



Identifying and prioritizing contributing factors in supply chain competitiveness by using PLS-BWM techniques (case study: Payam shoes company)

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ABSTRACT

In the growing economy of Iran, supply chain competitiveness (SCC) is one of the strongest tools and best solutions to the problems faced by organizations in this competitive environment. The main aim of this research is to identify and prioritize contributing factors in supply chain competitiveness in the footwear industry. Data were collected from 82 employees, experts and managers of Payam shoes firm and examined the impact of four different factors including green supply chain management, supply chain partnership, sustainable approach to supplier segmentation and knowledge management process capability on supply chain competitiveness. To analyze the data and test the proposed model in the statistical phase of research, the partial least squares (PLS) method, and to prioritize contributing factors in supply chain competitiveness in the operational research phase of research, the BWM technique (one of the new techniques of multiple criteria decision making (MCDM) methods) was used. The salient features of the proposed method, compared to the existing MCDM methods, are: (1) requiring less comparison data; (2) leading to more consistent comparisons and more reliable results. The results of the statistical phase of research indicate that “supply chain partnership”, “knowledge management process capability”, “green supply chain management” and “sustainable approach in supplier selection and segmentation” have a significant positive effect on supply chain competitiveness. The results of prioritizing contributing factors in supply chain competitiveness by using BWM indicate that “supply chain partnership” is the most important factor in supply chain competitiveness and after that “knowledge management process capability” was located in second

priority. Finally some practical strategies for managers are discussed and some suggestions for future research are provided.

Keywords: supply chain; competitiveness; Footwear industry; PLS; BWM

1. INTRODUCTION

The visions of the Islamic Republic of Iran in 1404, with emphasis on providing the necessary fields to meet the competitiveness of goods and the country service in the local and foreign markets level and establishing appropriate mechanisms to get rid of oil single-product economy and development of non-oil exports, recalls the importance of competitiveness in economic development of Iran and with the emphasis on the attempt to achieve a diversified economy relying on the interests of knowledge and awareness, human capital and new technologies, evokes in the minds of administrators and statesmen the necessity of paying attention to knowledge management and its capabilities as one of the contributing factors in competitiveness. One of the other provisions of the visions of 1404 may be noted as the necessity of utilizing the political relations with the developed countries to economically institutionalize the increased attraction of resources and foreign investment and advanced technology, which could also be a reminder of the importance of partnership as a way for economic development of the industry field in the country because partnership causes each of the partners to achieve a kind of competitive advantage that none of them could achieve that alone, before. Research conducted by Wilson and Boyle (2006) outlined the countless benefits from the implementation of cooperation and partnership between organizations, such as savings in scale, access to specific resources, risk and cost sharing, learning and flexibility (Wilson & Boyle, 2006).

On the other hand, the influx of Chinese footwear towards the market of Iran is a threat which seems that, if not to have a serious measure to deal with this crisis, the productive operations of the factories active in the footwear industry of Iran will be shut down and stopped in a near future, just like Melli and Bella shoe company which went bankrupt in recent years, and their market share will also be awarded to Chinese producers.

The research that have already been conducted in the field of competitiveness each have examined limited criteria which, not only are different in different situations and in the view of different researchers but also, because they don't consider all levels of the supply chain, so they have never been carried out and implemented and have been stopped in the theoretical stage, still. Managers, also, are confused in relation to how and on what basis they should choose a method or a set of criteria consistent with their organization. So, to adopt a systemic approach that considers many aspects and areas of supply chain is strongly felt to be needed. Such an approach could establish a coordination between strategic goals and activities of the organization. So, the aim of the present study is to investigate the effect of the components of green supply chain management, supply chain partnership, suppliers' segmentation and knowledge management process capabilities on the competitiveness of the Iranian footwear industry and then ranking of each discussed component. In fact, the purpose of this paper is to answer the following research question:

“What are the contributing factors in supply chain competitiveness in footwear industry and how much is the importance of each of these factors?”

The data required in this study were collected in three steps. Meaning that, first, prioritizing contributing factors in supply chain competitiveness were extracted by a detailed and extensive review of the literature; then, using snowball sampling method, 25 people among the experts of the studied industry were surveyed in order to accommodate and specialize the extracted factors; then, in order to evaluate the effect of the identified factors in the previous step, according to the requirements of the Structural Equation Modeling method and also smallness of the statistical population the partial least squares (PLS) were applied and then, using the final weights obtained from the BWM technique along with the path coefficients obtained from the PLS technique, the contributing factors in supply chain competitiveness of the footwear industry were ranked.

The remainder of this paper is organized as follows. In section 2, we will have a review on the literature about competitiveness and the factors affecting it including: supply chain partnership, green supply chain management, supplier's segmentation and knowledge management process capabilities. In section 3, research methodology, statistical population and sample, and data collection approach will be stated. In section 4, we will analyze the data using two techniques including: PLS and BWM. The conclusions and suggestions for future research will be presented in Section 5.

2. THEORETICAL BACKGROUND

Competitiveness

Having the competitiveness capability is one of the characteristics of modern successful companies and yet, the distinctive characteristic of unsuccessful companies is the lack of this feature. Competitiveness capability, over all, arises from having new insights into it (Ambashta & Momaya, 2002). Since different definitions have been presented of competitiveness and the areas related to it such as resource-based view, market-based view, and the view based on the capability of creativity and innovation, economy and production, so, it seems unlikely to be a probability in which all the definitions in the managerial decision-makings are applied in order to achieve competitive advantage (Barney, Wright & Ketchen, 2001).

Competitiveness is a multidimensional concept that can be considered in different national, industrial and organizational levels (Momaya, 1998). The word “competitiveness” is derived from the Latin word “competitor” meaning “to compete in commercial markets”. This word is applied to express the economic capability of an entity against its competitors in the global markets where goods, services, people, skills and ideas are presented at the levels beyond geographical boundaries (Murths, 1998).

Akimova (2000) considers competitiveness as a multidimensional concept and believes that the organizations have to strengthen themselves in all aspects of competitiveness in order to develop the competitive capability (Akimova, 2000).

Approaches related to competitiveness

- Resource-based approach

The approach based on capability or resources, as one of the approaches related to competitiveness, emphasizes on the role of the internal factors of organizations and industries in their competitive capability (Bartlett & Ghoshal, 1989). The central principle of resource-based view is that the organizations are consisting of a set of resources that is of high importance in achieving competitive advantage and the features and characteristics of resources determine the way of advantageousness and its reliability extent (Ma, 1999).

- The approach based on the position of the firm in the market

Market-based approach is based on the principle that the firms must be customer-oriented or market-oriented, innovator and entrepreneur as well as tending highly to learn, in order to gain sustainable competitive advantage. According to this view, market orientation is considered as an important source to gain competitive advantage and even sustainable competitive advantage (Liu, Sandra & et al, 2003). The aim of this approach is to identify the needs and desires of the customers and then providing the goods and services to meet those needs and demands in a way better than the competing companies (Rezayee Dolatabadi, 1384).

- The approach based on creativity and innovation

The approach based on the capability of creativity and innovation includes the capability of research and development, capability of utilizing information technology and knowledge management (McGahan & Silverman, 2006). This view can be considered as a component of the resource-based view. Resources can be classified into two categories: tangible and intangible. In this classification, capability of creativity and innovation is considered as an intangible resource (Dess & Lumpkin, 2003).

This view is important for the footwear industry because the authorities and practitioners of footwear industry have their traditional view, yet, and focusing extensively on the input resources and not to use new information technologies such as: E-commerce, internet marketing and knowledge management have brought about a further decline in exports for this industry.

In the present study, competitiveness was investigated from the perspective of all three aforementioned approaches and based on the research of Mehrgan et al, (2008).

Supply Chain Partnership (SCP)

Today, in spite that many organizations are aware of the importance of using supply chain partnership but still, there is some ambiguities about how to optimize these partnerships to maximize the corporate performance results (Li & Lin, 2006). Partnership is one of the core concepts in SCM that always acts as a driving force in achieving effective SCM (Horvath, 2001). In general, the partnership is an inter-organizational relationship that leads to a vertical integration through conclusion of contracts between the main suppliers (Ellarm & Cooper, 1990). Several definitions about partnership are presented in Table 1, in accordance with the literature.

Table 1. Definitions of supply chain partnership.

Partnership definition	References
A relationship formed between two independent entities in supply channels to achieve specific objectives and benefits	Maloni and Benton (1997)
An interorganisational entity developed between two independent organisations in a vertical relationship within a supply chain	Mentzer, Min, and Zacharia (2000)
A tailored business relationship featuring mutual trust, openness, and shared risk and reward that yields strategic competitive advantage	Hagelaar and Van Der Vorst (2001)
A tailored business relationship based on mutual trust, openness, shared risk and shared rewards that results in business performance greater than would be achieved by the two firms working together in the absence of partnership	Lambert (2008)

From the definitions given in Table 1, it can be concluded that partnership refers to a kind of inter-organizational relationship that means something beyond inter-organizational cooperation. On the other hand, concerning the partnership areas is one of the issues important to be considered. In this research, the model proposed by Rezaei et al, (2014) has been applied to extract the areas of partnership in different parts of the supply chain and the impact of supply chain partnership in the areas of marketing and sales, logistics and purchasing, R&D, manufacturing and financial on the competitiveness of footwear industry has been analyzed and scrutinized (Rezaei, Ortt & Trott, 2014).

Green Supply Chain Management (GSCM)

Another item that has been very important today and is one of the conditions of entry to global markets and achieving appropriate and sustainable position in international markets or, the power of competitiveness, according to Shurchuloo (2002), is considering the requirements and principles of green supply chain management. Srivastva (2007) has defined green supply chain as: “consideration of environmental issues in supply chain management including product design, selection and sourcing of the materials, manufacturing and production process, delivering the final product to the customer and product management after consumption and passage of its shelf life” (Srivastva, 2007). Green supply chain management components used in the current study includes the components of green policy, the green transportation practices, green marketing, green partnership with suppliers, green partnership with partners and green partnership with the clients (Yang, et al, 2013).

Suppliers’ Selection and Segmentation (SS)

Suppliers are the other items that have a significant impact on an organization’s output quality. The good suppliers provide the organizations with basic condition for achieving a high quality output by delivering high quality inputs and thereby, influence on

competitiveness capability and the position of the firm in the market. Therefore, selecting a supplier has become as one of the strategic activities of the modern organizations. After supplier selection, we have suppliers' segmentation. Suppliers' segmentation is one of the strategic activities in any organization through which, the organization divides its suppliers into different groups on the basis of some criteria and each of them vary in the way of managing and handling (Rezaei & Ortt, 2012). Supplier segmentation impacts, to a large extent, on the speed and flexibility of the organization that is one of the main conditions of competitiveness and survival of any organization in today's ever changing markets. Therefore, in this paper, selection and segmentation of the suppliers has been examined as one of the factors affecting the competitiveness. Already, different approaches and criteria have been used by different researchers in order to selecting and segmenting the suppliers. The criteria used for selection and segmentation of the suppliers have been extracted from the research by Rezaei and Ortt (2012) with a sustainable development approach and were evaluated in the form of the questionnaire.

Capabilities of knowledge management (KM)

Since 1990s, knowledge management has been raised as a knowledge about organizational management with emphasis on technology applications and networking, but recently, the world's leading organizations have paid more attention to knowledge management and have focused on the continuation of effective knowledge management development processes in order to empower the users that includes increased organizational productivity and innovation (Carneiro, 2002; Cardinal, et al, 2001; Darroch & McNaughton, 2002; Pyka, 2002; Adams & Lamnt, 2003; Shani et al, 2003).

Correct and useful application knowledge increases the competitiveness power of the organization (Aujiraponpan, et al, 2010). The ability of knowledge management is the capability of knowledge creation and application through combining and integrating a variety of resources and activities to influence positively on the competitiveness, effectiveness of knowledge management and organizational effectiveness (Chuang, 2004).

Shaabani et al, (2012) have considered two types of functionality for knowledge management based on the studies of Gold et al, (2001). In their study, they have considered infrastructural capabilities of knowledge management with the technical, structural, cultural and humanitarian aspects and have emphasized on acquisition, conversion, implementation and maintenance for process capabilities of knowledge management (shaabani et al, 2012; Gold, et al, 2001).

- **Infrastructural capabilities**

Infrastructure is an organization that increases the efficiency of knowledge management activities in the organization. Knowledge management infrastructure capabilities include technical, structural, cultural and humanitarian capabilities (Beliveau et al, 2011).

- **Process capabilities**

This feature is related to the creation, sharing and using the knowledge resources in the areas of organizational performance. Process capabilities involve acquisition, conversion, implementation and maintenance of knowledge (Chang & Chuang, 2011).

In the present study, the aspects of knowledge management capabilities include acquisition, conversion, implementation and maintenance of knowledge that is extracted from the studies of Shaabani et al, (2012).

Experimental background

- Bhatnagar and Sohal (2005) conducted a study entitled with “competitiveness of supply chain: measuring the effect of plant location, uncertainty and manufacturing operations”. The results indicated significant and positive impact of the factors of plant location, uncertainty of supply chain and manufacturing operations on the competitiveness of supply chain (Bhatnagar & Sohal, 2005).
- Aghazadeh et al, (2007) conducted a study entitled with “investigating the factors affecting the competitiveness of firms in Iran”. First, by reviewing the literature, the firm’s competitiveness factors were identified, purified, integrated and completed. In total, 28 components including: 16 ingredients and 12 affecting components and 15 strategic and 13 operational components were the basis for setting questionnaire. According to the results obtained, the experts suggest that all components of firm competitiveness are approved in the business environment of Iran and most of them are of great importance and unpleasant situation.
- Mehrgan et al, (2008) conducted a study entitled with “designing a model for investigate competitiveness in the firm-level”. This study was performed in Iranian Petrochemical Company. Research data through a distributed questionnaire to 262 people, including faculty members familiar with the concept of competitiveness, researchers familiar with the field of competitiveness, managers, deputies and experts of Iran’s National Petrochemical Company, knowledgeable people in the field of petrochemicals and major clients of petrochemicals were collected. Then, a model was developed with three components of corporate input resources, firm’s position in the market and power of creativity and innovation. Then, using factor analysis technique and structural equation modeling, this model was confirmed eventually after modifications for several times. According to the results obtained from this study, it was found that the competitiveness power of Iran’s National Petrochemical Company is primarily dependent on resources.
- Hagh-Shenas Kashani and Saedi (2011) conducted a study entitled “ranking the factors affecting the country’s carpet industry competitiveness by Fuzzy TOPSIS”. They tried to rank the factors affecting the hand woven carpet industry competitiveness by an integrated model test and developing it as the final model of research. The components of the conceptual model of their research consisting of three main criteria (input sources, position in the market and capability of creativity) and 44 sub-criteria were prioritized by Fuzzy TOPSIS that among the main criteria, the market-based view was selected as the most important criterion. In other words, in the aforementioned research, an approach based on improving position in the international markets was recommended.
- Zand Hesami, Ashtiani-pur and Pur-Khalil (2014). Conducted a study entitled “Evaluation of the impact extent of knowledge management on promoting the competitiveness power of the small and medium sized organizations”. Based on the

findings of research, knowledge management aspects are effective in small and medium sized organizations' competitiveness and the criterion of "team learning and knowledge sharing" was identified as the most influential factor. Also, among the competitiveness aspects, "profitability" was identified as the most severely affected one.

According to the above-mentioned contents, focusing on a range of factors or a particular approach to produce an appropriate tool to measure competitiveness is the work done in the past. In current study, it was tried to develop a conceptual model and accordingly, develop an integration of the factors and approaches so that the factors affecting the competitiveness undertake almost all sections of supply chain.

In this regard, a systemic approach is used to produce the research conceptual model. Systemic approach is an approach taking all three parts of input, processing and output of a system into consideration, simultaneously (Mehrgan et al, 2008). After the systematic review of the literature (using Meta-analysis technique), extraction and specializing the research components, research proposed model and then, research aspects and components in diagram 1 and Table 2, respectively, has been provided.

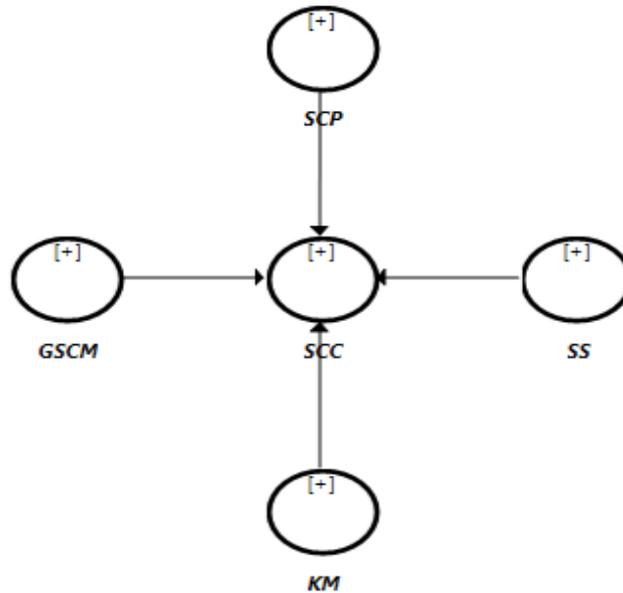


Diagram 1. Conceptual model of research constructs

Table 2. Main constructs of research and corresponding components.

Construct	Component	References	Construct	Component	References
GSCM	Green policies	Yang, et al (2013)	SCP	Partnership in Marketing & Sales	Rezaei, Ortt and Trott (2014)
	Green transportation practices			Partnership in Research & Development	

	Green marketing			Partnership in Logistics & Purchasing	
	Green participation with the suppliers			Partnership in Production	
	Green participation with the partners			Partnership in Finance	
	Green participation with customers			Knowledge acquisition	
SS	Economic	Rezaei and Ort (2012)	KMPC	Knowledge conversion	Shaabani, et. al, (2012)
	Social			Knowledge application	
	Environmental			Knowledge protection	
SCC ¹	Organization's internal resources	Mehrgan et al, (2008)			
	The firm's position in the market				
	Creativity and innovation capability				

3. RESEARCH METHODOLOGY

This study is based on subject is practical research and based on data collection method is descriptive-survey. It should be noted that, in order to form the initial model in this study, the components affecting the competitiveness were identified and extracted using meta-analysis of the literature of supply chain competitiveness and was then adapted to the studied industry (footwear industry) according to the view of the experts. As it was mentioned before, the key question in current research was developed as: “what are the Contributing factors in supply chain competitiveness in footwear industry and how much is the importance of each of these factors?” and research hypotheses were developed based on the research literature and were presented in Table 3. The variables were measured through a questionnaire with 134 questions with Likrate scale (5 points scale). The statistical population of this study is consisted of all managers and experts of the organization as well as all heads of Payam footwear company that have relative understanding of concepts and subject of the research.

¹. Supply chain competitiveness

According to the description provided and an interview with the CEO, the statistical population size was estimated at 90 people. In order to determine the sample size, considering Cochran formula with $t = 1.96$, $d = 0.05$, the minimum sample size was calculated equal to 79.63 people. In total, 90 questionnaires were distributed among statistics population and with the great efforts 82 questionnaires were gathered (return rate of 91.1%) and were used as the basis for subsequent analysis. To determine the content and face validity of the questionnaire, the comments of university professors and executives and the footwear industry experts familiar with the subject were used that considering the collected views, the questionnaire was confirmed to be valid. Also, the validity of questionnaire was evaluated by both convergent and divergent validity criteria that are specific to structural equation modeling. Then, in order to rank the factors identified in the previous stage, the collective view of 6 members among the experts was used to complete the matrix of paired comparisons. Also, in order to evaluate the reliability of the comparisons, consistency ratio were used and finally, consistency of all comparisons was confirmed after revision and replenishing some of the inconsistent matrixes.

Table 3. Research hypotheses

Hypotheses	References
Green supply chain management \longrightarrow Competitiveness	Yang, et al (2013)
Supply chain partnership \longrightarrow Competitiveness	Rezaei, et al (2014)
Supplier selection/ segmentation \longrightarrow Competitiveness	Rezaei and Ortt (2012)
Knowledge management process capability \longrightarrow Competitiveness	Zand Hesami, et al (2014)

4. DATA ANALYSIS

In this research, the structural equation modeling was applied to test the research hypotheses with the help of partial least square method and SmartPLS-Graph software version 3. PLS modeling is implemented in two stages. At first stage, the measurement model should be approved and evaluated through validity and reliability analysis and Confirmatory Factor Analysis (CFA) and at the second stage, the structural model should be evaluated through the route estimation between the variables and determining model's fitting indicators (Holland, 1999).

First stage: Measurement Model

The measurement model test is related to evaluating the validity and reliability of measurement tools.

Validity

To assess the convergent validity, the criteria of AVE (Average Variance Extracted) and CR (Composite Reliability) were applied and the results are shown in Table 4, for five main structure of the research. The composite reliability higher than 0.7 and average variance

higher than 0.5 are the two prerequisite for convergent validity and correlation of the structures (Lin & Huang, 2009). As is clear from Table 4, all composite reliability values are higher than 0.7 and values of the mean variance are higher than 0.5 and this entry confirms that convergent validity of current questionnaire is at an acceptable level.

Table 4. The results of AVE and CR of constructs (convergent validity)

Construct	Symbol	AVE	CR
Green supply chain management	GSCM	0.565	0.885
Knowledge management process capability	KMPC	0.528	0.817
Competitiveness	SCC	0.649	0.847
Supply chain partnership	SCP	0.561	0.864
Supplier selection/ segmentation	SS	0.621	0.831

At divergent validity section, the difference among indicators of construct is compared with indicators of other construct in the model. This is calculated through the comparison of AVE square root of each construct with the amount of correlation coefficient among the constructs. A matrix should be made for this which the amounts of the main diameter, is the matrix for square root of each construct and lower amounts for the main diameter, are the correlation coefficient amounts of each construct with another one. This matrix has been shown in Table 5, as it is clear from Table 5, the AVE square root of each construct has become higher than the correlation coefficient of the construct with other constructs which this is indicative of acceptability of divergent validity of the constructs.

Table 5. Comparison of The Matrix of AVE square root with construct’s correlation coefficients (divergent validity)

Constructs	GSCM	KMPC	SCC	SCP	SS
GSCM	0.752				
KMPC	0.544	0.727			
SCC	0.659	0.497	0.806		
SCP	0.687	0.508	0.677	0.749	
SS	0.305	0.290	0.362	0.305	0.788

Reliability

To evaluate the reliability of the questionnaire in addition to Cronbach’s Alpha Coefficient (Table 6), PLS Method has also been used. The index reliability is used in this

method (Revard and Huff, 1988). The index reliability is also measured through factor loads measurement and through the measurement of the correlation amount of a construct with that construct that if this amount equals or it becomes greater than 0.4(Holland, 1999), confirms this issue that the reliability regarding that measurement model is acceptable. As it is observed in Table 7, all values of factor loads between constructs and the questions more than 0.6 which shows high correlation.

Table 6. Cronbach’s Alpha Coefficient

Constructs	GSCM	KMPC	SCC	SCP	SS
Cronbach's alpha	0.845	0.708	0.729	0.804	0.703

Table 7. Factor load coefficients among constructs and corresponding indicators.

Constructs	Indicators	Factor load	Constructs	Indicators	Factor load
Competitiveness	SCC ₁	0.813	Supply chain partnership	SCP ₁	0.640
	SCC ₂	0.817		SCP ₂	0.715
	SCC ₃	0.786		SCP ₃	0.755
Green supply chain management	GSCM ₁	0.604		SCP ₄	0.812
	GSCM ₂	0.710		SCP ₅	0.808
	GSCM ₃	0.785	Supplier Selection/ Segmentation	SS ₁	0.765
	GSCM ₄	0.971		SS ₂	0.797
	GSCM ₅	0.832		SS ₃	0.802
	GSCM ₆	0.766	Knowledge management process capability	KM ₁	0.748
		KM ₂		0.715	
		KM ₃		0.739	
		KM ₄		0.705	

Second stage: Structural model and hypotheses test

The test of structural pattern is related to the research hypotheses test and the impact of latent variables on each other. Bootstrapping command of SmartPLS software is used to confirm the research hypotheses and the output shows t coefficients. The t values in the interval being greater than +1.96 and less than -1.96 indicate the significance of the

corresponding parameter at the 0.95 assurance level and being greater than +2.56 and less than -2.56 indicate the significance of the relevant parameter at the 0.99 assurance level supporting the research hypotheses, subsequently (Esposito-Vinz et al, 2010). In diagram 2, the results research main hypotheses has been shown. As it clear from the diagram 2, the t coefficient between supply chain partnership and competitiveness is equivalent to 4.262, and between green supply chain management and competitiveness is equivalent to 3.349 (greater than 2.56), indicating significance of the mentioned parameters and subsequently, accepting the corresponding hypotheses At the 0.99 assurance level. Also, the t coefficient between knowledge management process capabilities and competitiveness is equivalent to 2.135 and the t coefficient between supplier segmentation and competitiveness is equivalent to 2.393 (greater than 1.96) indicating the significance of the mentioned parameter and accepting the corresponding hypothesis at the confidence Level of 0.95, subsequently. The results of the proposed model test, path coefficients and t values of each path are outlined in table 8. As it clear from table 8, all research hypotheses are confirmed.

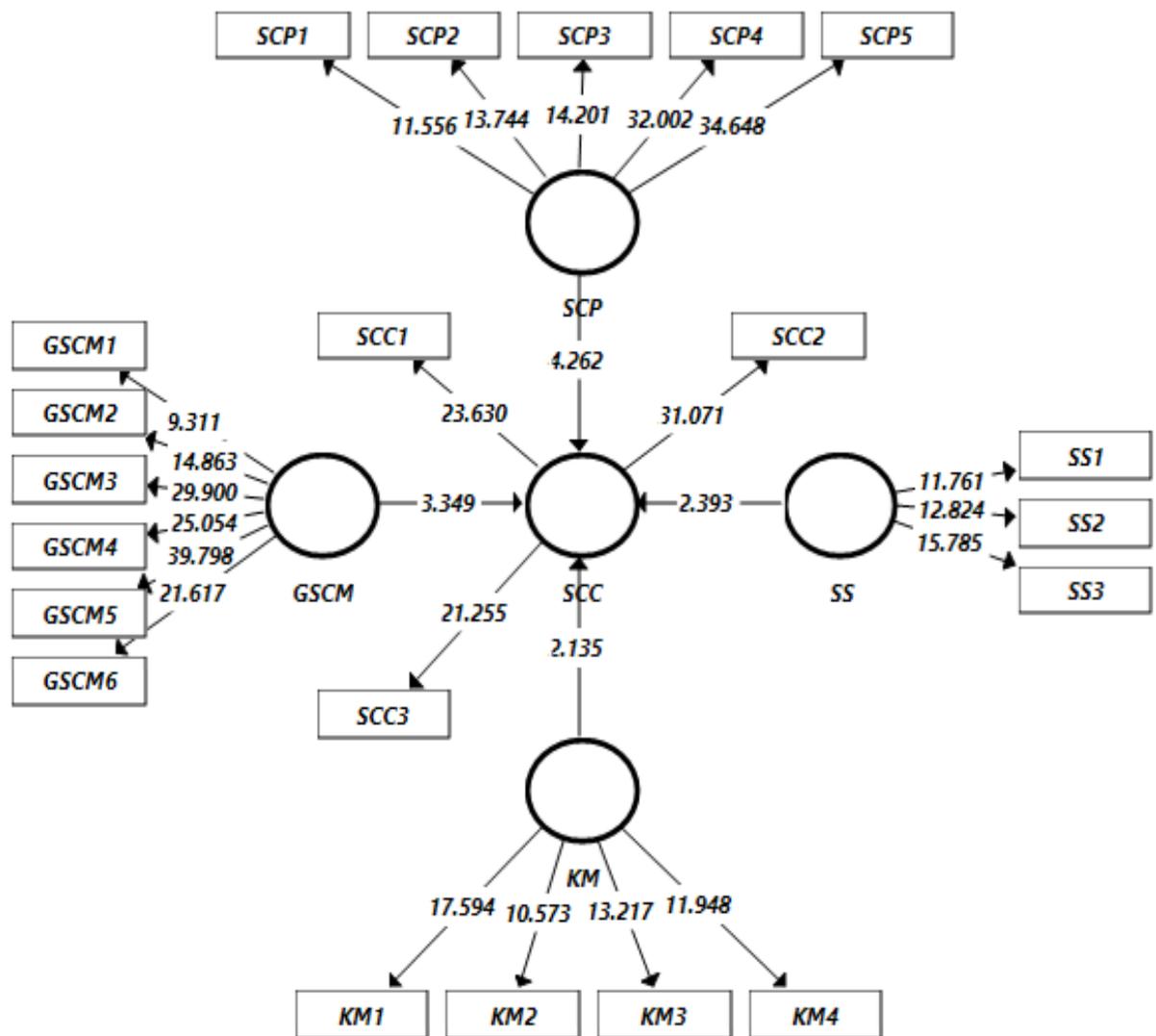


Diagram 2. Software output: Coefficient “t”

Table 8. Results of the research hypotheses test

Hypotheses	path coefficients	t values	Result
Green supply chain management \longrightarrow Competitiveness	0.259	3.349	Approved
Supply chain partnership \longrightarrow Competitiveness	0.365	4.262	Approved
Supplier selection/ segmentation \longrightarrow Competitiveness	0.134	2.393	Approved
Knowledge management process capability \longrightarrow Competitiveness	0.133	2.135	Approved

After the end of the statistical phase of research, it is turn to weighting the contributing factors in competitiveness using the BWM technique of the new techniques of Multi-Attribute Decision Making (MADM). However, before applying the BWM technique in order to ranking the parameters affecting the competitiveness, it is necessary to point out 3 groups of main inhibitors and problems derived from using the statistical tests in some special situations, including when: the conditions of using the parametric statistic techniques are not available, the data volume is very low or there is no appropriate hypothesis test to confirm the root causes.

Also, when the data volume or samples analyzed are not large enough, even if the population distribution or sampling distribution is normal the hypothesis tests provided in parametric and even non-parametric statistics space could not be used (Azar et al, 2007). However, the sample size in this research was only 82 people.

Due to the reasons stated based on inefficiency of statistical techniques in certain circumstances, it is obvious that the only way to authenticate and verify the contributing factors in competitiveness is using the experience, expertise and skills of people familiar, in many aspects, with the research issue and subject. In other words, regarding to the confirmation of the contributing factors in competitiveness and prioritizing these factors, multi-criteria decision-making techniques are very appropriate alternatives emphasizing on the knowledge of specialists.

On the other hand, due to the criticism on the multi-criteria decision-making techniques, as decision-making being based on the ideas and information of only a few experts in the organization (6 experts in this study), a hybrid approach has been adopted in current study and in order to a final prioritization of the contributing factors in competitiveness, the integration of path coefficients derived from PLS technique and the weights derived from BWM technique have been used. In the following, the BWM technique has been introduced and explaining its steps.

The proposed conceptual model relevant to the contributing factors in supply chain competitiveness in footwear industry is provided in Table 9.

Table 9. Conceptual model contributing factors in supply chain competitiveness

Main-criteria	Sub-criteria	References	Main-criteria	Sub-criteria	References
Green supply chain management	Green policies	Yang, et al (2013)	Supply chain partnership	Partnership in Marketing & Sales	Rezaei, Ortt and Trott (2014)
	Green transportation practices			Partnership in Research & Development	
	Green marketing			Partnership in Logistics & Purchasing	
	Green participation with the suppliers			Partnership in Production	
	Green participation with the partners			Partnership in Finance	
	Green participation with customers		Knowledge management process capability	Knowledge acquisition	Shaabani, et al(2012)
Supplier Selection/ Segmentation	Economic	Knowledge conversion			
	Social	Knowledge application			
	Environmental	Knowledge protection			

BWM technique

BWM technique was proposed by Rezaei (2015). This technique is one of the most efficient techniques of multi-criteria decision-making based on paired comparisons. The important issue in a variety of MCDM methods is how to calculate the weights. In most MCDM methods, the indices’ weights are calculated based on pairwise comparisons. Of disadvantages of the paired comparisons, firstly, lengthy calculations and secondly, increased inconsistency ratio of comparisons with the increased number of criteria could be pointed out. BWM technique, requiring less comparison data; (2) leading to more consistent comparisons and more reliable results than the other available techniques such as AHP (Rezaei, 2015).

Steps of BWM technique

Step 1. Determine a set of decision criteria: in this step, we determine a set of criteria that must be considered in decision-making. Criteria for this study are provided in Table 9.

Step 2. Determine the best (most important/desirable) and worst (least important/desirable) criteria: in this step, DM determines the most and least important criterion. Note that there is no comparison in this stage.

According to expert number 1, the most and least important criteria are selected as follows:

- The most important criteria: supply chain partnership (SCP)
- The least important criterion: supplier selection and segmentation with sustainable development approach (SS)

Step 3. Determine the preference of the best criterion over all the other criteria using a number between 1 and 9: the results derived from this comparison done by the expert 1 will be shown as Table 10. As it clear from Table 10, the preference rate of the most important criterion (supply chain partnership) is 5 times more than the first one ($\alpha_{\beta 1} = 5$), 9 times more than the third criteria (least important criteria) ($\alpha_{\beta 3} = 9$) and 2 times more than the fourth criteria ($\alpha_{\beta 4} = 2$).

Table 10. Pairwise comparisons (best criterion over all the other criteria)

Criteria	GSCM	SCP	SS	KM
Best criterion: SCP	5	1	9	2

Step 4. Determine the preference of all the criteria over the worst criterion using a number between 1 and 9: the results of this comparison will be shown as Table 11. As it clear from Table 11, the preference rate of the first criteria is 2 times more the least important one ($\alpha_{1\omega} = 2$), the preference rate of the second one, as the most important criteria, is 9 times more than the least important one ($\alpha_{2\omega} = 9$) and the preference rate of the fourth criteria is 6 times more than the least important one ($\alpha_{4\omega} = 6$).

Table 11. Pairwise comparisons (all the criteria over the worst criterion) - expert 1

Criteria	worst criterion: ss
GSCM	2
SCP	9
SS	1
KM	6

Step 5. Find the optimal weights ($w_1^*, w_2^*, \dots, w_n^*$): the weight of each criterion (w_j) and also the amount of ξ^* will be achieved by solving the following nonlinear programming model. As can be seen, placement of the paired comparisons' numbers (contained in Tables 10 and 11)

in equation 1 results in equation 2 and resolving this nonlinear programming model gives the ξ^* in addition to determine the final weights of research basic criteria.

<p>(1)</p> <p>$min \xi$</p> <p style="text-align: center;">s.t.</p> <p>$w_B/w_j - \alpha_{Bj} \leq \xi, \text{ for all } j$</p> <p>$w_j/w_w - \alpha_{jw} \leq \xi, \text{ for all } j$</p> <p>$\sum_{j=1}^n w_j = 1$</p>	<p>→</p> <p>(2)</p> <p>$min \xi$</p> <p style="text-align: center;">s.t.</p> <p>$w_2/w_1 - 5 \leq \xi$</p> <p>$w_2/w_3 - 9 \leq \xi$</p> <p>$w_2/w_4 - 2 \leq \xi$</p> <p>$w_1/w_3 - 2 \leq \xi$</p> <p>$w_4/w_3 - 6 \leq \xi$</p> <p>$w_1 + w_2 + w_3 + w_4 = 1$</p>	<p>Output</p> <p>$w_1^* = 0.098$</p> <p>$w_2^* = 0.527$</p> <p>$w_3^* = 0.056$</p> <p>$w_4^* = 0.319$</p> <p>$\xi^* = 0.347$</p>
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Clarifying the equation 1: w_B : weight of the most important criteria, w_w : weight of the least important criteria, w_j : the j -th criterion weight, α_{Bj} : the preference rate of the most important criterion rather than the j -th criterion, α_{jw} : the preference rate of the j -th criterion rather than the least important criterion

Consistency Ratio (CR)

In BWM technique, the Consistency Ratio is calculated using equation 3. That is, by replacing the ξ^* rate, calculated in the fifth step, in the numerator and extracting the inconsistency index Ratio from table 12 and putting it on the denominator, the consistency ratio will be calculated as follows:

Table 12. Consistency index (CI)

α_{BW}	1	2	3	4	5	6	7	8	9
Consistency index (max ξ)	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

$$CR = \frac{\xi^*}{CI} \tag{3}$$

$$CR = \frac{\xi^*}{CI} = \frac{0.347}{5.23} = 0.0663 \leq 0.1 \quad \longrightarrow \quad \boxed{\text{Consistent comparisons}}$$

As observed, the weights of all four main criteria of the research was calculated using BWM technique and according to the first expert. Then, using the data derived from completed questionnaires, the weight of other criteria and sub-criteria will be calculated by all six experts in the same way and through the five steps and finally, in order to integrate the six experts' comments, the arithmetic mean of weights calculated for each criteria will be used. It is worth to note that, due to the huge mass the calculations we don't represent the details and go straight to provide the final weights of criteria and sub-criteria after pooling the data derived from the experts' comments presented in the form of Tables 13 to 17.

Table 13. Average weights of main-criteria.

Main-criteria			
Criteria		W_j^{*M}	Average weight
Green supply chain management		W_1^{*M}	0.088
Supply chain partnership		W_2^{*M}	0.442
Supplier selection/ segmentation		W_3^{*M}	0.084
Knowledge management process capability		W_4^{*M}	0.386
	Total		1
	ζ^*		0.275
	CR		0.052

Table 14. Average weights of sub-criteria of green supply chain management.

Sub-criteria of green supply chain management			
Criteria		A_{jw}^G	Average weight
Green policies		A_{1w}^G	0.077
Green transportation practices		A_{2w}^G	0.075
Green marketing		A_{3w}^G	0.120
Green participation with the suppliers		A_{4w}^G	0.358
Green participation with the partners		A_{5w}^G	0.161
Green participation with customers		A_{6w}^G	0.209
	Total		1

	ξ^*		0.290
	CR		0.055

Table 15. Average weights of sub-criteria of sustainable approach to supplier selection/segmentation.

Sub-criteria of sustainable approach to supplier selection/segmentation			
Criteria		A_{jw}^S	Average weight
Economic		A_{1w}^S	0.591
Social		A_{2w}^S	0.408
Environmental		A_{3w}^S	0.001
	Total		1
	ξ^*		0.08
	CR		0.013

Table 16. Average weights of sub-criteria of supply chain partnership.

Sub-criteria of supply chain partnership			
Criteria		A_{jw}^P	Average weight
Partnership in Marketing & Sales		A_{1w}^P	0.126
Partnership in Research & Development		A_{2w}^P	0.288
Partnership in Logistics & Purchasing		A_{3w}^P	0.074
Partnership in Production		A_{4w}^P	0.117
Partnership in Finance		A_{5w}^P	0.395
	Total		1
	ξ^*		0.290
	CR		0.055

Table 17. Average weights of sub-criteria of Knowledge Management Process Capabilities

Sub-criteria of Knowledge Management Process Capabilities			
Criteria		A_{jw}^k	Average weight
Knowledge acquisition		A_{1w}^k	0.183
Knowledge conversion		A_{2w}^k	0.189
Knowledge application		A_{3w}^k	0.603
Knowledge protection		A_{4w}^k	0.025
	Total		1
	ξ^*		0.083
	CR		0.013

As the tables show, the Consistency Ratio (CR) of all comparisons is smaller than 0.1 and close to zero and this indicates the good consistency resulting a high reliability of the obtained results. With the completion of the five steps process relating to BWM technique, the process of weighting to the criteria will be ended. As mentioned before, in order to final prioritization of research criteria and sub-criteria, a composite approach has been used and by integrating the weights resulted from BWM and the path coefficients derived from PLS, the final score of the criteria and sub-criteria affecting the competitiveness of Payam footwear company were calculated by equation 4 and provided in Table 18. To calculate the final score of the main criteria, just the weight derived from BWM technique (W_i^{BWM}) should be multiplied by the path coefficient derived from PLS technique (P_i). Also, to calculate the score of the sub-criteria, just the final score calculated for the main criteria ($P_i * W_i^{BWM}$) should be multiplied by the weight of the corresponding sub-criteria (w_i^{BWM}), as follows:

$$S_i = P_i * W_i^{BWM} * w_i^{BWM} \tag{4}$$

Clarifying the equation 4: S_i : the final score of the criteria/sub-criteria, P_i : the path coefficient derived from PLS technique (for the main criteria), W_i^{BWM} : the main criteria weight derived from BWM technique, w_i^{BWM} : the sub-criteria weight derived from BWM technique.

As it clear from table 18, the “supply chain partnership” criteria, with a score of 0.161, was ranked in the first place, the “knowledge management process capabilities” criteria, with a score of 0.051, was located in second priority, the “green supply chain management”

criteria, with a score of 0.022, was located in third priority, and the “supplier selection and segmentation” criteria, with a score of 0.011, was located in last priority. Also, as it clear from table 19, among the sub-criteria, the first place was allocated to the “financial investment partnership” with a score of 0.06359.

Table 18. Final rank of main-criteria

Criteria	W_i^{BWM}	P_i	$P_i * W_i^{BWM}$	Rank
Green supply chain management	0.088	0.259	0.022	3
Supply chain partnership	0.442	0.365	0.161	1
Supplier selection/ segmentation	0.084	0.134	0.011	4
Knowledge management process capability	0.386	0.133	0.051	2

Table 19. Final rank of sub-criteria.

Sub-criteria	w_i^{BWM}	$P_i * W_i^{BWM} * w_i^{BWM}$	Rank
Green policies	0.077	0.00169	15
Green transportation practices	0.075	0.00165	16
Green marketing	0.120	0.00264	14
Green participation with the suppliers	0.358	0.00787	9
Green participation with the partners	0.161	0.00354	13
Green participation with customers	0.209	0.00459	11
Partnership in Marketing & Sales	0.126	0.02028	4
Partnership in Logistics & Purchasing	0.074	0.01119	6
Partnership in Finance	0.395	0.06359	1
Partnership in Production	0.117	0.01883	5
Partnership in Research & Development	0.288	0.04636	2
Economic	0.591	0.00650	10

Social	0.408	0.00440	12
Environmental	0.001	0.00001	18
Knowledge acquisition	0.183	0.00933	8
Knowledge conversion	0.189	0.00963	7
Knowledge application	0.603	0.03075	3
Knowledge protection	0.025	0.00127	17

5. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

In the present study, by recognizing the basic approaches in the field of competitiveness and by the effort of specializing the identified aspects of competitiveness and the factors affecting it in the studied organization, the results were reported in five main components and twenty-one indices including: the competitiveness component with three indices of the organization’s internal resources, the firm’s position in the market and creativity and innovation capability, the green supply chain management component with six indices of green policies, green transportation practices, green marketing, green participation with the suppliers, green participation with the partners and green participation with customers, the supply chain partnership component with five indices of partnership in marketing and sales, partnership in logistics and purchasing, partnership in financial investment, partnership in production and partnership in R&D, the suppliers selection/segmentation component with a sustainable development approach with three social, economic and environmental indices, and finally, the knowledge management process capabilities component with four indices of knowledge acquisition, knowledge conversion, knowledge application and protection of knowledge were reported. Also, in order to validate the relationships explained between the research’ variables and evaluate the causal relationship between the constructs and also evaluate the total effect of each constructs the structural equations modeling based on the variance and PLS technique was applied in addition to referring to the supporting literature. Finally, in order to rank the contributing factors in supply chain competitiveness in footwear industry, a composite approach was used and a new and very efficient technique called BWM was used in addition to the statistical approach based on structural equations modeling,

Given that competitiveness is a relatively novel issue, there is little understanding of competitiveness in modern organizations and the existing related literature does not help much to provide the Practical strategies in the field of competitiveness. As noted earlier, competitiveness power comes from having new insights into it, over anything (Ambashta & Momaya, 2002); In other words, every researcher may consider specific criteria and factors as affecting the competitiveness, depending on the research circumstances and the studied industry, which not only this is not problematic but also helps the development of the research literature in the field of competitiveness. This research helps to development of theoretical literature available about supply chain competitiveness and answering the question that “What are the contributing factors in supply chain competitiveness in footwear industry and how much is the importance of each of these factors?” helps the footwear industry managers as

well as other industries to have a maximum use of the results of this research and strengthen their position in global markets, considering the contributing factors in supply chain competitiveness. The results of this study showed that the “supply chain partnership” criterion with the highest score had the first position, the “knowledge management process capabilities” had the second and the “green supply chain management” and “suppliers’ selection and segmentation” had the third and fourth position, respectively. Also, among the sub-criteria, “partnership in financial investments” was selected as the most important sub-criterion.

Since, the present research was an indication of the ideal situation of footwear industry, not the status quo, given the “partnership in financial investment” and “partnership in R&D” in the first and second position, respectively, it can be found that the respondents consider financial resources’ increase as the most important and noteworthy factor affecting this industry competitiveness power development so that, in addition to providing the necessary financial resources, they can achieve the specialized knowledge and the global modern technology and strengthen their position in global markets by partnership in R&D through establishing partnership relations with the leading countries in this industry.

With the inclusion of “knowledge application” in third place, it can be acknowledged that this aspect of knowledge management can also increase the competitiveness in the footwear industry, somehow. Using the knowledge, experience and skills of the experienced craftsmen and expertise of the educated youth coupled with using the high quality raw materials in production leads to the development of various competitive aspects in footwear such as quality, standardization, beauty and durability.

On the other hand, because of the fourth position for “partnership in marketing and sales”, it can be acknowledged that the increase of knowledge in the field of marketing, advertising and internet marketing research to compete with the internet exporters will affect the development of the existing markets and penetrate into the new markets.

Paying attention to the “environmental” factor in suppliers’ selection and segmentation was ranked last. This can be interpreted as the point that, while the footwear industry is one of the industries with low pollution, the exact surveillances by the authorities on the environmental issues in recent years have greatly made the manufacturers and raw material suppliers to comply with the environmental standards and now, domestic manufacturers need the financial resources and knowledge increase through partnership in the financial fields and R&D and applying the knowledge, experience and skills of the experienced craftsmen and the expertise of the educated youth in order to increase their competitiveness power, rather than the need to improve the environmental factor. The major limitation of this study is using the questionnaire (subjective measure) for those variables that have an objective nature. Due to the lack of a comprehensive database and the managers’ sensitivity, the researchers could not access to real data. It is suggested for the future research to test the conceptual model of this research on the basis of the objective data for the indices that have an objective nature. In the present study, because of the limitations such as small sample size and etc. There was not the possibility to use the other methods and structural equation modeling soft-wares such as LISREL, Amos, etc.; it is suggested for the future studies to use the other structural equation modeling software such as LISREL and Amos, if the necessary conditions was available. Also, in the future research, the other multi-criteria decision making methods such as crisp or fuzzy AHP could be used for measuring the importance of each of the contributing factors in supply chain competitiveness in footwear industry.

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