Low cost country sourcing complexities and supply chain strategies

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Abstract

This paper analyses Low Cost Country Sourcing (LCCS) complexities and examines how firms manage to overcome these complexities through supply chain strategies. The purpose of this research is to suggest appropriate supply chain strategies based on material flow and contractual relationships, to align product and process complexities. The findings of this research are useful to supply chain practitioners for leveraging product and process complexities into competitive advantage.

Keywords: Complexity, Low cost country sourcing, Supply chain strategy

Introduction

Global sourcing is defined as management of R&D, manufacturing and marketing interfaces on a global basis. Global sourcing involves identifying typical production that would serve a particular market and various means of components supply. This process exploits a firm's own advantages and the comparative advantages of various countries (Kotabe, 1994). Globalisation has been identified as having two phases. In the first phase, trade flows were centred on goods to and from developed countries, whereas in the second phase services, information and knowledge are sourced not only from developed countries but also from developing countries with emerging and transition economies (Baldwin and Martin, 1999). The use of LCCS implies the coordination and integration of procurement requirements of worldwide business units, through acquisition of goods and services from suppliers in countries with a lower comparative price level than that of the buying firm's home country (Lockstrom, 2007).

It is commonly believed that LCCS is adopted by firms to lower cost. However, in actual practice LCCS provides other advantages, such as the acquisition of advanced production technologies through the setting up of joint ventures and strategic alliances (Bozarth et al., 1998); shortened product life cycles; an influence on end-product prices;

the reduction of the total cost of ownership for acquired supplies; the involvement of suppliers in responding to end-customers requirements and reducing the supplier base (i.e. moving towards fewer, but more strategic, suppliers) (Trent and Monczka, 1998).

We find through our literature review that traditionally LCCS goods were sourced to a 70 percent greater extent than services (Quinn, 1999). This most likely continues because of the complex nature of services. Services involve a higher degree of social interaction, which is sometimes restricted by language and cultural barriers, thus further complicating the issue (Vargo and Lusch, 2004).

It is evident from the literature that there are numerous challenging factors, such as what to procure from LCCS; complexity / heterogeneity; rate of change; volatility and managerial perception of uncertainty; type of channel preferred; flexibility; efficiency; responsiveness; type of supplier involvement; cross functional collaboration and spend consolation (Burgeois, 1980; Lockstrom, 2007). These challenges could be addressed by understanding various complexities in supply chains and adopting suitable supply chain strategies. The complexities of supply chains are related to numerousness, variety of business processes and number of interacting pairs.

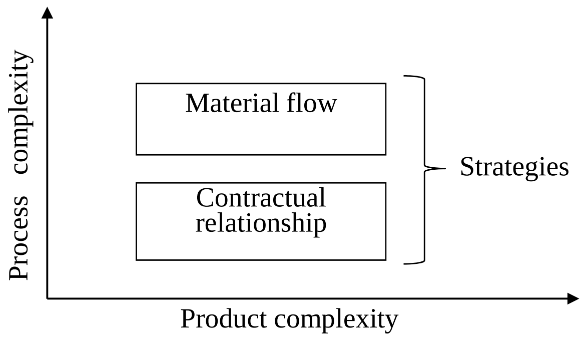


Figure 1- Product-process complex mapping

Supply chain complexities can be classified with respect to product and process. Product complexity refers to number of components, materials, process stages, technologies, performance criteria, technological difficulty in design, manufacture and assembly of a product. Process complexity refers to supply base; with aspects such as number of suppliers, methods of supply, methods of cost calculation, difference in capabilities, several operational practices and different modes of connectivity. Supply chain complexity is driven by internal drivers, such as managerial decisions, and external drivers, such as uncertainty and dynamics in the marketplace (Kaluza et al., 2006). Aligning proper material flow and contractual relationship strategy with respect to complexity, as shown in Figure 1, is a challenging managerial decision to be taken by top level organisations. The purpose of this research is to suggest appropriate supply chain strategies based on material flow and contractual relationships, to align product and process complexities.

Complexity

Complexity science is the study of the phenomena that emerge from a collection of interacting objects. To a certain extent complexity could be defined as the situation in which a collection of objects are competing for some kind of limited resource. In some instances, it is difficult to exactly define complexity, in such scenarios it could be viewed in terms of its characteristics, such as when a system contains a collection of many interacting objects or "agents", the behaviour of these objects is affected by memory or "feedback". The objects can then adapt their strategies according to their history: whether the system is typically "open", appears to be "alive", or exhibits emergent phenomena which are generally surprising (and may be extreme). Emergent phenomena typically arise in the absence of any sort of "invisible hand" or central controller (Johnson, 2007). The space of complexity is that state which the system occupies and which lies between order and chaos. It is a state which embraces paradox; a state where both order and chaos exist simultaneously. It is also the state in which maximum creativity and possibility exist for realization and exploration. In consideration of the space of complexity, chaos is defined as the deterministic behaviour of a dynamic system in which no system state is ever repeated (Chapman, 2009; Wilding, 1998).

Gottinger (1983) stated that if we are not in a position to describe the complexity of an object, then there is more scope to learn about the object. More recently, Choi and Krause (2006) showed the impact of complexity on firms' business efficiency and performance. They referred to process complexity and identified how the suppliers in a supply base are different in various aspects and how they interact with one another. They also argued that the degree of supply base complexity affects transaction costs, supply risk, supplier responsiveness and supplier innovation. In terms of product complexity, a framework to measure complexity in a new product's development phase has been proposed by Barclay and Dann (2000)**.** They viewed product complexity in terms of structural complexity, functional complexity, product newness and other commercial constraints. Attempts were made to quantify complexity (Mariotti, 2008).

It is evident from the above discussion that LCCS may lead to more complexities. To the best of our knowledge there are no studies from a collective perspective citing the important constituent factors of complexity, in terms of both the products and processes that take place between a firm and its suppliers. We make an attempt, through a literature review, to classify the factors based on the tangible and intangible nature of both product and process, which is summarised in Table 1. We classify tangible product and process complexities into the categories of numerousness and differentiations, as well as number of interacting pairs and level of inter-relationship. Based on the sourcing characteristics suggested by Fredriksson and Jonsson (2009), intangible process complexities have been categorised as human capital, culture, infrastructure and policies and regulations.

Table 1- Tangible and Intangible process and product complexity factors

Tangible process complexity factors	**Tangible product complexity factors**
Numerousness • number of suppliers • methods / channel of supply • supply lead-time variations • total landed cost • mass production and mass customization • number of interfaces and systems • proximity to supplier location	*Numerousness* • number of components for assembly products • number of materials for all product types, except software (number of lines in this case) • number of process stages • number of technologies • number of performance criteria
Differentiations • difference in technical capabilities • several operational practices • Number of logistics constraints	*Differentiations* • technological difficulty in design, manufacture and assembly
Number of interacting pairs and level of inter-relationships • Different modes of connectivity • Number of inter relations	*Number of interacting pairs and level of inter-relationships* • Degree of interrelatedness or connectivity (number of interfaces among components and strength of interrelationships between components)
Intangible process complexity factors	**Intangible product complexity factors**
• *Human capital:* lack of supplier skills and knowledge; complexity of cognition. • *Culture:* criminality and corruption, cost for exiting legacy assets and quality problems, price erosion from increased competition, language and political instability, organizational culture, cultural difference, prioritization of other business initiatives. • *Infrastructure:* increased comparative price levels, complexity of network constellation and configuration, opacity, sharing information, describing and demarcation of the supply chain, time zones. • *Policies and regulations:* currency risks, intellectual property risks, risk of supply, regulations and laws, lack of a holistic view, different perspectives and ignorance, volatility in demand, dynamic customer requirements.	• Aesthetic appearance • Safety of product • Style • Comfort • Flavour • Smell • Texture • Handling

Supply Chain Strategies

The fundamental objective of a typical supply chain strategy is to ensure smooth flow at minimum cost (Christopher et al., 2006). However, it is not easy to identify an appropriate strategy, based on product and process complexities. Christopher et al. (2006) argued that sourcing strategy, operations strategy and route to market need to be appropriate to specific product market conditions. Chopra and Meindl (2007) stated that supply chain strategies determine the nature of material procurement, transportation of materials, manufacture of product or creation of service and distribution of product. Fisher (1997) explained the need of different supply chain strategies for functional and innovative products with examples from a diverse range of consumer products including food, fashion apparel and automobiles. The taxonomy, suggested by Christopher et al. (2006), for selecting an appropriate supply chain strategy for material flow, is based on product uncertainty and lead time. The success of Japanese firms in the early 80s and 90s prompted practitioners and academics to examine their firm-supplier relationships. Firms started concentrating on methods to develop long-term, close-knit and cooperative relationships with suppliers (Liker and Choi, 2004; Jean et al., 2010). The next section describes a few supply chain strategies based on material/service flow and contractual relationships between supplier and manufacturer.

Material/service flow strategies in supply chains

There are four material/service flow strategies in supply chains: agility, lean thinking, leagile and risk-hedging. Each is outlined briefly below.

Agility: Agility is primarily concerned with responsiveness—the ability to match supply and demand in turbulent and unpredictable markets. The key characteristic of agility is flexibility. Lockstrom (2007) predicted that many smaller, more agile firms would gain market share at the expense of the industry titans that find it more difficult to change with product and process requirements. Agility is a strategy most suitable for highly innovative products, with more uncertain demand and supply as it is a strategy which adapts inventory pooling, or dual sourcing, to absorb uncertainty. A good example of agility is the case of Zara, the Spanish fashion garment manufacturer and retailer (Christopher, 2006).

Lean: The idea of lean thinking was developed by Womack and Jones (1996), among others. The focus of lean thinking has been on the elimination of waste. Christopher (2000) has suggested that the lean concept works well when demand is relatively stable, predictable and variety is very low. This minimises the cost of making and delivering the product to the customer. This strategy is most applicable to functional products with a lower uncertainty of demand and supply. A lean strategy is followed by Procter & Gamble to manage its supply chain for volume products to Wal-Mart in the USA.

Leagile: Leagile is a hybrid strategy that combines lean and agile principles. Lean principles are used for predicable, standard products and agile principles for unpredictable or special products. Leagile principles are used for unpredictable demand and long lead times. Leagile is used as a classic postponement strategy by Hewlett Packard for its range of desktop printers (Christopher et al., 2006).

Risk-hedging: Risk-hedging is applicable for less demand uncertain product (functional) and high supply uncertain supply processes (evolving processes). An example given by Christopher et al. (2006) is a million plastic Christmas trees ordered each year by the UK retailer Woolworths from its numerous suppliers in China.

Contractual relationship strategies

To understand contractual relationship strategies one needs to be cognisant with the components: what are the relationships involved, what is supply chain integration and how do these impact type of channel preferences.

Relationship: A supplier's relationship varies from a transactional to a strategic one. Nordin (2008) suggested this, based on transaction cost theory claiming that a translational relationship is applicable for products with low uncertainty and large volume, and an integration or partnership type supplier relationship is when the uncertainty is higher and volumes lower. Rycroft and Kash (1999) postulated that complex technologies are innovated by equally complex innovation networks (strategic alliances, research consortia) involving firms, universities, government agencies and other organisations. Recently, Jean et al. (2010) hypothesised that there is a positive relationship between technological uncertainty and a transactional relationship.

Supply Chain Integration: Supply chain integration deals with technology and knowledge integration, information sharing, trust and joint sense making (Myers and Cheung, 2008). Advanced IT systems have been widely adopted for improving the efficiency of global business operations. International OEMs are willing to share critical information and knowledge with a trustworthy supplier in a cross-border relationship. Selnes and Sallis (2003) have argued that the greater the environmental uncertainty, the greater the supply chain integration, within or between firms. The logic of this argument is that firms will be willing to share more critical knowledge to overcome the adaptation problems caused by environmental uncertainty, including difficulties in forecasting sales volumes and volatility in sales and market share.

Type of channel preferred: Decision on type of channel preferred depends on the mode of purchase, which can be direct purchasing from low cost country (LCC) supplier (DPS), purchasing from LCC supplier through foreign subsidiary (PFS), purchasing from LCC through a supplier's subsidiary in home country (SSH), purchasing through a third-party intermediary (P3P), or purchasing through International Procurement Office (IPO). According to Hall (1976), people in a high-context culture, such as Japan or China, rely on the communication context more than those in a low-context culture, such as the United States or Germany. That is, people from high-context cultures mainly try to obtain information from their personal information network. In contrast, people from low-context cultures seek information from a research base or use information sources such as reports, databases, and the internet. A high-context culture that emphasizes human elements and personal relationships in communication will have better trust-building processes (Rosenbloom and Larsen 2003).

Aligning complexities with supply chain strategies

This section discusses, through literature, the nature of alignment required to minimise complexity in the supply chain. High value-added competition is based on the innovation of technologies that are knowledge intensive (supported by large investment in R & D) and complex. Examples include automobiles, aircraft and telecommunication equipment. These are the technologies that underpin the major knowledge-based economies, provide the most prized competitive advantages and support a host of non-economic capabilities as well such as health care, national security and environmental protection (Rycroft, 2007). In the literature we found some evidence that increased relationship integration enables firms to examine, and re-examine, their own product strategies, creating more opportunities to develop new products (Chen, et al. 2008). With greater technological uncertainty in the global supply chain, suppliers need more critical information from their customers (OEMs) to keep ahead of the competition. Moreover, demand-driven supply networks have forced dominant customers to outsource part of their high-level value-adding activities, including new product development, to small suppliers. In a more unpredictable technological environment, customers are willing to share knowledge with their small suppliers, to maintain their product quality and develop better new product strategies. Branded OEMs such as Apple and IBM collaborate with many original development manufacturers to develop next-generation products, mobile phones and laptops for example. These companies share much critical information about end-user preferences and market trends with their innovative original development manufacturers (Jean et al., 2010). Other examples include Boeing, which has outsourced the design of wing parts to Russia and Texas Instruments and Intel which have each outsourced the development of devices to Indian firms (Engardio et al., 2003). Nordin (2008) stated that cost could be reduced if suppliers were kept at arms length in transactional relationships and contracts awarded through competitive bidding. He also suggested transactional purchasing for simpler services bought in bulk as they have low asset specificity and uncertainty and do not directly impact on core business processes.

To explain our proposed alignments we use by way of example two products with varied product and process complexities, an aircraft and a car instrument panel. This is summarised in Figure 2.

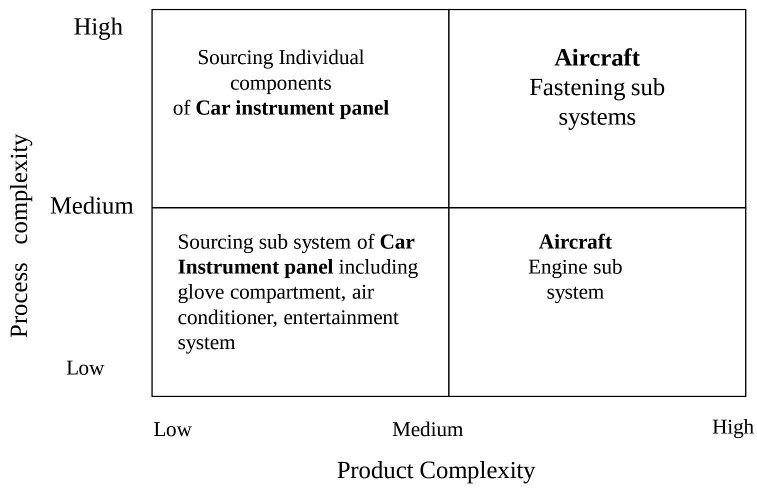
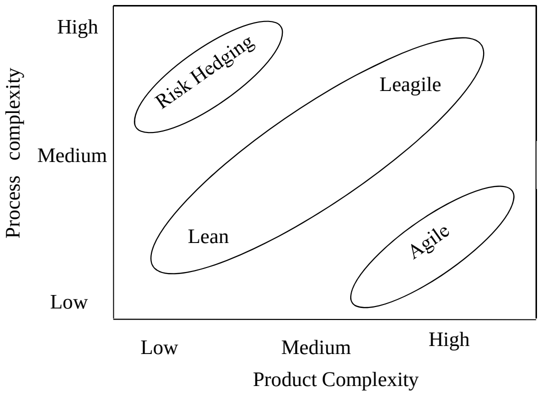


Figure 2: Examples illustrating different process complexity

Aircraft could be placed under the product category of medium to high product complexity spectrum and have various sub-systems which have varied categories of process complexity, such as the engine sub-system for low to medium process complexity and fastening sub-systems (such as inserts and locknuts) could be treated as belonging to the high process product complexity category. It is assumed that an engine sub-system would sit in the low to medium process complexity category as an aircraft manufacturer (e.g., Boeing, airbus) is most likely to have only limited suppliers (e.g., Rolls Royce, Honeywell) so the number of managed interfaces would be minimal and of limited variety as there is not much difference in technical capability among suppliers and limited modes of connectivity. However, in the case of fastening sub-systems the aircraft manufacturer could procure from different suppliers (e.g., Aircraft Fasteners Ltd) with different capabilities and product systems, hence this component is assumed to be in the medium to high process complexity category.



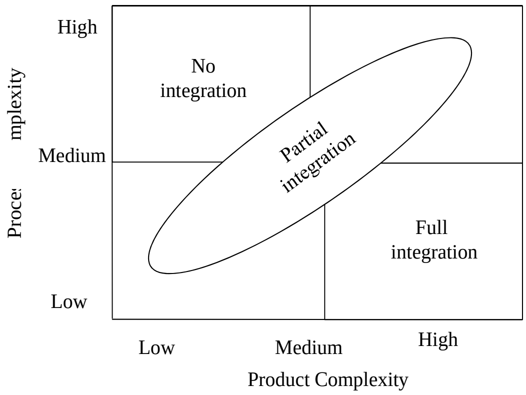


Figure 3 – Complexity and material flow strategies

Figure 4 – Types of integration

If product complexity is from medium to high then, based on process complexity, it can be aligned using a leagile supply chain strategy (Figure 3). If process complexity is from low to medium it can be aligned with an agile strategy. In the aircraft example, agile strategy for the engine sub-assembly is used to align low to medium process complexity. The aircraft manufacturer would be dealing with one or two suppliers and, in turn, suppliers should be responsive enough to take care of changes in demand, variety, lead time and innovation. With respect to integration, they should have full integration with suppliers (Figure 4). This would include processes such as regular monitoring and face-to-face communication. A strategic peer-to-peer relationship is necessary for them to succeed (Figure 5), as well as having an IPO at the supplier's location (Figure 6). Jean et al. (2010) emphasised that in a high-context culture, firms rely more on person-to-person relationships to communicate with supply partners. They have indicated that, to augment integration, close relational bonding and ties can facilitate information sharing, and thus aid the development of innovative behaviours. Nordin (2008) emphasises the importance of close collaboration and a strategic relationship when there is greater complexity, and lower standardisation, of the products and services offered.

If the process complexity is from medium to high, then a leagile strategy would be used to align with the medium to high product complexities. In the case of fastener sub-assembly there could be many suppliers with many variations. To avoid disruptions, the manufacturer has to pool inventory to meet the uncertainties. In terms of alliance a partial integration would be appropriate as would a consultant client relationship. When it comes to preferred channel, the most appropriate would be to purchase from LCC through a SSH or purchase through a P3P. Similarly the sourcing of car instrument panel can be explained using Figure 3- Figure 6.

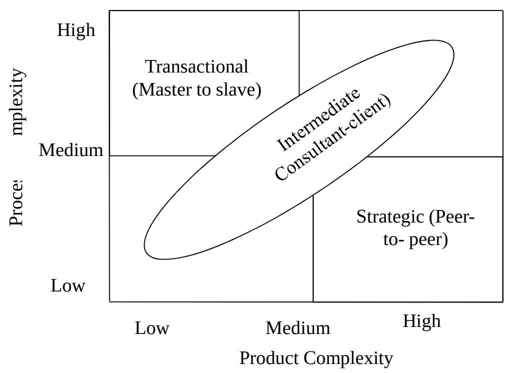


Figure 5- Types of relationship

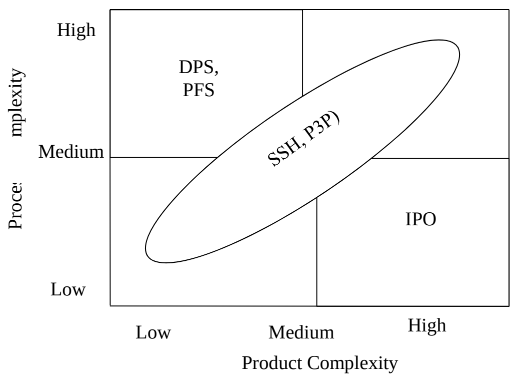


Figure 6- Types of channel

Concluding remarks

This paper analyses the complexity issues in a supply chain when a low cost country sourcing strategy is adopted and attempts to classify product and process complexities. A major outcome of this work is an examination of the complexities, in terms of supplier and firm perspectives. Both the product and the supply process complexity have been considered. This study also takes into account both tangible and intangible complexity factors. An attempt has been made to align product and process complexities with different types of supply chain material flow and contractual relationship strategies. The strategy alignment has been illustrated with simple examples.

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