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Developing a Model for Agile Pharmaceutical Distribution: Evidence from Iran

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ABSTRACT

Agility is the fundamental characteristic of a supply chain needed for survival in turbulent markets, where environmental forces create additional uncertainty resulting in higher risk in the supply chain management. Agility further helps providing the right product, at the right time to the consumer. As pharmaceutical distributors play a vital role in health continuum. The purpose of this research is developing a model for distributors companies to be agile according to determining basic factors. The present study analyzes the distribution part of pharmaceutical supply chain based on SCOR model, used to assess agile supply chains by highlighting their specific characteristics and applicability in distribution of products. In addition, for making priority of critical factors, TOPSIS algorithm as a common technique of MADM model has been used. In result, several factors are identified as critical factors to being agile in distributing. The paper adds insights into the pharmaceutical supply chain, examining this from multiple perspectives.
KEYWORDS: Agile distribution, Pharmaceutical industry, Supply chain, Iran.

INTRODUCTION

The global pharmaceutical industry stands at the center of the health of nations– rich and poor nations– alike. Drugs are often substitutes for other more costly means of treatment such as surgery. The innovation of new drugs and their rapid diffusion at affordable prices have been major driver's source of the phenomenal increase in longevity of the human race over the past 100 years (Rao, 2008). The pharmaceutical marketplace is facing major pressures from a broad range of dynamic and powerful forces (Holdford, 2005; Chen and Hung, 2009). Accordingly, government agencies and third party payers expect the provision of pharmaceutical products to be cost effective, keeping costs to a minimum, so strategic planning has become imperative for all organizations in the pharmaceutical distribution system (Birdwell, 1994).

In other side, in today's extremely competitive universal market, productive supply chain management (SCM) has a crucial role and is accepted as a key factor for organizational presentation and competitive advantage (Akyuz and Erkan, 2009; White and Mohdzain, 2009). The competitive environment needs that companies supply upward quality products and services, deliver quick service response and improve dynamic capabilities that are in tune with the growing changing business environment (Teece, 2009; Lee, 2011). In this unstable market, firms face aggressive competitive environment due to globalization, technological changes, shorter goods' life cycles, diminished margins, economic downsized markets and more informed and well-informed customers with unique and quickly changing needs. The focus of supply chain has changed from production efficiency to customer-driven and collaboration synchronization approaches which need a high degree of cooperation among all supply chain partners (Lou et al., 2005).These changing market situations forces organizations to alter the path their supply chains structured and handle in order to be more responsive to these changes. In order to response to the challenges and demands of today's business environment, firms have been undergoing a revolution in terms of implementing novel operations strategies and technologies (Gunasekaran *et al*., 2008).

Recent literature in supply chain has addressed this flow and proposes that the key factor to survive in these changing situations is through agility by formation of responsive supply chain (Christopher, 2000). In a continuously changing global competitive environment, an organization's supply chain agility directly affects its ability to produce and give products to its customers in a timely and cost efficient manner (Swafford *et al*., 2006a). As a part of organizational agility, supply chain agility represents the capacity of an organization's interior supply chain functions to present a strategic advantage by replying to marketplace uncertainty. Due to strategic worth, supply chain agility must be operationalized in a way so companies can manage their agility through their strategic decisions (Swafford, 2003).

The pharmaceutical distributors play a significant role in the medical and health system, so that they can shape a suitable bridge between retailers and pharmaceutical companies. Considering this intermediate role, they can easily transfer information between them. As result, continuous flow of drugs to patients at optimal price, with minimal delays and few shortages would be possible (HDMA, 2009). Finally, the purpose of this paper is to address this question:

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"In order to being agile in distribution of pharmaceutical products, which factors (providers) should be taken in to account by companies?"

To answer the question, this article benefits from the fuzzy TOPSIS to quantify critical factors. The remainder of the paper is organized as follows: Section 2 presents the literature on pharmaceutical supply chain and a review of agile supply chain. In Section 3 and 4 research methodology and data collections are developed. Section 5 presents the data analysis and results and ultimately, in section 6 and 7 conclusion, implementations and limitations are provided.

2. LITERATURE REVIEW

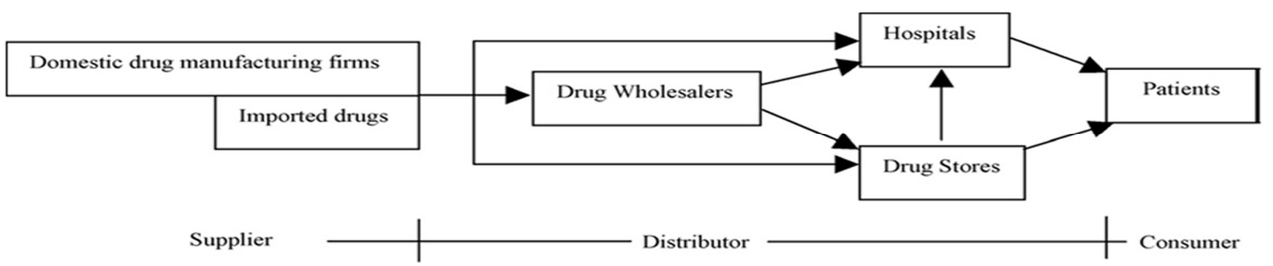
2.1 Pharmaceutical Supply Chain

The pharmaceutical industry is explained as a system of procedures, operations and organizations involved in the discovery, development and production of drugs and medications. The pharmaceutical supply chain (PSC) represents the path through which essential pharmaceutical products are distributed to the end-users at the right quality, at the right place and at the right time (Mehralian *et al*., 2012). The Pharmaceutical Supply Chain is very complicated and greatly responsible to ensure that the appropriate drug, reaches the right people at the right time and in the right situation to fight against sickness and sufferings. This is a highly sensitive supply chain that everything less than 100% customer service level is unacceptable as it directly influence the health and safety. The solution that a lot of Pharmaceutical industries adopt is to bear a vast inventory in the supply chain to ensure close to 100 percent fill rate. However, it is a great war to ensure 100 percent product availability at an optimum cost unless supply chain processes are streamlined towards customer requirements and demands (Chandrasekaran and Kumar, 2003).

The time to market, R & D productivity (Innovations), good's life cycle reduction, government regulations, decreasing exclusive patent life, production flexibility, and increasing cost are the main problems that pharmaceutical industries are facing today (Gurău *et al*., 2010). A manufacturer who can adjust improvement time by 19% can save up to $100 million. At the time of a drug getting delayed to access the market, firm may get rid of around $1 million a day, therefore the time to market is so important for pharmaceutical companies in order to gain market share (Chandrasekaran and Kumar, 2003). The pharmaceutical supply chain (PSC) like to other industries begins with the sourcing of active and inactive ingredients for approved products. Dosages are planned and packed into different configurations. Products moved along to company's warehouses, wholesale distributors, retail pharmacies, medicinal organizations (hospital pharmacy) and finally to end- users. The data flow and funds flow start from customer to producer through different channels (Chandrasekaran and Kumar, 2003).

A supply chain is the arrangement of organizations, their facilities, acts, and activities; that are involved in manufacturing and giving a product or service. A typical pharmaceutical supply chain consists of the following members: initially manufacturing, secondary producing, market warehouse/distribution centers, wholesalers, retails/hospitals and patients (Shah, 2004). Previously, under a centrally organized economy, the whole pharmaceutical products were distributed by an owned monopoly firm (first-tier wholesaler) to some regional wholesalers (second-tier wholesalers) who would then deliver the products to local wholesalers (third-tier wholesalers) (Shao, 2006). Among pharmaceutical supply chain components, it has been argued that delivery of medicines has substantial effect on customers' satisfaction (Rossetti *et al*., 2011). Furthermore, because of the changing economic system; pharmaceutical supply chain has been reformed. Drugs play an important role in the delivery of health care. Generally, a large number of prescriptions are dispensed annually, and the drugs flow through a supply chain that includes the manufacturers, wholesalers, and pharmacies according to Figure 1.

Figure 1. Pharmaceutical supply chain.



Source: Mehralian *et al.* (2012)

Wholesalers play a key role in the distribution of pharmaceuticals as over 80 percent of the prescription drugs currently flow through wholesalers in the USA (HDMA, 2009). Some recent trends in the pharmaceutical supply chain, such as consolidation, mail-

order business, and third party logistics, have put additional competitive pressure on the already low-margin pharmaceutical wholesaling business (Jambulingam *et al*., 2009). However, most of the developing countries have unique characteristics like lack of education and democracy, instability, corruption, shortage of skilled labor force and raw materials, under utilization of available production capacity, the inferiority and lack of quality standards, low purchasing power of customers, inadequate consumers know how, lack of balance between import and export, foreign exchange constraints, incomplete infrastructure, etc. (Curry and Kadasah, 2002). Understanding these characteristics, by definition, justifies the reasons why a pharmaceutical distribution sector is so important, and also wholesaling should play a special role in the development of these markets. Samli and El-Ansary (2007) argue that wholesaling accelerates economic growth. Table I, illustrates six key characteristics of underdeveloped country's markets and the role of wholesaling in performing functions necessary to bridge demand and supply gaps in these markets.

Developing country market features	**Role of the wholesaler**
1. Small markets with limited income	Wholesalers can make money by selling products to retailers at low prices
2. Scattered markets throughout the countryside	By selling multiple products wholesaler justifies reaching out to these markets
3. Consumers can buy very limited volume of many different products	Wholesalers by definition handle larger variety of products than manufacturers
4. Because of the scattered populations, retailing is also scattered	Wholesalers, again, can reach out whereas manufacturers cannot
5. Manufacturers prefer to concentrate on production	Wholesalers develop marketing skills and support manufacturers
6. Scattered small-scale manufacturing	Wholesalers can bring together the critical product combinations for retailers

Table 1**.** The role of wholesalers in developing countries.

Source**:** Samli and El-Ansary (2007).

2.2 The agile supply chain

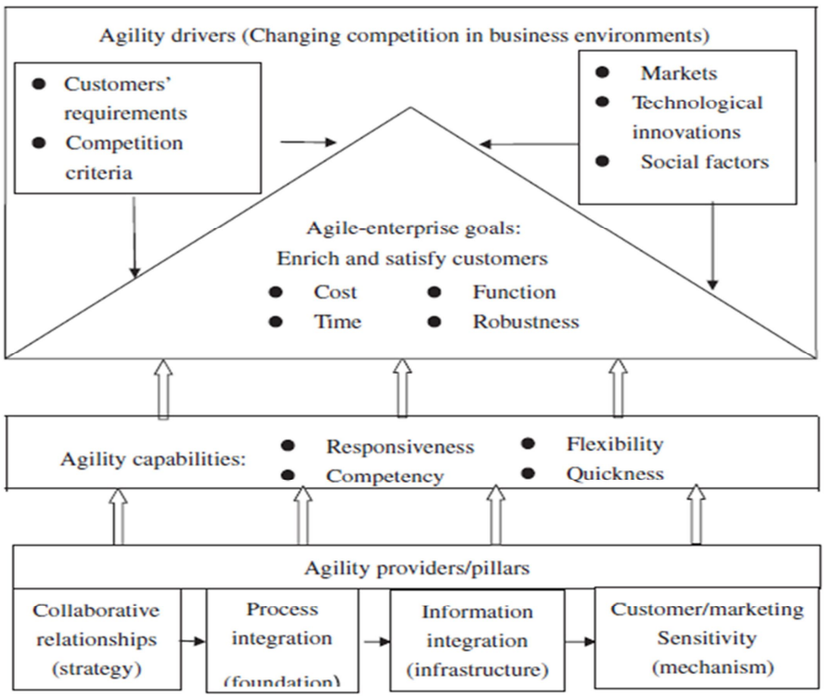
Supply chain agility has been receiving very consideration recently as a way for organizations to reply in a quick manner to changing business environment and improve their customer services level. In order to comprehend this concept, it is important to first establish the definition of the agile companies.

Agility has been proposed as a reply to the high levels of intricacy and uncertainty in advanced markets (Christopher and Juttner, 2000). According to Naylor et al. (1999), "agility means applying market knowledge and a vital corporation to exploit profitable opportunities in a rapidly changing market place". The relation between agility and flexibility is extensively discussed in the literature (Christopher, 2000; Swafford *et al*., 2006a). It has been proposed the origins of agility lie in flexible manufacturing systems (Gosling *et al*., 2010).

The target of an agile company is to enrich/satisfy clients and employees. A company basically possesses a set of capabilities for making appropriate replies to changes occurring in its business environment. Anyway, the business situations in which a lot of companies understand themselves are characterized by volatile and unpredictable demand. So, an increased insistence exists for pursuing agility. Agility might, hence, be defined as the ability of a firm to reply rapidly to changes in the market and customer demands. To be really agile, a firm should control a number of differentiating agility-providers. Therefore, these firms need a number of distinguishing attributes to promptly deal with the changes inside their environment. Such attributes include four main elements (Sharp *et al*., 1999): responsiveness, competency, flexibility/adaptability and quickness/ speed. The base for agility is the joining of information technologies, staff, business process organization, innovation and facilities into main competitive attributes.

The embracing of agile strategies has some benefits for firms, including quick and efficient reaction to changing market requests; the ability to customize products and services delivered to customers, the capability to manufacture and deliver new products in a cost-efficient mode (Swafford et al., 2006a), decreased producing costs, enhanced customer satisfaction, removal of non-value-added activities and increased competitiveness. Therefore, agility has been advocated as the commerce paradigm of the 21st century and in addition agility is considered the winning strategy for becoming a universal leader in an increasingly competitive market of quickly changing customers' requirements (Agarwal *et al*., 2006; Ismail *et al*., 2007). Tseng *et al.* (2011) have developed an agile enterprise conceptual model, as shown in Figure 2.

Figure 2**.** Components of an agile supply chain.



Source: Tseng *et al.* (2011).

2.3 Capabilities of agility

Agile enterprises require a number of distinguishing capabilities or ‘‘fitness’’ to deal with the change, uncertainty and unpredictability within their business environment. These capabilities consist of four principle elements (Giachetti *et al*., 2003): (1) responsiveness which is the ability to identify changes and respond quickly to them, reactively or proactively, and recover from them; (2) competency which is the ability to efficiently and effectively reach firm’s aims and goals; (3) flexibility/adaptability which is the ability to process different processes and achieve different goals with the same facilities; and (4) quickness/speed which is the ability to carry out activity in the shortest possible time. Furthermore, underpinning these fours principles is a methodology to integrate them into a coordinated, interdependent system, and to translate them into strategic competitive capabilities (Sharp *et al*., 1999). These principles must be taken into account if an organization is to carry out an agile firm (Tseng *et al*., 2011).

2.4 **Agility providers**

Achieving agility needs responsiveness in strategies, technologies, personnel, business processes and facilities. Agility **providers** should manifest agile features as well as make them available and determine the agility capabilities and behavior of a firm. In order to identify agility-providers, several studies have been conducted from which organization managers can select dimensions appropriate to their own strategies, organizational business processes and information systems (Tseng *et al*., 2011; Swafford *et al*., 2008; Sherehiy *et al*., 2007; Swafford *et al*., 2006b; Yusuf et al., 1999; Sharifi and Zhang, 1999) . For instance, according to Sharifi and Zhang (1999), agility providers can be derived from four manufacturing areas: organization, technology, people, and innovation. Furthermore, Yusuf et al. (1999) addressed a set of thirty-two agility-providers categorized into four dimensions: (1) core competency management, (2) virtual enterprise, (3) capability for reconfiguration, and (4) knowledge- driven firms. These characteristics, representing most perspectives of agility, determine the entire behavior of a firm. According to Sherehiy *et al*. (2007), in a review of firm’s agility, seven main components comprising thirty-five attributes were recognized as the critical features of an agile firm: (1) flexibility and adaptability, (2) responsiveness, (3) speed, (4) integration and low complexity, (5) mobilization of core competences, (6) high quality and customized products, and (7) culture of change. From this review we can conclude that different researchers present various insights into different aspects of agility providers. It is likely that there is no single set of agility providers manifesting all aspects.

2.5 Fuzzy TOPSIS

TOPSIS (technique for order preference by similarity to ideal solution) technique of solving the multi-criteria decision choosing tasks that implies full and complete information on criteria, expressed in numerical form. The method is very useful for solving of real problems; it provides us with the optimal solution or the alternative's ranking. In addition to this, it is not so complicated for the managers as some other methods which demand additional knowledge. TOPSIS technique would search among the given alternatives and find the one that would be closest to the ideal solution but farthest from the anti-ideal solution at the same time. Modification of the method aims to set a different manner of determining the ideal and anti-ideal point – through standardization of linguistic attributes' quantification and introduction of fuzzy numbers in description of the attributes for the criteria expresses by linguistic variables (Karimi *et al.*, 2011).

3. RESEARCH METHODOLOGY

In this section we provided a methodology for operationalizing the variables and factors, acquiring the data and determining the reliability of factor grouping. The data used in this study gathered from questionnaires distributed to managers involved in pharmaceutical companies. The pharmaceutical industry is chosen because it has a heavy and complete supply chain from sourcing to deliver, so such firms have tried to improve their supply chain performance due to increasing concerns and importance of drug supply issues in the society. As mentioned earlier, there is no single set of agility providers manifesting all aspects, inevitably based on industry-specific characteristics, related agility providers can be proposed. Accordingly, the questionnaire in this study was designed based on the ten critical factors listed in Table I adopted from previous studies (Tseng *et al*., 2011; Swafford *et al*., 2008; Qureshi *et al*., 2008; Baker, 2008; Agarwal *et al*., 2007; Sherehiy *et al*. 2007; Yusuf *et al*., 1999) with 30 questions measuring attitude: the chosen response can be strongly disagree, disagree, no opinion, agree, or strongly agree. In addition to the above questions, information related to the basic profile of the participants was requested at the end of the questionnaire. The main sampling targets were senior managers, department's managers and personnel who involved in decision making process.

3.1 Research model

Based on previous studies, our research model is presented in Figure 3. The key dependent variable of interest is agility in distributing that is expected to be influenced by some independence variables. These variables connected to their sub factors which shown in Table 2, and as a result agility can improve responsiveness, quickness, flexibility and competency of distributers.

Figure 3. Research model.

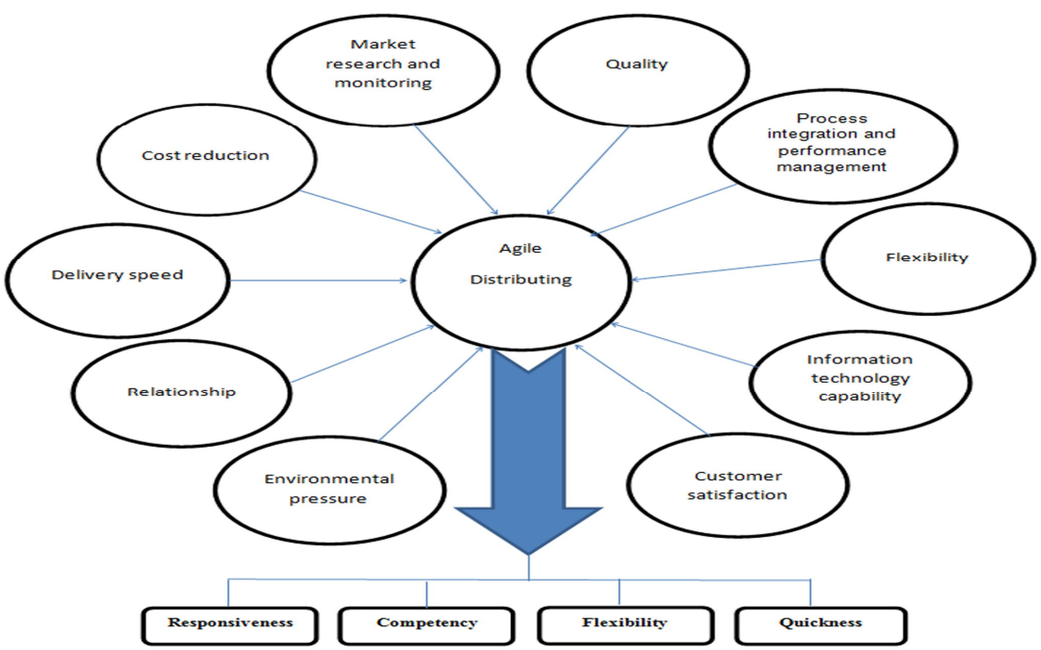


Table 2. Agility providers in distributor companies.

Factors	Factor dimension	Citations
Information technology capability	• Utilizing of IT for Information sharing • RFID (Radio frequency identification) • Utilizing of IT for distribution	(Tseng et al., 2011; Swafford et al., 2008; Qureshi et al., 2008)
Flexibility	• Flexibility in warehouses space • Utilizing of flexible equipments • Skilled employee • Flexibility in operation and delivery	(Tseng et al., 2011; Swafford et al., 2008; Qureshi et al., 2008;Baker,2008; Agarwal et al., 2007)
Process integration and performance management	• Co-managed inventory • Just in time • Process integration	(Agarwal et al., 2007; Tseng et al., 2011)
Quality	• Quality of service • Management Quality	(Qureshi et al., 2008; Lin et al., 2006; Antonio et al., 2007)
Market research and monitoring	• Sale feedback • Customer orientation • Forecasting crisis capacity	(Agarwal et al., 2007; Tseng et al., 2011; Qureshi et al., 2008)
Optimum cost	• Inventory cost • Transportation and delivery cost • Penalty cost	(Agarwal et al., 2007; Tseng et al., 2011; Qureshi et al., 2008; Patil, 2006)
Customer satisfaction	• Product reliability • Customer complaints	(Yeung, 2008; Agarwal et al., 2007;) (Antonio et al., 2007; Agarwal et al., 2007; Tseng et al., 2011 Swafford et al., 2008; Qureshi et al., 2008)
Delivery speed	• Delivery speed • Reliability delivery • reduced production lead time	
Relationship	• Geographical distribution range • Reputation • long-term relationship	(Qureshi et al., 2008)
Environmental pressure	• Political factor • Economic factors • Social factors	(Sharifi et al., 1999; Tseng et al., 2011)

3.2 Reliability and Validity of the questionnaire

The validity of a measure refers to the extent to which it measures what is intended to be measured. Face validity is not evaluated numerically, it is subjectively judged by the researchers (Kaplan, 1987). It can be argued that because the measurement items were based on an extensive review of the literatures on various SCM approaches. To gauge the acceptance of the questionnaire, 10 people who qualified in field of SCM, participated in a pilot test. The participants suggested adding and omitting some parts of questionnaire. Finally, all the pretest participants expressed strong agreement with the suitability of the questionnaire. Besides the face validity, using principal components method for extraction, factors with eigenvalues greater than 1 were retained. The Factor analysis (i.e. Pearson's principal component analysis) was tested with and without rotation (i.e. Varimax rotation with Kaiser normalization). The

conservative factor loadings of greater than 0.4 were considered at 95% level of confidence (Hair *et al*., 1998). The internal consistency of a set of measurement items refers to the degree to which items in the set are homogeneous. Internal consistency can be estimated using reliability coefficient such as cronbach's alpha (Saraph *et al*., 1989). In this research, it was calculated 0.89. The questionnaire was considered finalized after modifying the some questions, then ready to be delivered.

4. Data collection

Data for this study has been gathered using questionnaire that was distributed to 31 pharmaceutical distribution firms which affiliated to tree large holding companies. In order to understand the deep viewpoints from key sectors related to agile distributing, we choose respondents from managers who had comprehensive knowledge about company's process, products and general pharmaceutical related issues. The number of questionnaires sent out was 240; the number returned was 138, a return rate 56 percent. Except 3 of them, remaining of the returned questionnaires was complete.

5. Data analysis and results

Data analysis has been done by statistical analysis and also Multiple Attribute Decision Making (MADM) algorithm. In statistical analysis we have used t- student tests (one sample t- test), Pearson correlation and for MADM algorithm we applied fuzzy TOPSIS technique. In this section we used fuzzy TOPSIS technique in order to prioritize agility factors. There are many applications of fuzzy TOPSIS in the literature. Chen *et al.* (2006) presented a fuzzy TOPSIS approach to deal with the supplier selection problem in a supply chain system. Yang and Hung (2007) used fuzzy TOPSIS methods for a plant layout design problem (Karimi *et al*., 2011). The TOPSIS method was firstly proposed by Hwang and Yoon in 1981. The basic concept of this method is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from a negative ideal solution. A positive ideal solution is a solution that maximizes the benefit criteria and minimizes cost criteria (Karimi *et al*., 2011); whereas, a negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. In the classical TOPSIS method, the weights of the criteria and the ratings of alternatives are known precisely and crisp values are used in the evaluation process. However, under many conditions crisp data are inadequate to model real-life decision problems. Therefore, the fuzzy TOPSIS method is proposed, in which the weights of criteria and ratings of alternatives are evaluated by linguistic variables represented by fuzzy numbers to deal with the deficiency in the traditional TOPSIS (Ertugul and KarakaşoGlu, 2008).

This paper presents an extension of the TOPSIS method proposed by Chen *et al*. (2006). The related algorithm can be described as follows (Chen *et al*., 2006).

Step 1: A committee of the decision-makers is formed. Fuzzy rating of each decision maker. $D_k = (k = 1,2,...,k)$ can be represented as triangular fuzzy number $\tilde{R}_k = (k = 1,2,...,;)$ with membership function $\mu_{\tilde{R}_k}(x)$

Step 2: Criteria evaluation is determined.

Step 3: After that, appropriate linguistic variables are chosen for evaluating criteria and alternatives.

Step 4: Then the weight of criteria are aggregated. The aggregated fuzzy rating can be determined by:

$$\tilde{R} = (a,b,c), k = 1,2,...,k.$$

$$\text{where, } a = \min\{a_k\}, b = \frac{1}{k}\sum_{k=1}^{k} b_k, c = \max\{c_k\} \qquad (1)$$

$$a_{ij} = \min_k\{a_{ijk}\}, b_{ij} = \frac{1}{k}\sum_{k=1}^{k} b_{ijk}, c_{ij} = \max_k\{c_{ijk}\} \qquad (2)$$

Then, the aggregated fuzzy weight ($\tilde{w}_{ij}$) of each criterion are calculated by:

$$(\tilde{w}_{ij}) = (w_{j1}, w_{j2}, w_{j3}) \qquad (3)$$

$$w_{j1} = \min_k\{w_{ik1}\}, w_{j2} = \frac{1}{k}\sum_{k=1}^{k} w_{jk2}, w_{j3} = \max_k\{w_{jk3}\} \qquad (4)$$

Where

Step 5: Then the fuzzy decision matrix is constructed.
Step 6: The above matrix is normalized.
Step 7: Considering the different weight of each criterion, the weighted normalized decision matrix is computed by multiplying the importance weights of evaluation criteria and the values in the normalized fuzzy decision matrix.
Step 8: the fuzzy positive ideal solution (FPIS, A*) and fuzzy negative ideal solution (FNIS, A*) are determined by:

$$A^{*} = (\tilde{V}_1^{*}, \tilde{V}_2^{*}, ..., \tilde{V}n^{*}), \quad (5)$$

$$A^{-} = (\tilde{V}_1^{-}, \tilde{V}_2^{-}, ..., \tilde{V}_n^{-}) \quad (6)$$

$$\tilde{V}_j^{*} = \max_i \{V_{ij3}\} \text{ and } \tilde{V}_j^{-} = \min_i \{V_{ij1}\}$$

Where,

$$i = 1,2,...,m; \quad j = 1,2,...,n$$

Step 9: Then, the distance of each alternative from FPIS and FNIS are calculated by:

$$d_i^{*} = \sum_{j=1}^{n} d_v(\tilde{V}_{ij}, \tilde{V}_j^{*}) \quad i = 1,2,..., m \quad (7)$$

$$d_i^{-} = \sum_{j=1}^{n} d_v(\tilde{V}_{ij}, \tilde{V}_j^{-}) \quad i = 1,2,... m \quad (8)$$

Where $d_v(...)$ is the distance measurement between two fuzzy numbers.
Step 10: A closeness coefficient (CCl) is defined to rank all possible alternative. The closeness coefficient represents the diatance to the fuzzy positive ideal solution (A*) and fuzzy negative ideal solution (A-) simultaneously. The closeness coefficient of each alternative is calculated by:

$$CC_i = \frac{d_i^{-} i}{d_i^{*} + d_i^{-}}, \; i = 1,2,...,m \quad (9)$$

Step 11: According to the closeness coefficient, the ranking of the alternative can be determined.

5.1 T-test analysis

In the first step we have done t test analysis for determining the situations factors. Results show that the all factors have the significant difference with cut point3.
Note: Significant level at *0.05.

5.2 Correlation analysis

We have used Pearson correlation to test the relations among risk factors. It means what's the inter correlation among critical factors. The results indicated that these factors have generally correlated together.

5.3 Result of fuzzy TOPSIS

In order applying fuzzy TOPSIS, the language terms have been converted to fuzzy numbers according table 3:

Table 3. Language term.

Very low	1	(0,0.1,0.2)
Low	2	(0.1,0.25,0.4)
Medium	3	(0.3,0.5,0.7)
High	4	(0.6,0.75,0.9)
Very high	5	(0.8,0.9,1)

As shown in table 4, the priorities of basic factors according to fuzzy TOPSIS's results show that the market research and monitoring has first priority and quality, delivery speed, customer satisfaction, Relationship with customer, IT, process integration and performance management, environmental pressure, optimum cost and finally flexibility are subsequent factors.

Table 4. TOPSIS Rank of Factors.

Factors	Ci (rank of TOPSIS)
Market research and monitoring	0.6523
Quality	0.6571
Delivery speed	0.7199
Customer satisfaction	0.7739
Relationship with customer	0.8049
Information technology capability	1.0463
Process integration and performance management	1.1327
Environmental pressure	1.1463
Optimum cost	1.5752
Flexibility	2.3159

6. Conclusion

Today, organizations encounter dynamic and changing environments where product life cycles are short and environmental pressures make a lot of uncertainty that lead to more risk management. Organizations need agility to deal with these situations and they should track these categories not only in the organization but also in their entire supply chain (Ismail and Sharifi, 2006; Charles et al., 2010). Among health sectors pharmaceutical distributors would still have a large role in distributing mass-market drugs with high volumes and could make a far larger contribution by assuming responsibility for packaging such products and managing their distribution on a regional and national level. In addition, such companies must create stronger relationships with retail pharmacies and hospitals that distribute their products and focus on the needs of patients through channel-to-market innovations.

In this study all attempts aimed at providing an efficient and optimized model for agility of distribution sector (as a component of supply chain) in Pharmaceutical Industry. To do so, first there is an attempt to identify factors affecting supply chain agility followed by providing the relationship between these factors and supply chain agility capabilities. According to fuzzy TOPSIS's result, 10 main indicators were identified as the most important factors affecting process of agile distribution that including: market research and monitoring, quality, delivery speed, customer satisfaction, relationship, Information technology capability, process integration and performance management, environmental pressure, optimum cost, flexibility.

In the present study, market research and monitoring along with sub-indices (sale feedback, customers' requirement and forecasting) were identified as the most and influential agents in shaping agile distribution in pharmaceutical sector, and they are in consistent with several work that have demonstrated the ability of this issue to increase responsiveness, flexibility and agility of supply chain (Sharifi *et al*., 1999; Christopher, 2000; Gunasekaran *et al.*, 2008). Quality as an important factor in pharmaceutical distribution was recognized as a second factor, and it also can be in closed connection with good distribution practice (GDP) which has been reinforced by regulatory affairs to guaranty the quality of drugs until they reach to end- users (Friedli *et al*., 2010). Furthermore, according to national drug policy (NDP), quality are generally accepted as a critical factor besides efficacy and safety, almost in every country, so that pharmaceutical distributors must seriously take in to account this issue along of drug supply chain (Awan *et al*., 2009). Agarwal *et al.* (2007) believe that agile supply chain can effectively increase quality of pharmaceutical products and as a result patient satisfaction could be attained. According to result, it can be suggested that delivery speed should be considered simultaneously with customer satisfaction extensively in the beginning time of starting distribution activities (Christopher and Towill, 2001). Christopher (2000) believes that delivery speed and sensitivity to customer satisfaction should be considered as the most important factors in shaping agile supply chain; because of they can enable pharmaceutical distributors to recognize and also satisfy customers' needs at right time and right amount. Relationship and process integration following the information technology capability could get high priorities in agile pharmaceutical distribution. The process integration stands for cooperation between buyers and suppliers (as an important strategy to develop products and sharing information) can increase response to customers' requirements (van Hoek, 2001; Agarwal *et al*., 2007; Vickery *et al*., 2003). In addition, Breu *et al*., (2001), asserted information technology as a non-separable component of agile supply chain, will enhance speed and flexibility of drug supply chain. Other factors which have partial potentiality to be considered in agile pharmaceutical distribution especially in developing countries including; environmental pressure, optimum cost and flexibility. Several researchers (Sharifi and Zhang, 1999; Agarwal *et al*., 2007; Christopher and Towill, 2001) have noticed that these factors can effectively promote function of supply chain particularly considering its agility features. It is important to note that cost reduction is one of the main goals of agile supply chain especially in developing countries, can directly and indirectly reduce unit cost of products. Finally, considering flexibility as fundamental element of agile supply chain (Goldman *et a*l., 1994), Gunasekaran *et al.* (2008) stated that aforementioned issue can directly increase responsiveness of drug supply chain as well.

7. Implications and limitations

During the recent decades, SCM has become a popular agenda for both the pharmaceutical industry and non- pharmaceutical industries. Pharmaceutical companies that can successfully minimize and manage the risk and uncertainty inherent in their supply chain value stream, so that they will achieve superior competitive over competitors in the marketplace. Globalization, outsourcing, single sourcing, just-in-time supply chain management, lean and agile supply chain have made pharmaceutical supply chain more sensitive to environment. To survive and thrive in the 21th century economy, pharmaceutical distributors should learn how to encounter to ongoing challenges in their environment. This forces pharmaceutical distributors to select a new way of operating that gives them ability to be flexible and response quickly to unpredictable changes. Therefore, to succeed, distributors must consider supply chain management deeply, in order to become resilient to unexpected disruptions in their supply chain. Finally, it should be said due to unbelievable relationship between response to consumers' requirements and firm's success (like profitability and corporate social responsibility), pharmaceutical distributors must extensively pay attention to their supply chain activities.

Our study has some limitations. One limitation refers to specific industry which can be developed by researchers to other knowledge- based environments, and in those environments should be delivered with care as some modifications may be required because of industry-specific characteristics and market differences. Next, a larger sample could help to improve the generalizability of this study.

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