

THEORETICAL GUIDELINES TO MANAGE AGILE SUPPLY CHAINS

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ABSTRACT

With tremendous levels of competition businesses and supply chains are looking at ways to become more responsive to customers. Supply chains of the future will be distinguished by how agile they are in meeting demands. The objective of this article is to report on a study where theoretical guidelines were developed to manage agile supply chains. In theory, agile supply chains have an unpredictable market demand and have agility as a market winner. A literature research was used to develop guidelines for agile supply chains to manage supply chain drivers. The theoretical guidelines were tested in six firms that show agile supply chain characteristics. These firms were selected by means of convenience, judgmental and purposive sampling. A structured questionnaire was used and the data were collected by means of personal interviews with supply chain managers. The research found that firms do not always choose the right supply chain strategy, and/or manage the supply chain drivers in line with an agile strategy. The article provides a guide for firms to align agile supply chains with the correct supply chain strategy and to manage the drivers in line with the strategy. The research showed that the theoretical guidelines could be useful for firms with agile supply chains.

Keywords: agile supply chain, supply chain strategy, supply chain agility

1. Introduction

'With the tremendous levels of competition businesses and supply chains are looking at ways to become more responsive to customers' (Wisner, Tan & Leon, 2012:24). Current business trends such as growing product varieties, shorter product life cycles, increased outsourcing, globalisation, and advances in information technology, as well as supply chain risks require very specific supply chains (Mangan, Lalwani, Butcher & Javadpour, 2012:66). Therefore, firms have to formulate and execute clear supply chain strategies to be successful (Webster 2008:349). Clear and effective supply chain strategies provide firms with radically new opportunities to create competitive advantage (Ross, 1998:334). Supply chain strategies are strategies that firms use to manage the integration of all their supply chain activities and require a focus across the entire supply chain to provide optimum value to the end customers (Qrunfleh & Tarafdar, 2013:571, 573). Essentially, there are two main strategies in the supply chain. These two strategies are lean and agile supply chain strategies (Sharma & Bhat, 2014:202). However, it may not be ideal for a firm to pursue both supply chain strategies simultaneously because different products will require different supply chain strategies (Hilletoft, 2012:1275). The ideal is to align the supply chain strategy with supply chain characteristics (such as environmental uncertainties) to enhance supply chain performance (Hallavo, 2015:73).

Strategies must be reviewed and adjusted regularly (Webster, 2008:349). Supply chains of the future will be distinguished by how agile they are and how quickly they can change to meet emerging demands (Leach, 2013). Shortening the time to respond to customer needs (agility) has been the focus of much attention in recent years (Coyle, Langley, Novack & Gibson, 2013:660). This article endeavours to make a contribution by focussing on agile supply chains.

Agility is the ability of a firm to respond rapidly in a continuously changing, uncertain, unpredictable business environment. In the context of supply chain management, agility thus focuses on flexibility and responsiveness. Therefore, agile supply chains create customer value by being able to respond quickly and efficiently to a volatile marketplace (Sharma & Bhat, 2014:201, 202; Wisner et al., 2012:24; Jacobs & Chase, 2014:405; Swink, Melnyk, Cooper & Hartley, 2014:34). This is no easy task. Besides the fact that many firms do not have updated supply chain strategies in place, many firms also select the incorrect supply chain strategy for their supply chains, which results in poor supply chain performance (Webster, 2008:349). The objective of this article is to provide firms with some theoretical guidelines on how to manage agile supply chains.

Therefore, the research question for this article can be formulated as follows: How can existing literature be used to compile theoretical guidelines for firms to effectively manage agile supply chains? The research on which this article reports endeavoured to answer the research question with the main objective: to suggest theoretical guidelines to manage agile supply chains. The secondary objectives in this article are firstly to conduct a literature review to determine when an agile supply chain should be implemented and, secondly, to determine how supply chain drivers should be managed to improve agility within the supply chain. The theoretical guidelines to manage agile supply chains, as determined from the literature review, were tested in selected firms.

2. Literature review

The agility of a supply chain is determined by the ability of the whole supply chain to be flexible and adapt quickly and effectively to rapidly changing customer needs (Qrunfleh & Tarafdar, 2013:573; Sharma & Bhat, 2014:201). Supply chain agility can be defined as the ability to quickly adjust supply chain operations and tactics (Gligor, 2014:579). Supply chain agility enables a firm to respond rapidly to changes in demand by increasing flexibility through, for example, coordinated planning and shorter lead times

(Hilletofth, 2012:1276). Agility in supply chains has been considered a lot recently because today's business environments are characterised by increasing level of unpredictability. Speed, quality, flexibility and responsiveness have become more important key elements to meet the unique needs of customers. These are all key elements of agile supply chains (Mehralian, Zarenezhad & Ghatari, 2015:75, 76).

2.1 Agile supply chain strategies

From the above it is clear that an agile supply chain strategy aims to be flexible (Qrunfleh & Tarafdar, 2013:573). Agile supply chain strategies are required in supply chains with high levels of demand and supply uncertainties, because agile supply chains need to utilise strategies aimed at being flexible and responsive to customer needs where demand and supply uncertainties exist (Jacobs & Chase, 2014:405; Gattorna, 2010:51). Therefore, agile supply chains are relevant for products where demand is unpredictable and where end customers want a lot of variety (Webster 2008:35).

Customers seek a rapid response to unpredictable supply and demand conditions (Gattorna, 2010:228). Therefore, agile supply chains have to be market sensitive by being closely connected to end customers' needs and with the ability to respond to actual real time changes in demand (Sharma & Bhat, 2014:201; Webster 2008:351-352). In fact, Mason-Jones, Naylor and Towill (2000:4064) suggested that the market winner for agile supply chains is service levels. High service levels can be expressed in terms of timeliness, availability and flexibility such as placing small orders (Christopher, 2004:32; Bozarth & Handfield, 2013:47)).

Therefore, if firms have an unpredictable market demand and agility as market winner an agile supply chain strategy is appropriate. However, if firms (1) have an unpredictable market demand and low cost as market winner or (2) have a predictable market demand and agility as market winner, another solution is required. In these cases the *decoupling point* should be used to determine a supply chain strategy.

The decoupling point is the point at which real demand penetrates upstream in a supply chain. It is the point in the product flow stream where forecast-driven activities higher up in the supply chain (supply-side) meet real-time data (real sales) as determined from customers' orders (Christopher, 2011:85; Lysons & Farrington, 2012:142). The decoupling point, allows supply chain members upstream of this point to operate more independently than supply chain members downstream of this point (Jacobs & Chase, 2014:514). Activities in the supply chain upstream of the decoupling point are not affected as much by particular customer orders because customisation takes place at the decoupling point (Bozarth & Handfield, 2013:65). The decoupling point is the point where firms move from the standard (or base) product to the customised product as demanded by the customer (Mangan et al., 2012:67), thus indicating where the firm switches from managing the supply chain using one strategy, to managing it using another strategy (Simchi-Levi, Kaminsky & Simchi-Levi, 2009:190). The firms downstream from the decoupling point are organised to be agile and to be able to cope with fluctuating demands and high levels of product variety (Lysons & Farrington, 2012:142). Therefore, if firms (1) have an unpredictable market demand and low cost as market winner or (2) have a predictable market demand and agility as market winner, an agile supply chain strategy will be suggested to firms that are positioned downstream from the decoupling point.

To conclude, when the supply chain characteristics of market demand predictability, market winner and decoupling point (if necessary) are used, a supply chain strategy can be suggested or implied to firms. This is illustrated in Figure 1.

2.2 Managing supply chain drivers in agile supply chains

Supply chains have performance drivers. According to Chopra and Meindl (2013:53) the supply chain drivers are facilities, inventory, transportation, information, sourcing and pricing. Supply chain drivers interact with each other to determine the supply chain performance. The supply chain drivers will be managed differently for different supply chain strategies (Chopra & Meindl, 2013:53). These supply chain drivers will be examined briefly to determine how they should be managed in agile supply chains.

2.2.1 Facilities

In agile supply chains, facilities must be managed to be responsive. Facilities are the actual physical locations in the supply chain network where the product is stored, assembled, or fabricated. Decisions regarding the role, location, capacity and agility of facilities have a significant impact on the supply chain's performance (Chopra & Meindl, 2013:53; Hugos, 2011:10). Location and capacity factors must be managed correctly to enhance agility (Reid & Sanders, 2007:316). Facilities can be made more responsive if they have more excess capacity (Hugos, 2011:31). Therefore, when implementing agile supply chain strategies, firms must acquire capacity capability to be able to manage possible volatility in customer demand.

Firms can also utilise smaller facilities that are close to major groups of customers so that delivery times will be shorter (Hugos, 2011:31, 32). However, firms will have to realise that it will be more costly to operate smaller and decentralised facilities than to operate centralised facilities with the same total capacity (Simchi-Levi *et al.*, 2009:232). Therefore, a firm with more decentralised facilities will increase responsiveness, but reduce efficiency (Chopra & Meindl, 2013:53). Decentralised facilities should thus be used in agile supply chains which means that both the cycle inventory and the safety stock levels will increase (Simchi-Levi *et al.*, 2009:51).

2.2.2 Inventory

Inventories refer to controlled quantities of materials that are stocked or used in facilities. Inventory is thus the stock of any item or resource used in a firm. Examples include production inventories, MRO inventories, in-process inventories and finished goods inventories (Jacobs & Chase, 2014:515; Burt, Petcavage & Pinkerton, 2012:273, 274). In agile supply chains, inventory acts as buffer against uncertainty in the supply chain. Holding higher levels of inventory for a wide variety of products allows a firm to be more responsive to fluctuations in customers' demands (Chopra & Meindl, 2013:53; Hugos, 2011:6, 32), but does increase carrying cost in the form of, for example, insurance costs, property taxes, storage costs, obsolescence and deterioration as well as opportunity cost of the invested capital (Burt *et al.*, 2012:278, 279).

2.2.3 Transportation

Transport is necessary to physically move materials between different locations in the supply chain (Waters, 2009:404; Coyle *et al.*, 2013:401). Transportation can be used with many combinations of modes and routes, each with its own performance characteristics (Chopra & Meindl, 2013:53; Coyle *et al.*, 2013:401). Transportation also has a large impact on a supply chain's responsiveness (Chopra & Meindl, 2013:53). Responsiveness (and therefore a supply chain's agility) can be increased by transportation modes that are fast and flexible. It can also be increased when firms use more frequent shipments (Hugos, 2011:34). However, firms must also realise that these factors will also increase costs (Chopra & Meindl, 2013:53).

2.2.4 Information

Supply chains are also networks of information flows and managing information (Hopp, 2008:201). In agile supply chains, information plays an important role in demand planning. Determining and quickly getting hold of, for example, customers' responses to a firm's product offerings are important because current data is essential in agile supply chains. It reduces a firm's dependence on forecasts (Swink et al., 2014:422). Therefore, the use of information technology to share timely and accurate data between supply chain members is crucial in an agile supply chain because supply chain members must be able to quickly align their collective capabilities to respond to changes in the market (Gligor & Holcomb, 2012:438).

Sharing data increases visibility of requirements. Therefore agile supply chains are more likely to be information based. Firms can be more responsive if they collect and share accurate and real time data generated by the operations of the other supply chain drivers (Coyle et al., 2013:661). The Internet and other information technology applications are allowing supply chain members to be connected to each other. These interconnections are providing integration and facilitating more rapid and accurate information exchange across the supply chain. As a result, firms can speed up their supply chains and reduce lead times (Schroeder, Goldstein & Rungtusanathan, 2013:242). Opportunities for improvement are usually extended beyond the firm throughout the supply chain when lead times are reduced (Swink et al., 2014:423). However, firms have to weigh the benefits of obtaining good information against the cost of acquiring it (Hugos, 2011:33).

2.2.5 Sourcing

Sourcing is the process of identifying, selecting and developing suppliers (Lysons & Farrington, 2012:359). It can therefore involve the choice of who will perform a particular supply chain activity, such as production, storage, transportation, or the management of information. Sourcing certain processes to other parties may increase a supply chain's responsiveness (Chopra & Meindl, 2013:54). Firms with agile supply chains that aim to increase their agility should select suppliers based on speed, flexibility, superior quality and dependability. They will therefore carefully analyse suppliers' quality capabilities, capacity capabilities, service capabilities, flexibility capabilities, lead times, and information technology capabilities to make sure that suppliers are selected that will enhance the agility across the supply chain Burt et al., 2012:379, 381).

2.2.6 Pricing

Pricing determines how much a firm will charge for products that it makes available in the supply chain (Chopra & Meindl, 2013:54). Thus far, it has become clear that generally agility across supply chains increases supply chain costs. To cover these higher costs, firms with agile supply chain strategies will use higher margins which are also intended to increase profits.

2.3 Supply chain driver components

The supply chain drivers discussed above consist of more specific elements or components that supply chain managers need to manage in line with the strategy. Nine supply chain driver components were identified in the literature review within the six supply chain drivers, although more might exist. Table 1 indicates the supply chain drivers as well as the supply chain driver components. Table 1 also provides theoretical guidelines, as derived from the literature review, on how to manage each of the supply chain

driver components. These supply chain driver components are:

- Capacity utilisation;
- Location of facilities;
- Inventory levels;
- Lead times;
- Transportation flexibility;
- Transportation frequency;
- Information;
- Supplier selection; and
- Pricing margins.

3. Research methodology

The research methodology for this article comprised of two phases. The first phase was a literature review conducted on the topic of agile supply chains. With a comprehensive literature review supply chain strategies were explored, the characteristics of agile supply chains were identified and studied and the management of supply chain drivers in line with agile supply chain strategies were identified. This part of the research concluded with a set of guidelines on how agile supply chains should be managed.

The second phase of the research consisted of empirical research to analyse the agile supply chain management practices in selected firms. The sample for the research comprised thirteen firms. These firms were selected by means of convenience, judgmental and purposive sampling to ensure that specific firms were selected in the sample. The firms were from the manufacturing, wholesale, distribution and retail industries and were either market leaders or in the top three firms in their respective industries. For confidentiality purposes, these firms were named Firm A to Firm M. A structured questionnaire was used as research instrument and the data were obtained by means of a qualified field worker, who conducted the personal interviews with managers who are involved in the firm's supply chain. As this article only focuses on agile supply chains only supply chains that demonstrate agile characteristics were included and analysed for this article.

Of the thirteen firms, only three indicated that they were implementing an agile supply chain strategy. They were firms F, H and L. Firms D, G and K were also included and analysed in the article because even though they did not indicate an agile supply chain strategy, their supply chains demonstrated agile characteristics according to the theoretical study guidelines of market demand predictability, market winners and, the supply chain's decoupling point. The theoretical guidelines indicate that these firms should be using an agile supply chain. Therefore, the research results of these six firms were included and analysed in the research on which this article is based. The findings are presented in the next section.

4. Research findings

This article reports on the research findings of six firms and more specifically on (1) the rationale behind the supply chain strategy of each firm; and (2) whether the firms were managing their supply chain drivers for agility based on theoretical principles.

4.1 Suggested supply chain strategy

As already mentioned, the supply chain characteristics of market demand predictability, market winners and the position of the decoupling point in the supply chain (if necessary) were used to suggest a supply chain strategy for firms. If firms had an unpredictable (or volatile) market demand and market winner that required a focus on high service levels in terms of availability of products, timeliness of service, flexibility, innovation, and supreme quality, an agile supply chain strategy was suggested. However, if firms (1) had a predictable market demand and had a market winner that requires high service levels (as mentioned above) or (2) had an unpredictable market demand and low cost as market winner, the decoupling point was used to determine a supply chain strategy. If the decoupling point was positioned upstream from the firm, an agile supply chain strategy was suggested.

Four of the firms (D, F, H and K) in the research sample had an unpredictable market demand and three of these firms (F, H and K) had high service levels as their market winner. An agile supply chain strategy was the obvious strategy for firms F, H and K based on market demand predictability and market winners. The position of firm D in terms of its decoupling point was used to suggest a supply chain strategy for firm D. Firm D had low cost as a market winner.

Firms G and L had a predictable market demand. However, these two firms had a high service level as market winner. On the other hand, firm D had an unpredictable market demand but had low cost as a market winner (as mentioned above). Therefore, the decoupling point was used to suggest a supply chain strategy for these three firms. Based on the position of these firms in terms of the decoupling point in their supply chain, an agile supply chain strategy was suggested for them. The decoupling point was upstream for all three these firms.

4.2 Focus of current supply chain strategy

Three firms (F, H and L) indicated that the focus of their supply chain strategy was on agility (i.e. to be responsive and flexible in the supply chain). The other three firms (D, G and K) indicated that they were implementing a combination of lean and agile supply chain strategies. Table 2 indicates that an agile supply chain is suggested to all six firms based on supply chain characteristics (market demand and market winner) that were identified with the theoretical study (column two in table 2). Table 2 also shows whether an agile supply chain strategy is the focus of the firm's current implemented supply chain strategy (column 3). The firms that are currently implementing an agile supply chain strategy as suggested to them from theoretical principles, are shaded.

Table 2 shows that three firms (F, H and L) indicated that they were implementing an agile supply chain strategy in line with the supply chain characteristics of market demand predictability, market winners and the position of the decoupling point (if necessary). Table 2 also shows that there was a misalignment in firms D, G and K between the supply chain strategies (based on supply chain characteristics) and the focus of their implemented supply chain strategy.

4.3 Management of supply chain drivers

As already mentioned there are nine supply chain driver components across the six supply chain drivers. The shaded areas in Table 3 show where the firms are managing their supply chain drivers for agility according to theoretical principles. A four point Likert scale was used (where 1 = a very strong focus on lean supply chain principles to 4 = a very strong focus on agile supply chain principles) to determine the extent to which these firms were managing their supply chain drivers according to agile supply chain

principles. A response of three or four was deemed satisfactory to indicate that the supply chain drivers components were being managed according to agile supply chain principles.

Firm D was managing three of the nine supply chain driver components (33,3%) according to agile supply chain principles. The three supply chain driver components that were being managed according to agile supply chain principles were transportation frequency, information management and supplier selection. Firms F and H were also managing these same three supply chain driver components according to agile supply chain principles from literature. However, firms F and H were also managing capacity utilisation according to agile supply chain principles. Therefore Firms F and H were managing 44,4% of their supply chain driver components according to agile supply chain principles.

Firms G and L were managing five of the nine supply chain driver components according to agile supply chain principles. Firm G did not respond to one component, namely supplier selection. Therefore, firm G was managing 62,5% and firm L was managing 55,5% of their supply chain driver components according to agile supply chain principles. Three of the five components that firms G and L were managing according to agile supply chain principles from the literature review were similar. They were transportation flexibility, transportation frequency and information management. Additionally, firm G was managing location of facilities and lead times for agility while firm L was also managing supplier selection, as well as pricing and profit margins for agility according to theoretical principles. Firm K was managing only pricing and profit margins (11,1%) according to agile supply chain principles.

5. Conclusions and recommendations

This article suggests theoretical guidelines for firms to manage agile supply chains. Supply chains that demonstrate characteristics of an unpredictable market demand and with agility as market winner should implement an agile supply chain strategy. According to theory, if firms in supply chains (1) have an unpredictable market demand and low cost as market winner, or (2) have a predictable market demand and agility as market winner, an agile supply chain strategy is suggested to firms that are positioned downstream from the decoupling point. In agile supply chains, the supply chain drivers will be managed to achieve agility. There are six supply chain drivers. They are facilities, inventory, transportation, information, sourcing and pricing margins. The article highlighted how these supply chain drivers ought to be managed to achieve responsiveness according to theoretical principles.

Based on the characteristics (identified in literature) of their supply chains, six of the thirteen firms needed to have an agile supply chain strategy and they were included in the research in this article. As in Table 2, the shaded areas in Table 4 show which of these six firms are purposefully implementing an agile supply chain strategy that is in line with the characteristics of the supply chain according to theoretical principles. Table 4 also shows how many supply chain driver components (also expressed as a percentage) are being managed in line with agile supply chain principles from literature by each firm.

Based on the supply chain characteristics of market demand predictability, market winners and the decoupling point (if necessary), firms D, G and K (not shaded in tables 2 and 4) should consider focussing on an agile supply chain strategy.

The six firms for which an agile supply chain is suggested do not manage all their supply chain drivers according to agile supply chain principles. Not one firm was managing more than five of the nine supply chain driver components according to agile supply chain principles from literature. Moreover, not one of the nine supply chain driver components was managed according to agile supply chain principles by all six firms. Five firms were managing two of the nine supply chain driver components (transportation

frequency and information management) according to agile supply chain principles. Four firms were managing supplier selection according to agile supply chain principles. One firm did not indicate how it was managing the selection of its suppliers. Not one firm was managing inventory levels according to theoretical agile supply chain principles. Therefore, it can be concluded that transportation frequency, information management and supplier selection were the three supply chain driver components that were being managed correctly by the majority of firms for agility according to theoretical agile supply chain principles.

Specific guidelines were identified from literature for firms to manage their supply chain driver components for agility. These were summarised in Table 1. Table 5 presents these guidelines as possible suggestions to the firms that formed part of the research for this article. Each firm mentioned in Table 5 should consider the suggested strategy for agility which is mentioned alongside the specific supply chain driver component.

It is clear from table 5 that the supply chain drivers of capacity utilisation, location of facilities, inventory levels, lead times, transport flexibility and price margins are problematic in the management of agile supply chains. Transportation frequency, information and supplier selection are supply chain drivers that are managed according to agile supply chain strategy.

In conclusion, the theoretical guidelines to manage agile supply chains could be useful. It clearly indicates when firms should be implementing an agile supply chain strategy based on theoretical principles of specific supply chain determinants. It then clearly indicates how firms with agile supply chain strategies should be managing their supply chain drivers. However, these theoretical guidelines were tested in only six firms. The testing of these guidelines was thus very limited, but provides some insight into the need for firms to analyse their supply chain management practices for agility. In some cases, there may be potential for improvement and further research will help to improve (or fine tune) these theoretical guidelines mentioned in the article.

6. Figures and Tables

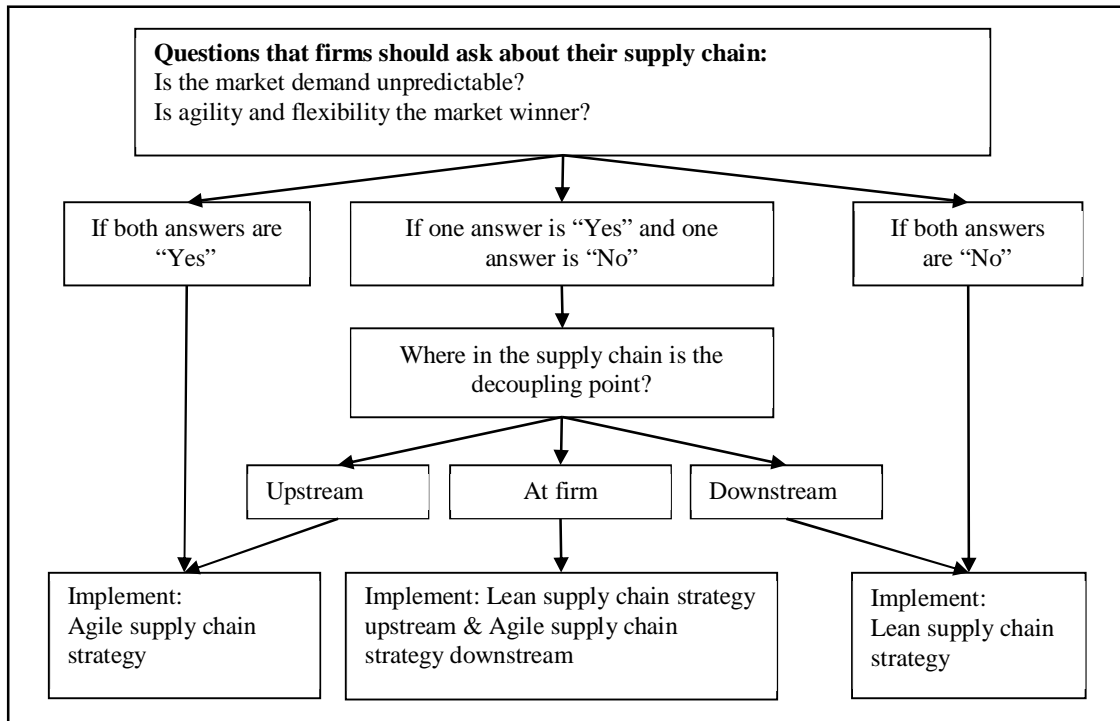


Figure 1: Suggesting a supply chain strategy based on supply chain characteristics

Source: Authors

Table 1: Theoretical guidelines on how to manage supply chain drivers for agility

Supply chain driver	Supply chain driver component	Management for agility (Responsiveness)
Facilities	Capacity utilisation	Allow for excess capacity to be flexible to meet unexpected customer demands.
	Location of facilities	Decentralise with many smaller facilities closer to customers
Inventory	Inventory levels	Maintain buffer (or safety) stocks (in supply chain)
Transportation	Lead times	Select fast means of delivery to reduce lead times
	Transportation flexibility	Use flexible modes of transport to meet customer needs
	Transportation frequency	Use more frequent shipments
Information	Information	Invest in information systems to collect real time market demand and ensure visibility with reliable supply chain partners.
Sourcing	Supplier selection	Select suppliers based on speed, flexibility, superior quality and dependability (cost considerations are important but of secondary importance).
Pricing	Pricing margins	Use high profit margins

Source: Compiled from Chopra and Meindl (2013); Coyle et al. (2013); Hugos (2011); Simchi-Levi et al. (2009) and Waters (2009).

Table 2: Alignment between suggested and implemented agile supply chains

Firm:	Agile supply chain strategy is suggested based on supply chain characteristics	Agile supply chain strategy is the focus of the current implemented supply chain strategy
D	Yes	No
F	Yes	Yes
G	Yes	No
H	Yes	Yes
K	Yes	No
L	Yes	Yes

Table 3: Management of supply chain drivers according to agile supply chain principles

Supply chain driver components	Firm's management according to agile supply chain principles:					
	D	F	G	H	K	L
Capacity utilisation	No	Yes	No	Yes	No	No
Location of facilities	No	No	Yes	No	No	No
Inventory levels	No	No	No	No	No	No
Lead times	No	No	Yes	No	No	No
Transportation flexibility	No	No	Yes	No	No	Yes
Transportation frequency	Yes	Yes	Yes	Yes	No	Yes
Information	Yes	Yes	Yes	Yes	No	Yes
Supplier selection	Yes	Yes	No response	Yes	No	Yes
Pricing and profit margins	No	No	No	No	Yes	Yes

Table 4: Summary of firms' agile supply chain strategy practices

Firm:	Agile supply chain strategy is suggested based on characteristics	Agile supply chain strategy is the focus of the current implemented supply chain strategy	Supply chain driver components managed according to agile supply chain principles from literature.
D	Yes	No	3 out of 9 (33,3%)
F	Yes	Yes	4 out of 9 (44,4%)
G	Yes	No	5 out of 8 (62,5%)
H	Yes	Yes	4 out of 9 (44,4%)
K	Yes	No	1 out of 9 (11,1%)
L	Yes	Yes	5 out of 9 (55,5%)

Table 5: Suggestions for firms on how to manage supply chain driver components for agility

<i>Supply chain driver component</i>	<i>Suggested strategy for agility</i>	<i>Firm that needs to consider this strategy:</i>
Capacity utilisation	Allow for excess capacity to be flexible to meet unexpected customer demands.	D, G, K & L
Location of facilities	Decentralise with many smaller facilities closer to customers	D, F, H, K & L
Inventory levels	Maintain significant buffer (or safety) stocks (in supply chain)	D, F, G, H, K & L
Lead times	Select fast means of delivery to reduce lead times	D, F, H, K & L
Transportation flexibility	Use flexible modes of transport to meet customer needs	D, F, H & K
Transportation frequency	Use more frequent shipments	K
Information	Invest in information systems to collect real time market demand	K
Supplier selection	Select suppliers based on speed, flexibility, superior quality and dependability (cost considerations are important but of secondary importance).	K
Pricing margins	Base profit margins on higher pricing margins	D, F, G & H

References

1. Bozarth, C.C. & Handfield, R.B. (2013). *Introduction to operations and supply chain management*. Boston: Pearson.
2. Burt, D.N., Petcavage, S.D. & Pinkerton, R.L. (2012). *Proactive purchasing in the supply chain: the key to world-class procurement*. New York: McGraw-Hill.
3. Chopra, S. & Meindl, P. (2013). *Supply chain management: Strategy, planning and operation*. Boston: Pearson.
4. Christopher, M. (2011). *Logistics and supply chain management*. Harlow, Pearson.
5. Christopher, M. (2004). Supply chains: A marketing perspective, in S. New & R. Westbrook (eds.). *Understanding supply chains: Concepts, critiques and futures*. New York: Oxford University Press. 23–42.
6. Coyle, J.J., Langley, C.J. (Jr), Novack, R.A. & Gibson, B.J. (2013). *Managing supply chains: A logistics approach*. Canada: South-Western Cengage Learning.
7. Gattorna, J. (2010). *Dynamic supply chains*. Harlow, Pearson.
8. Gligor, D.M. (2014). The role of demand management in achieving supply chain agility. *Supply Chain Management: An International Journal*, 19/5/6:577-591.
9. Gligor, D.M. & Holcomb, M.C. (2012). Understanding the role of logistics capabilities in achieving supply chain agility: a systematic literature review. *Supply Chain Management: An International Journal*, 17/4:438-453.
10. Hallavo, V. (2015). Superior performance through supply chain fit: a synthesis. *Supply Chain Management: An International Journal*, 20/1:71-82.
11. Hilletoft, P. (2012). Differentiation focused supply chain design. *Industrial management & Data Systems*, 112(9):1274-1291.
12. Hopp, W.J. (2008). *Supply chain science*. Boston: McGraw-Hill Irwin.
13. Hugos, M. (2011). *Essentials of supply chain management*. Hoboken, NJ: John Wiley.
14. Jacobs, F.R. & Chase, R.B. (2014). *Operations and supply chain management*. New York: McGraw-Hill Irwin.
15. Leach, A. (2013). Flexibility will differentiate supply chains in future. *Supply Management*. Available at <http://www.supplymanagement.com/news/2013/flexibility-will-differentiate-supply-chains-in-the-future>. Accessed 2013/08/19
16. Lyons, K. & Farrington, B. (2012). *Purchasing and supply chain management*. Harlow: Pearson.
17. Mangan J, Lalwani C, Butcher T & Javadpour R. (2012). *Global logistics and supply chain management*. Chichester, West Sussex: Wiley.
18. Mason-Jones, R., Naylor, B. & Towill, D.R. (2000). Lean, agile or leagile? Matching your supply chain to the marketplace. *International Journal of Production Research*, 38(17):4061–4070.
19. Mehralian, G., Zarenezhad, F. & Ghatari, A.R. (2015). Developing a model for an agile supply chain in pharmaceutical industry. *International Journal of Pharmaceutical and Healthcare Marketing*, 9(1):74-91.

20. Qrunfleh, S. & Tarafdar, M. (2013). Lean and agile supply chain strategies and supply chain responsiveness: the role of strategic supplier partnership and postponement. *Supply Chain Management: An International Journal*, 18/6:571-582.
21. Reid, R.D. & Sanders, N.R. (2007). *Operations management: An integrated approach*. Hoboken, NJ: John Wiley.
22. Ross, D.F. (1998). *Competing through supply chain management: Creating market-winning strategies through supply chain partnerships*. New York: Chapman & Hall.
23. Schroeder, R.G., Goldstein, S.M. & Rungtusanathan, M.J. (2013). *Operations management in the supply chain: decisions and cases*. New York: McGraw-Hill Irwin.
24. Sharma, S.K. & Bhat, A. (2014). Modelling supply chain agility enablers using ISM. *Journal of Modelling in Management*, 9(2):200-214.
25. Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E. (2009). 3rd ed. *Designing and managing the supply chain: Concepts, strategies, and case studies*. Boston: McGraw-Hill.
26. Swink, M., Melnyk, S.A., Cooper, M.B. & Hartley, J.L. (2014). *Managing operations across the supply chain*. McGraw-Hill Irwin, New York.
27. Waters, D. (2009). *Supply chain management: An introduction to logistics*. London: Palgrave Macmillan.
28. Webster, S. (2008). *Principles and tools for supply chain management*. McGraw-Hill, New York.
29. Wisner, J.D., Tan, K-C. & Leong, G.K. (2012). *Principles of supply chain management: A balanced approach*. Mason, Ohio: South-Western Cengage Learning