration element for optimising performance throughout the supply chain [7].

Data share within the groups of the supply chain would accelerate knowledge flow, increase the efficiency and productivity of the supply chain, as well as provide rapid access to necessary knowledge, a sensitive approach to customer needs and a quick answer to altered customer needs [4, 8, 9]. Thus knowledge share would gain a long term advantage in terms of rivalry for the organisation [4, 8 - 12]. Both the business and academic worlds agree that rivalry advantage can be obtained by efficient knowledge management [12].

Materials and methods

The research aimed to determine the effects of knowledge management since the importance of knowledge management on the clothing supply chain is becoming more and more significant. Thus the hypothesis of the research was defined as follows: "If used efficiently, knowledge management elements have

a positive effect on the performance of clothing supply chain management". The reason is that it is really hard to determine the effects of knowledge management on supply chain management objectively. In parallel, supply chain performance indicating efficient supply chain management is included in the hypothesis as measurable criteria. In accordance with this hypothesis, the main aim was to determine which element of knowledge management has the most prominent effect on supply chain performance.

In order to be able to test the hypothesis, a survey was initially conducted in clothing enterprises, and afterwards the results obtained were evaluated with mathematical modelling. The mathematical model was defined as an "ANP: Analytic Network Process".

After the specification of mathematical modelling, the model belonging to the present study was created (*Figure 1*) [13]. In this model, knowledge management elements compose the alternatives, whereas clothing supply chain performance elements comprise the main and inferior criteria. Alternatives, main and inferior criteria, the relationships be-

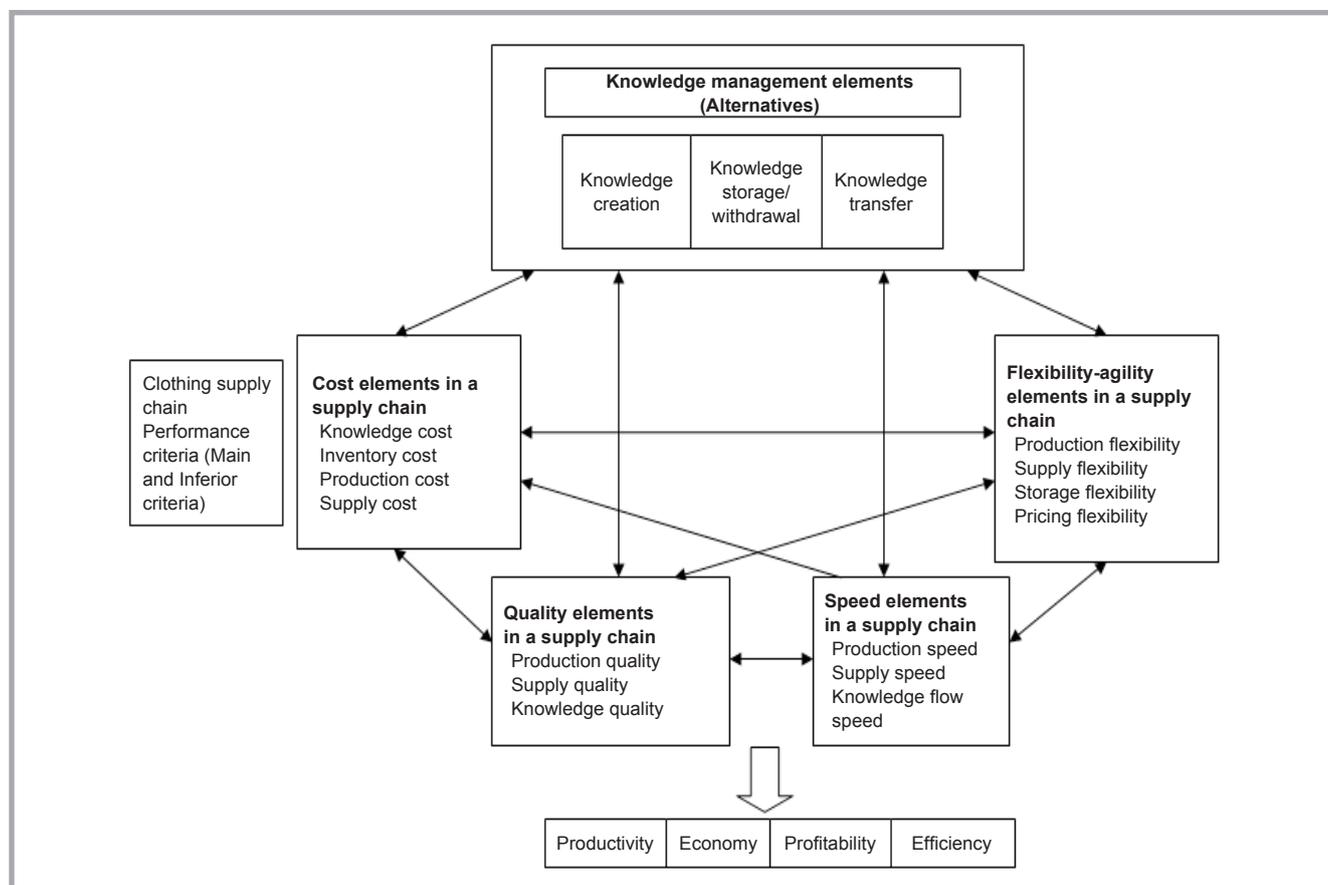


Figure 1. Model created within the context of research.

tween them and their directions were established from literature and discussion.

The elements of knowledge management compose the alternatives in the model. These elements are collected under three main titles, which are knowledge creation, knowledge storage and knowledge transfer. Knowledge creation elements are defined as transforming tacit knowledge to explicit knowledge, studying problems, creating and implementing solutions, solving problems systematically, learning from past experiences and filtering in a manner adopted by the organisation. Knowledge storage/withdrawal elements are as follows: specifying which knowledge is significant according to the organisation, the grouping and storing of knowledge, and deciding which is going to be used with whom. Knowledge transfer elements comprise knowledge share-exchange, knowledge exchange frequency, knowledge flows, knowledge transfer between individuals and knowledge transfer between supply chain partners.

The supply chain performance criteria are grouped under four main titles: cost, flexibility-agility, quality and speed elements in the supply chain. Besides this inferior criteria are determined for each main criterion. Cost elements in a supply chain are composed of the inferior criteria: knowledge, inventory, production and supply costs. Quality elements in a supply chain include production, supply and knowledge quality as inferior criteria. Speed elements in a supply chain are composed of inferior criteria: supply, production and knowledge flow speed. Flexibility-agility elements in a supply chain include production, supply, storage and pricing flexibility as inferior criteria. The outputs of this model are productivity, economy, profitability and efficiency.

A survey consisting of 69 main questions (300 inferior questions) was prepared taking into account the model and properties of the analytic network process. The questions refer to all of the relationships within the model. The options are whole numbers from 1 to 9, which also make up a scale that is used in the analytic network process. Thus the answers that are given to the survey can be evaluated with the analytic network process. An example question is given in **Table 1**:

Table 2 is the evaluation scale made up for the questions. All evaluations were made according to this scale.

In the analytic network process, the scaling process of the relationships between criteria is usually carried out by the specialists who answer the questions. Within the context of the research a different way was followed and questions directed to clothing enterprises. The scaling process was implemented by calculating the arithmetic mean of the answers of the enterprises. Thereby it could be observed whether the efficiency of theoretical knowledge can be protected or not in industrial implementations. Besides this a different method was used for the development of bilateral comparison matrices. That is, bilateral comparison matrices were not made by the enterprises and data acquired is transferred to the bilateral comparison matrices with an original method.

The clothing enterprises within the context of the research should be large-size, successful, competitive and leading enterprises which have their own production facilities and preferably their own trademarks. In order to be able to answer the survey questions correctly, these enterprises should possess efficient and successful supply chain management and knowledge management systems. Therefore the target population of the study was chosen as clothing enterprises that are listed amongst the 500 biggest industry enterprises in Turkey. There are 15 clothing enterprises within the 500 biggest industry enterprises, located in six different provinces.

The survey was conducted in the 15 enterprises by the face to face meeting technique. The people who answered the questions of the survey work as technical managers, deputy general managers responsible for supply chain management, purchasing managers, planning managers and production managers. Only one enterprise refused to take part in the survey due to corporate secrets.

The answers of all the enterprises are transferred to the bilateral comparison matrices with an original method (**Table 3**, see page 12). Let us assume that the manager who answers the survey indicates 5 for knowledge creation and 7 for knowledge storage. This shows that knowledge storage is 2 points more important than knowledge creation. In this case, option 3 located on the right side on the first line of the bilateral comparison table is marked. Whenever two criteria are equally important, option 1 is marked. The right side is chosen because knowledge storage is more important. If

Table 1. Example question.

How important are the below criteria for knowledge costs?									
Knowledge creation	1	2	3	4	5	6	7	8	9
Knowledge storage	1	2	3	4	5	6	7	8	9
Knowledge transfer	1	2	3	4	5	6	7	8	9

Table 2. Evaluation scale.

Significance level	Explanation
1	All criteria are equally important
2	Intermediate value
3	It is somewhat more important than the other criteria
4	Intermediate value
5	It is much more important than the other criteria
6	Intermediate value
7	It is very much more important than the other criteria
8	Intermediate value
9	It is absolutely more important than the other criteria

7 points are given to knowledge creation and 5 points to knowledge storage, option 3 located on the left side on the first line is marked.

The points given for the answer of each question are transferred to an excel file. During this transfer, the points located on the left side are written as 9, 8, 7, 6, 5, 4, 3, 2 and the points on the right side - $1/2$, $1/3$, $1/4$, $1/5$, $1/6$, $1/7$, $1/8$, $1/9$, because if criterion A is twice more important than the criterion B, criterion B is half more ($1/2$) important than criterion A. Option 1 written as 1 indicates equal importance. There are 14 different answers for each of the 300 questions. An arithmetic mean is taken for each question.

Packaged software is used to make the calculations and evaluations of the analytic network process. Primarily all alternatives and the main and inferior criteria in the model are put into the Super Decisions 1.6 programme, and after that all of the bilateral relationships are defined and the model loaded. In the second step the arithmetic means specified for each bilateral comparison are loaded into the programme. Afterwards unweighted, weighted and limit super matrices are obtained via the programme.

Findings of the research

The Super Decisions 1.6 programme yields **Table 4** (see page 12), which shows priority values of the criteria and

Table 3. Bilateral comparison matrices prepared in the context of analytic network process.

Knowledge creation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Knowledge storage
Knowledge creation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Knowledge transfer
Knowledge storage	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Knowledge transfer

Table 4. Priorities of criteria and alternatives.

Criteria and alternatives	Normalised by cluster	Limiting
Knowledge storage	0.28915	0.063713
Knowledge transfer	0.24392	0.053748
Knowledge creation	0.46693	0.102887
Storage flexibility	0.15421	0.030985
Pricing flexibility	0.20528	0.041246
Supply flexibility	0.30520	0.061324
Production flexibility	0.33531	0.067373
Knowledge flow speed	0.24914	0.042020
Supply speed	0.39826	0.067171
Production speed	0.35260	0.059469
Knowledge quality	0.29273	0.059538
Supply quality	0.31934	0.064951
Production quality	0.38793	0.078901
Knowledge cost	0.31729	0.065576
Inventory cost	0.18557	0.038353
Supply cost	0.25140	0.051957
Production cost	0.24574	0.050788

Table 5. Cluster matrix.

Component labels	Knowledge management elements (alternatives)	Flexibility elements in the supply chain	Speed elements in the supply chain	Quality elements in the supply chain	Cost elements in the supply chain
Knowledge management elements (alternatives)	0.000000	0.253922	0.285215	0.273127	0.317761
Flexibility elements in the supply chain	0.216610	0.000000	0.308812	0.223712	0.269085
Speed elements in the supply chain	0.271019	0.289851	0.000000	0.249285	0.000000
Quality elements in the supply chain	0.200420	0.205500	0.192990	0.000000	0.413154
Cost elements in the supply chain	0.311952	0.250728	0.212983	0.253876	0.000000

alternatives. Besides this the program yields a cluster matrix, which is demonstrated in **Table 5**.

When the last step is completed, the model and main hypothesis are confirmed. Efficiently used elements of knowledge management have positive effects on the performance of clothing supply chain management. Also the most significant criteria of knowledge and supply chain performance are designated for clothing enterprises.

According to the results, knowledge creation of the knowledge management elements has the most significant impact on supply chain performance (46.69%). The second most important criterion is knowledge storage (28.91%), whereas less importance is designated for knowledge transfer (24.39%).

According to the clothing enterprises, the most significant criterion of supply chain performance is the cost elements in the supply chain (31.19%). This criterion is followed by the speed elements (27.10%), flexibility elements (21.66%) and quality elements in the supply chain (20.04%), respectively.

Knowledge cost is the most important criterion of performance within cost elements in the supply chain (31.72%). This criterion is followed by supply costs (25.14%), production costs (24.57%) and inventory costs (18.55%), respectively.

Supply speed is the most important criterion of speed elements in the supply chain (39.82%). This criterion is followed by production speed (35.26%) and knowledge flow speed (24.91%), respectively.

Production flexibility is the most important criterion of flexibility elements in the supply chain (33.53%). This criterion is followed by supply flexibility (30.52%), pricing flexibility (20.52%) and storage flexibility (15.42%).

Production quality is the most important criterion of quality elements in a supply chain (38.79%). This criterion is followed by supply quality (31.93%) and knowledge quality (29.27%), respectively.

Conclusions and suggestions

Clothing enterprises should implement correct management strategies perfectly in order to stay alive and be competitive in markets where wild rivalry and aggressive commerce dominate. The supply chain is the most important management event for managers of clothing enterprises. Management of the supply chain has gained so much importance that rivalry occurs among supply chains rather than between enterprises.

The clothing supply chain has a variable and complicated construction. Chain members should be speedy and flexible so that the desires and expectations of customers should be met perfectly. The biggest desire of a customer is to get orders at the right time and the highest quality with the lowest price. Therefore supply chain management comes into the procurement of orders in the time required, with the highest quality and lowest price. Nevertheless knowledge management is needed for perfect or less faulty management of a variable and flexible supply chain.

Knowledge management would provide the most efficient and correct control of knowledge flows throughout the supply chain. When knowledge is considered as the key of every success, the importance of being an owner and efficient manager of knowledge becomes clear. If the knowledge required is at the right place at the right time, mistakes would be minimised throughout the supply chain. Therefore the performance of the supply chain would increase.

The hypothesis proposed in the paragraph above is proved by the results of the study. Elements of knowledge management efficiently used exert a positive impact on the performance of clothing supply chain management. The theoretic-

cal hypothesis is valid at implementation. The analysis of the survey points out that theoretically significant facts are also important in the implementation for managers of clothing enterprises [13].

According to the participating clothing enterprises, the most important element of knowledge management is knowledge creation. The enterprises taking part are aware of the situation that knowledge is the key of success. Apart from the creation of new knowledge, the information and experiences of qualified employees (who are the most valuable entities of the enterprises) should be clarified, written and kept. In other words it is very important to clarify and emit employee experiences, verbal rules and business methods of the enterprises. Thus employee experiences, verbal rules and business methods of the enterprises should be recorded and written to make these issues accessible and usable. The findings of the present study show that they give importance to this element and use it actively. Since it is impossible to hide non-existing knowledge, the creation of it is much more important than its storage and transfer.

The results of the present study indicate knowledge storage as the second important element of knowledge management. Nowadays most of the enterprises utilise information technologies for knowledge storage, maintenance and transfer. Managers provide suitable software for their enterprises so that the data required should be stored and transferred by these programmes. Besides this the knowledge is categorised during storage and decisions are made about which knowledge can be used. Not all members of the supply chain can reach all of the knowledge. Most of the time, the enterprises cannot categorise the knowledge correctly and are unable to transfer the knowledge required by people. Sometimes the knowledge that does not need to be transferred is done so, resulting in knowledge pollution. When the knowledge required cannot be transferred to the correct people, the processes flow wrongly and faults and disruptions emerge throughout the chain. Eventually the costs increase and the speed, flexibility and quality decrease throughout the chain. Therefore the knowledge required should be correctly and properly transferred to the right people. Knowledge hidden throughout the supply chain would reduce the success of all the chain and competitive power of all enterprises therein, instead of increasing

the competitive power of the enterprise in the chain. If unnecessary knowledge is transferred, rivals of the enterprise can gain strength and the competitive power of the enterprise can be impaired. Therefore enterprises should categorise the knowledge correctly and direct that required to the people who need it so that the supply chain is managed correctly.

According to the participating clothing enterprises, knowledge transfer is the third most important element of knowledge management. Clothing enterprises assign less importance to knowledge share or, in other words, exchange among supply chain members. Once knowledge is created, kept and correctly categorised, it can be easily transferred from one point to another. Problems occurring in knowledge transfer throughout the supply chain do not originate from ineffective transfer; they rather occur due to non-accessible knowledge. If the knowledge is accessible, its transfer becomes very easy and smooth due to improved technology.

Clothing enterprises should manage their supply chains efficiently and successfully in order to be successful in an environment of great rivalry. Efficient knowledge management is required for efficient supply chain management. Knowledge management increases the performance and success of supply chain management. Categorised, stored, correctly transferred and accessible knowledge minimises faults and disruptions throughout the supply chain. Briefly power is correctly managed knowledge which can be defined as possessed, correctly used, and correctly and speedily transferred knowledge. The correct and efficient utilisation of this power, in other words, efficient and successful knowledge management would provide a great advantage for successful supply chain management. Consequently clothing enterprises should assign the significance required to knowledge management while they manage their supply chain.

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