Benchmarking: An International Journal

Analysis of BSC perspectives as related to the alignment of environmental uncertainty and supply chain strategy

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Received 17 November 2012
Revised 21 January 2013
Accepted 25 January 2013

Abstract

Purpose – Selecting the right supply chain (SC) strategy which is aligned with environmental uncertainty will definitely improve SC performance. Lee (2002) proposed a framework to consider the impact of alignment between SC strategy and environmental uncertainty and its impact on SC performance. The purpose of this paper is to apply this framework in Iran and extend it using balanced scorecard (BSC) approach.

Design/methodology/approach – A research survey was completed to consider the aim of this research. A total of 124 questionnaires were returned.

Findings – The alignment between SC strategy and environmental uncertainty and its positive impact on SC performance has been proven (except for risk-hedging strategy). Efficient strategy enhances all the four BSC perspectives, while agile strategy only improves learning and growth perspective.

Originality/value – This research extends the work of Lee (2002) and Sun *et al.* (2009) by emphasizing the impact of SC strategy on each of the four perspectives of BSC.

Keywords Performance, Supply chain management, Environmental uncertainty, Balanced scorecard, Supply chain strategy, Decision-making analysis

Paper type Research paper

1. Introduction

Supply chain management (SCM) is thought to be an appropriate approach for organizational progress in today's competitive environment. In recent years, this area has attracted the attention of both researchers and practitioners, as the focus of an organization is to satisfy its customers' needs. To this end, all organizations across the chain should integrate their efforts so that customers receive the right product at the right time and place. This requires the chain partners to adopt a clear strategic direction in order to organize complicated activities, resources, communications and processes effectively (Qi *et al.*, 2009).

A strategy describes the basic characteristics of the match between an organization's skills and resources and the opportunities and threats it must deal with in its external environment (Chrisman *et al.*, 1988). The main function of strategy is to create competitive advantage and this can be achieved by creating more value for customers than competitors do. Thus, to enact changes, making a strategic plan and choosing the right strategy are necessities for any organization

Benchmarking: An International Journal
Vol. 21 No. 6, 2014
pp. 903-916

1463-5771
DOI 10.1108/BIJ-11-2012-0075

(Acur and Englyst, 2006). In order to be able to select the appropriate supply chain (SC) strategy, a manufacturer should take into account its main product specifications (Huang *et al.*, 2002). As SC managers face ever-increasing challenges in their competitive environments, an appropriate strategy is a tool that informs and enables responsiveness to changes. Thus, there is a need to study the impact of SC strategy on SC performance more widely. It is assumed that adopting the right SC strategy with regard to the SC attributes of price, flexibility, quality, delivery and customer service will increase a SC's competitiveness and, in turn, its performance.

One of the main components of SCM, which has been ignored in recent years, is SC performance evaluation. SCM requires the SC partners to select a tool for evaluating SC performance by which an organization can satisfy its needs as well as the needs of its customers. Therefore, choosing the right strategy, based on the capabilities of each partner, leads to an efficient and effective SC which is appropriately responsive to both customers and suppliers (Miller and Roth, 1994). This research aims to study the impact of SC strategies on the performance of SCM.

2. SC strategies

SC strategies comprise "a focal firm's behavioral orientation toward collaborative partners in the chain or network and include process configurations across the key supply chain processes" (Jüttner *et al.*, 2010, p. 105). Different types of SC strategies have received increasing attention from both researchers and practitioners. A primary classification (Hoekstra and Romme, 1992) divides SC strategies into five different strategies based on the location of the decoupling point. These include buy-to-order, make-to-order, assemble-to-order, make-to-order and ship-to-order strategies. Fisher (1997) argues that products can be classified as functional and innovative based on demand patterns. He further discusses how, according to this classification, two SC strategies can be adopted as physically efficient and market-responsive, respectively. Naylor *et al.* (1999) propose leanness, agility and leagility to distinguish between the approaches to SC strategies. Proposing the new approach of leagility, they argue that the combination of leanness and agility within a total SC strategy addresses the need for responding to downstream volatile demand while providing level scheduling upstream from the marketplace. Childerhouse *et al.* (2002) developed a classification schema known as DWVŁ (duration of life cycle, time Window for delivery, volume, variety and variability). Based on these variables, they identify four clusters of product. They argue that four different SC configurations with four different positions of their decoupling points and order penetration points can be adopted: MRP, packing center, design and build. Cigolini *et al.* (2004) categorize SC strategies as efficient, lean and quick supply. This is based on two main factors: the dominance of the product life cycle (i.e. introduction, growth, maturity and decline), and product complexity. Table I explains some of the key classifications put forward in the SC strategy literature.

Table I. Classification of studied companies

SC strategies	No. of companies
Efficient SC	19
Reactive SC	31
Risk-hedging SC	16
Agile SC	20

A highly referenced classification is proposed by Lee (2002), who highlights the relevance of supply and demand uncertainty. Lee's strategies are classified in four groups:

(1) Efficient SC: the main aim of this type of SC is to achieve cost efficiencies through the elimination of non-value-added activities and by targeting in economies of scale. An efficient SC is pursued when the market is mature and competitive advantage is sought primarily via low cost and high productivity.

(2) Risk-hedging SC: this is a SC with a high supply and low demand uncertainty. To reduce the risk of supply, a company may increase the safety stock of its key components and share the cost of buffer stock with other companies. In order to transship the stock between two locations effectively, it is necessary for firms to provide each one with real-time information on inventory and demand.

(3) Responsive SC: being responsive and flexible to changing customer needs is the main attribute of a responsive SC. To this end, the production of the final form of a product would be postponed until the demand is present. Thus, mass customization can be applied. Accurate specification of customer requirements is the key to the success of this type of SC as the demand is uncertain.

(4) Agile SC: this type of strategy is characterized by both high supply and demand uncertainty and focusses on the strengths of risk-hedging and responsive SC. An agile SC takes into account the responsiveness to volatile and unpredictable demands of customers and, at the same time, minimizes the risks of supply disruptions.

Lee (2002) discusses that environmental uncertainties usually affect SC performance and determine which competitive factors should be emphasized and evaluated to help formulate a winning competitive strategy. This study uses Lee's approach for classifying SC strategies.

Alignment

The suitable reaction to increased environmental uncertainty and market complications is not a new concept. Alignment, as related to a firm's external opportunities and internal policies and actions, has been an important topic among researchers for some time. Organizational behavior scholars consider alignment as an important concept for evaluating the performance impacts of environment-strategy coalignment (Venkatraman and Prescott, 1990).

Rooted in organizational behavior science as fit, congruence, consistency and alignment, the concept describes the relationship of a firm's internal systems and strategies with its organizational opportunities and possibilities (Bernhardt *et al.*, 2000; Gelade and Young, 2005; Schneider *et al.*, 2000).

The conceptual uncertainty framework proposed by Lee (2002) underlines an alignment between SC strategy and environmental uncertainty in order to gain better SCM performance. According to previous literature, this alignment improves the performance of a firm. Lee (2002) categorizes SC strategies, based on environmental uncertainty (supply and demand uncertainty), as efficient, reactive, risk-hedging and agile strategies. This study aims to consider the generalization of this alignment in the context of a Middle East country and extends it beyond the mere performance appraisal of the balanced scorecard (BSC) model as a whole.

SC performance

A correct SC strategy is presumed to be able to enhance SC performance. Green *et al.* (2006) studied the impact of SC strategies on marketing performance and market orientation. Their results show that SC strategies mediate the relationship between market orientation and organizational success. The work of Qi (2006) investigated the moderating impact of environmental uncertainty on the relationship between competitive strategy, SC strategy and financial performance. This study concluded that environmental study moderates the strength of the relationship between competitive strategy and SC strategy, and between SC strategy and financial performance. Sun *et al.* (2009) examined how alignment between SC strategy and environmental uncertainty affects perceived SCM performance. They concluded that the alignment between SC strategy and environmental uncertainty is positively associated with SCM performance. Qi *et al.* (2009) investigated the impacts that SC strategies (lean, agile and leagile) have on the operational and financial performances of the SC. They found that firms with traditional strategies do not emphasize either leanness or agility. Moreover, these firms do not achieve higher performance compared to those firms adopting lean, agile and leagile strategies. Fantazy *et al.* (2009) considered the relationship between SC strategy, flexibility and firm performance empirically and explored the positive impact of SC strategy on firm performance through flexibility. They also found the direct effect of strategy on firm performance. Finally, Kristal *et al.* (2010) examined the mutual impact of SC strategy on competitive capabilities and business performance and found a positive relationship among these variables.

There are various components for measuring SCM performance. Successful performance management requires a balance between financial and non-financial performance measures as well as casual relationships among them (Schnetzler *et al.*, 2007).

The traditional performance measurement systems face serious challenges because they emphasize financial measures in order to satisfy regulatory and accounting reporting requirements. The use of multiple performance measures in the BSC model is timely in today's competitive environment as businesses cannot rely solely on narrowly focussed internal financial measures for performance evaluation (Jusoh *et al.*, 2008).

The BSC model divides measures into four different groups of perspectives that are constituted by considering short-term and long-term objectives and measures. Measures are a combination of operational and financial indices which are connected to long- and short-term objectives. These perspectives are:

- Financial perspective: the main objective of financial perspective is to serve shareholders well. Financial perspective provides the ultimate outcome or bottom-line improvement of the organization where it measures the economic consequences of actions already taken in the learning and growth, internal business process, and customer perspective phases. Financial measures are typically related to profitability such as operating income, return on investment and economic value-added (EVA), while other financial measures may also include sales growth, cost control and cash flow.
- Customer perspective: this area focusses on what must be done and what is most important to achieve the mission from the customer's perspective. Therefore objectives, measures, targets and, eventually, activities are planned to implement strategy with a regard for customer satisfaction.
- Internal processes perspective: this component focusses on what an organization must be doing well to meet the customer needs defined by the customer

perspective. It also lets managers know how well their business is running and how well that internal processes are designed to meet objectives.

- Learning and innovation perspective: this perspective focusses on how an organization is improving its ability to innovate, improve and learn in order to support success with the critical operations and processes defined by the internal processes perspective. This may include employee training and inculcating corporate culture attitudes.

BSCs have four perspectives. These include internal processes, customers, learning and financial perspectives by which SCM goals, and financial and customer satisfaction results may be assessed. Assessments are made through internal processes measures, and from financial and customer satisfaction perspectives. Finally, the learning perspective improves SC capabilities in the long term.

The research model and hypotheses

This research applies Lee's (2002) classification of SC strategies as the independent variable. SCM performance is the dependent variable and is evaluated using the BSC approach proposed by Brewer and Speh (2000). Thus, in this research, the impact of SC strategy on SCM performance is studied as shown in Figure 1.

Four hypotheses are proposed as follows:

H1. Efficient strategy influences SCM performance.

H1-1. Efficient strategy influences each perspective of BSC separately.

H2. Reactive strategy influences SCM performance.

H2-1. Reactive strategy influences each perspective of BSC separately.

H3. Risk-hedging strategy influences SCM performance.

H3-1. Risk-hedging strategy influences each perspective of BSC separately.

H4. Agile strategy influences SCM performance.

H4-1. Agile strategy influences each perspective of BSC separately.

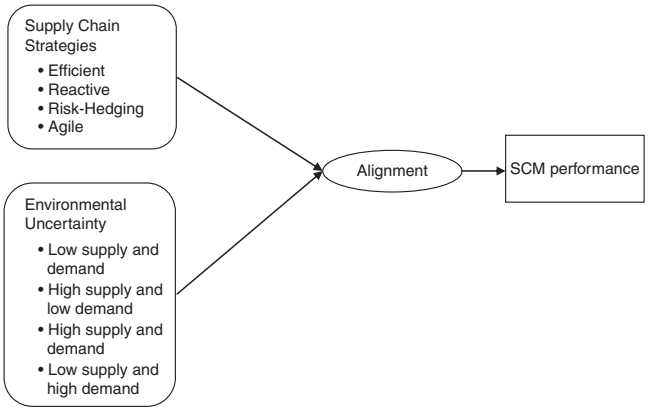

Figure 1.
The conceptual framework of the research

3. Research methodology

The aim of this research is to examine the impact of SC strategy on SC performance. With this aim, survey research was conducted. The sample consisted primary of all manufacturing companies located at an industrial estate in the northeast region of Iran. It included 170 companies, of which only 124 returned questionnaires. Of the 124 respondent companies, 86 could be grouped based on the attributes of the four SC strategies (Table I). Table II reports sample characteristics of the respondent firms in this study.

The items measuring SC strategy have been adopted from the work of Sun *et al.* (2009) (Table II). These items are based on the manufacturing competitive capabilities proposed by Miller and Roth (1994) and Frohlich and Dixon (2001) which include price, quality, flexibility, delivery and customer service (Tables III and IV). Environmental uncertainty was also assessed using supply and demand uncertainty variables (Premkumar *et al.*, 2005; Sun *et al.*, 2009). Finally, we used Brewer and Speh's (2000) variables to assess SC performance (Table V).

In order to test the validity of the variables, content validity was used. Therefore, experts were asked to give their opinions regarding the variables. Cronbach's α was used to assess the reliability of the measures. As shown in Table VI, excepting quality and the learning and innovation perspective, the reliability coefficients of variables ranged from 0.54 to 0.86 which indicated an acceptable level of reliability (Srinivasan, 1985; Nunnally and Bernstein, 1994).

In this study, the path analytical approach was used to test the hypothesized relationships. Path analysis compares the magnitudes of influence of each included variable and uses a path diagram to display all of the casual relationships (Ahn *et al.*, 2002).

Regression was used to examine the cause-effect relationship balanced scorecard. Figure 2 shows the relationship between them and for perspectives of BSC also. The most significant relationship is located between the two that include the learning and innovation and internal processes perspectives.

Table II.
Respondents and company sample characteristics

	n
Employees	
50 or fewer	62
50-100	12
100 or more	12
Gender	
Men	70
Woman	16
Age	
30 years or fewer	25
30-40 years	41
40-50 years	11
50 years or more	2
Management experience	
<5 years	31
5-10 years	16
10 years or more	8

Construct	Measure
PRC: Factor 1 for SC strategy attribute – price	
PRC1	The ability to compete on price compared with main competitors
FLX: Factor 2 for SC strategy attribute – flexibility	
FLX1	The ability to make rapid design changes and/or introduce new products quickly compared with main competitors
FLX2	The ability to response to swings in volume compared with main competitors
FLX3	The ability to deliver a broad product line compared with main competitors
QAL: Factor 3 for SC strategy attribute – quality	
QAL1	The ability to offer consistent quality compared with main competitors
QAL2	The ability to provide high-performance products compared with main competitors
DLI: Factor 4 for SC strategy attribute – delivery	
DLI1	The ability to deliver products quickly compared with main competitors
DLI2	The ability to deliver on time (as promised) compared with main competitors
SRV: Factor 5 for SC strategy attribute – service	
SRV1	The ability to provide after sale service compared with main competitors
SRV2	The ability to distribute the product broadly compared with main competitors

Source: Adopted from Sun *et al.* (2009)

Table III.
Items measuring supply chain strategy and environmental uncertainty

Cost	Product cost reduction (labor, material and overheads)
Quality	Consistent quality with low defects
	Conformance to design specifications
	High-performance products
Flexibility of volume	To respond to swings in volume quickly
	Capacity to profitably operate at different levels of output
Flexibility of product	Changes in product design
	Wide range of products easily and quickly manufactured without modifying facilities
	Different products with multiple features, characteristics,
Delivery	Options: Swamidass and Newell (1987), Miller and Roth (1994), Vickery and Dunwiddie (1997), Vickery *et al.* (1994), Dean and Snell (1996), Ward *et al.* (1998), Avella *et al.* (2003), Kathuria and Partovi (1999) and Kathuria (2000)
	Rapid change in the product mix
	Delivery: Quick delivery of products
	Delivery of products on time
	Facilitating of orders and possible returns
Service	Provide an effective after sales service
	Attend to client requirements or needs
	Provide clients with complete information on products

Source: Penã and Garrido (2008)

Table IV.
Manufacturing competitive priorities

4. Results

This study involves 19, 31, 16 and 20 organizations that are characterized by their low supply and demand, low supply and high demand, low demand and high supply, and high supply and demand, respectively. Thus, the efficient, reactive, risk-hedging and agile SC strategies can be labeled to each category of the organizations respectively, as was shown in Table I.

Table VII presents the results for the aligned SC strategy (as the independent variable) and for SC performance (as the dependent variable). The *f*-values for efficient ($n = 19$, $f = 4.933$, $p < 0.001$), reactive ($n = 31$, $f = 6.326$, $p < 0.05$), and agile ($n = 20$, $f = 33.468$, $p < 0.001$) SC strategies were significant, while it was rejected for the risk-hedging strategy ($n = 16$, $f = 0.553$, $p < 0.05$). Therefore, the results indicate that there is an alignment between the right SC strategies (except the risk-hedging strategy) and improved SC performance. Thus, *H1*, *H2* and *H4* are accepted.

Tables VIII-XI illustrate the results for subsidiary hypotheses. The impact of efficient SC strategy on each of the four BSC perspectives is significant ($p < 0.05$, $f = 5.472$, $n = 19$ for customer perspective; $p < 0.001$, $f = 20.677$, $n = 19$ for learning and innovation perspective; $p < 0.001$, $f = 40.255$, $n = 19$ for internal processes perspective; and $p < 0.05$, $f = 10.992$, $n = 19$ for financial perspective). However, *H1-2* and *H1-3* were rejected. This means that reactive and risk-hedging strategies support none of the four BSC perspectives. Finally, according to the results for *H1-4*, agile strategy just positively impacts on learning and innovation perspective ($p < 0.001$, $f = 19.680$, $n = 20$).

5. Findings and discussion

The goal of this study was to examine the impact of SC strategy on SC performance. The results confirmed the positive impact of alignment between efficient strategy and

SC strategy attributes	Efficient SC	Responsive SC	Risk-hedging SC	Agile SC
Price	High	Medium	Medium	Low
Flexibility	Low	High	Low	High
Quality	High	High	High	High
Delivery	High	High	Medium	Medium
Service	Low	Medium	High	High

Source: Adopted from Sun *et al.* (2009)

Table V.
Supply chain strategies attributes

BSC perspective	Measure
Customer perspective	Number of customer contact points
	Relative customer order response time
	Customer perception of flexible response
	Customer value ratio
Learning and innovation perspective	Product finalization point
	Product category commitment ratio
	Number of shared data sets/total data sets
	Performance trajectories of competing technologies
Internal processes perspective	Supply chain cost of ownership
	Supply chain cycle efficiency
	Number of choices/average response time
	Percentage of supply chain target costs achieved
Financial perspective	Profit margin by supply chain partner
	Cash-to-cash cycle response time
	Customer growth and profitability
	Return on supply chain assets

Source: Adopted from Brewer and Speh (2000)

Table VI.
Measuring supply chain performance

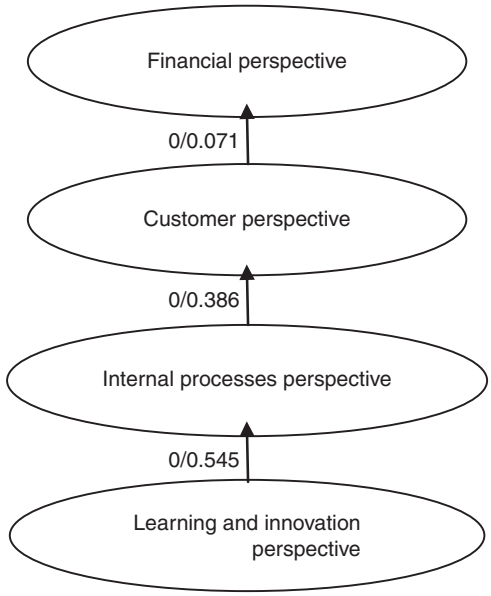

Figure 2.
Cause-effect relationship balanced scorecard

Latent variable	No. of items	Cronbach's α	Mean	SD
SC strategy	10	0.677	3.569	0.942
Environmental uncertainty	9	0.789	2.884	1.064
SCM performance	17	0.793	3.231	1.015

Table VII.
Composite reliability

	R^2	Adjusted R^2	f-value	Standard coefficient
Efficient SCS	0.206	0.164	4.933*	0.454
Responsive SCS	0.311	0.262	6.326*	0.558
Risk-hedging SCS	0.217	0.175	0.553	0.466
Agile SCS	0.438	0.425	33.468**	0.662

Notes: $^{*}p < 0.05$; $^{**}p < 0.001$

Table VIII.
Implications of alignment for SCM performance

	R^2	Adjusted R^2	f-value	Standard coefficient
Efficient SCS	0.224	0.183	5.472*	0.473
Responsive SCS	0.001	0.500	0.001	0.001
Risk-hedging SCS	0.011	0.012	0.485	0.106
Agile SCS	0.045	0.023	0.656	0.212

Note: $^{*}p < 0.05$

Table IX.
The impact of supply chain strategies on customer perspective

environmental uncertainty on SC performance. This is consistent with the work of Sun *et al.* (2009) who studied the impact of efficient strategy on SC performance along with the alignment between SC strategy and environmental uncertainty. As efficient strategy focusses on cost reduction, the results also confirm the work of Doise (2008), who investigated the impact of cost leadership strategy on firm performance through the mediating impact of organizational culture.

The positive impact of alignment between reactive strategy and environmental uncertainty on SC performance was validated. Sun *et al.* (2009) also found a positive relationship between these two variables along with the alignment between SC strategy and environmental uncertainty. As reactive strategy focusses mainly on product differentiation and flexibility, this study's results are in line with the work of Doise (2008) who considered the impact of differentiation on firm performance through the mediating impact of organizational culture.

The results, however, do not support the proposition that there is a positive impact of alignment between risk-hedging strategy and environmental uncertainty on SC performance. It was also found that the alignment of agile strategy and environmental uncertainty has a positive effect on SC performance. Several previous studies have found a direct and positive relationship between agility and SC performance (Qi *et al.*, 2009; Qi, 2006; Sun *et al.*, 2009). An agile SC is attributed with high flexibility. Thus, short product life cycle, variable demand and high profit margins are a necessity. As mentioned previously, this strategy combines the strengths of reactive and risk-hedging strategies (Lee, 2002). Consequently, agile strategy affects learning and innovation, internal processes, financial and customer perspectives, respectively.

6. Conclusion and practical suggestions

Our results showed that three of the four SC strategies proposed by Lee (2002) improve the performance of supply chains, when they are aligned with their given types of environmental uncertainty. The reason for the lack of acceptance of the third hypothesis can be attributed to the numbers of employees at the surveyed organizations (Table XII). As most of them are small sized (less than 50 employees), it

Table X.
The impact of supply chain strategies on learning and innovation perspective

	R^2	Adjusted R^2	f-value	Standard coefficient
Efficient SCS	0.521	0.496	20.677*	0.722
Responsive SCS	0.778	0.666	6.989	−0.882
Risk-hedging SCS	0.007	0.016	0.304	0.084
Agile SCS	0.584	0.555	19.680**	0.764

Note: $^{**}p < 0.001$

Table XI.
The impact of supply chain strategies on internal processes perspective

	R^2	Adjusted R^2	f-value	Standard coefficient
Efficient SCS	0.679	0.662	40.255**	0.824
Responsive SCS	0.832	0.748	9.917	−0.912
Risk-hedging SCS	0.035	0.012	1.552	0.187
Agile SCS	0.080	0.014	1.211	0.282

Note: $^{**}p < 0.001$

can be assumed that they cannot afford the risk of market fluctuations. In addition, as they lack structured information systems, these organizations cannot combat supply fluctuations by sharing information regarding their inventories with other SC partners (Table XIII).

Firms adopting an efficiency strategy should move toward cost reduction, elimination of non-value added activities and pursue policies that promote reliable and fast delivery speeds (Sun *et al.*, 2009). This strategy is best fitted to products with long life cycles and environments with low supply and demand uncertainty. This conclusion also applies to companies supplying functional products (low product variety and low profit margin) (Fisher, 1997). SC integration, elimination of intermediates and on-time delivery are the ways to improve the efficiency of supply chains. In addition, mass production and cost leadership can be adopted as competitive strategies. Although cost reduction is the main attribute of an efficient strategy, attention paid to delivery speeds can lead to increased profits and customer satisfaction. Besides efficiency, the increased cost of quality, in order to reach increased customer satisfaction, as well as increased delivery channels (customer perspective) is of high importance. To improve financial performance, improved productivity and horizontal integration can be good solutions.

Reactive strategy is characterized by customer flexibility and responsiveness. This strategy is adopted when the product has a short or medium life cycle, and there is low supply and high demand uncertainty. It also applies to innovative products (volatile market demand, high variety and profit margin) (Fisher, 1997). In order to respond to demand variations and to achieve high delivery speeds, the use of integrated information systems can be helpful. Moreover, differentiation can be adopted as the competitive strategy, as can product variety to become aligned with customer requirements. Modern technologies can reduce product cycle time and consequently, a firm's performance will be improved from the aspect of financial and, particularly, learning and innovation perspectives. Firms adopting this strategy should not ignore quality, as customers require flexibility along with increased quality.

A risk-hedging strategy requires resource sharing and integration among SC partners so that supply uncertainty can be reduced (Lee, 2002). This strategy applies to products with medium to long life cycles where the environment is characterized by

	R^2	Adjusted R^2	f-value	Standard coefficient
Efficient SCS	0.367	0.333	10.992*	0.605
Responsive SCS	0.832	0.748	9.917	−0.912
Risk-hedging SCS	0.044	0.021	1.967	0.209
Agile SCS	0.024	−0.464	0.049	0.155

Note: $^{*}p < 0.05$

Table XII.
The impact of supply chain strategies on financial perspective

	Less than 50	50-150	More than 150	Total
Efficient strategy	18	0	1	19
Reactive strategy	21	7	3	31
Risk-hedging strategy	13	1	2	16
Agile strategy	11	4	5	20

Table XIII.
No. of employees in each category

high supply and low demand uncertainty. To decrease the risks of supply fluctuations, partners can share information regarding safety stocks by using structured information systems. In this condition, however, organizations should not focus on inventory issues and supply fluctuations and ignore process innovations and cost-effective supply chains as a result (from the points of view of both cost and delivery time). As mentioned, demand uncertainty in this scenario is low, thus, market development and customer attraction strategies could be used to increase profitability. Here, organizations can change the appearance of the product according to the needs of markets.

An agile SC requires flexibility and responsiveness to customer needs, while it must mitigate the risks of supply fluctuations (Sun *et al.*, 2009). This strategy fits to products with short life cycles in circumstances where there is high supply and demand uncertainty.

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