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## **Assessing the challenges and opportunities of global supply chain management**

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## Assessing the challenges and opportunities of global supply chain management

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**Abstract:** Business organisations all over the world are striving hard to evolve strategies to survive in the new era of competition ushered in by globalisation. Global Supply Chain Management (GSCM) is one such strategy. In this paper, various countries across the world have been separated on the basis of various regions and development in their respective economies. To compare the degree of implementation of an ideal supply chain in these countries, a Supply Chain Management Index (SCMI) has been formulated with the help of questionnaire survey and analysis. The difference between the SCMI of underdeveloped, developing and developed nations with respect to the ideal SCMI has been evaluated by using the method of gap analysis. Various strategies have been suggested for different economies in the world for optimising their supply chain network and improving its respective SCMI. Opportunities and challenges offered by the global supply chain, as suggested by various experts, have been pointed out and discussed thoroughly. The effect of bullwhip on global supply chain has also been analysed. Further, the factors affecting the GSCM have been identified and discussed.

**Keywords:** Global Supply Chain Management (GSCM); Supply Chain Management Index (SCMI); challenges; opportunities.

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College of Engineering and his ME (with distinction) in Industrial Engineering in 2002 from REC-Trichy. His area of research is global supply chain management and logistics.

Prem Vrat is a Director at IIT Roorkee, India. He obtained his BTech (Hons) in Mechanical Engineering in 1966 and his MTech (IE and OR) in 1968 from IIT Kharagpur. He received his PhD degree in IE and OR from IIT Delhi in 1974. Professor Vrat has more than 35 years of experience in teaching, research, and consultancy and management development at IIT Delhi. He has guided 30 PhD theses and 115 MTech dissertations. His research areas include system dynamics, productivity, supply chain management, value engineering, total quality management and optimisation of inventory systems. He has published more than 325 research papers in international journals and proceedings of international and national conferences. He has received seven best paper/case studies medals and prizes for his papers. He has been on the BOG of many technical institutes/universities, on the editorial boards of many international and national journals, and chairman, NWRC, AICTE.

Pradeep Kumar is a Professor in the Department of Mechanical and Industrial Engineering at IIT Roorkee. He earned his BE in Industrial Engineering in 1982, an ME in Production Engineering in 1989 and a PhD degree in 1994, all from University of Roorkee, Roorkee, India. His research interests include quality engineering, reliability analysis, product and process design, optimisation, nonconventional machining process and metal casting. He has published 90 papers in international and national journals and conference proceedings. He has supervised three PhD theses and several Graduate theses. He is a life member of national societies such as ISME and ISIAM.

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## 1 Introduction

Global competition is transforming the way products are produced and moved around the world. Globalisation brought a new structure into the business world called global supply chain. A global supply chain is a network of factories and material sourcing on a worldwide basis. International value chains are a mechanism by which firms can achieve a competitive advantage of either low cost or differentiation through the processing activities performed and their corresponding linkages with suppliers and buyers (Klassen and Whybark, 1994). These networks have to be carefully managed to improve quality and reduce cost as well as lead time. It requires controlling the inbound, outbound and procurement functions, with a supporting information system. These activities, nodes and linkages of the international value chain become spread out around the world, and therefore it is essential to coordinate the operations carefully. The first step in improving the coordination is to identify the present scenario of the supply chain management practices across countries, the challenges and opportunities and the salient factors that affect the performance of global supply chains.

The literature on supply chain management is quite extensive (Tan, 2001) and a number of articles deal with global supply chains. However, much of the literature is too general or focuses on a particular country. But the literature is limited in dealing with the degree of implementation of SCM practices across countries.

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## 2 The research

The research was undertaken with the following scope of work:

- to know the current practices of supply chain management followed across countries by developing a Supply Chain Management Index (SCMI) to benchmark one country's performance against another
- to find out the potential need for improvement that would increase the National Average of Supply Chain Management (NASCM) practices
- to identify the challenges and opportunities of the supply chain of a company when it operates or tends to operate globally
- to identify the major factors affecting the Global Supply Chain Management (GSCM).

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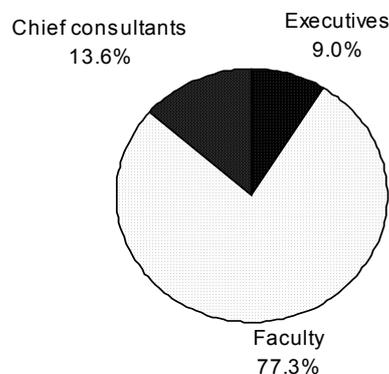
The main emphasis of this research is exploratory. For the purpose of this study, from all over the world around 26 countries were selected to identify the present state of the SCM practices. These countries were selected randomly on the basis of their economic growth (GDP) in the global market. The selected countries were China, India, Japan, Thailand, Singapore and Indonesia (in Asia); Sweden, the UK, Germany, France and Italy (in Europe); USA, Canada, Mexico and the Caribbean (in North America); Brazil, Argentina, Venezuela, Peru and Uruguay (in South America); South Africa, Botswana, Kenya and Ethiopia (in Africa) and Australia (in Australia).

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## 3 The survey

A survey instrument in the form of a questionnaire was used based on the constructs described. The survey questionnaire was mailed to 425 target experts from industries, academia and consulting organisations. For questions regarding the percentage of implementation of SCM concern, the respondents were asked to highlight their responses using a five-point Likert scale, and for the rest of the questions they were asked to select the salient factors and components among the listed items. Eventually, 44 usable responses were received with a response rate of 10.35%. Individuals who responded ranged from the senior level executives from companies (9.0%) to faculty from academia (77.3%) to chief consultants (13.6%), as shown in Figure 1.

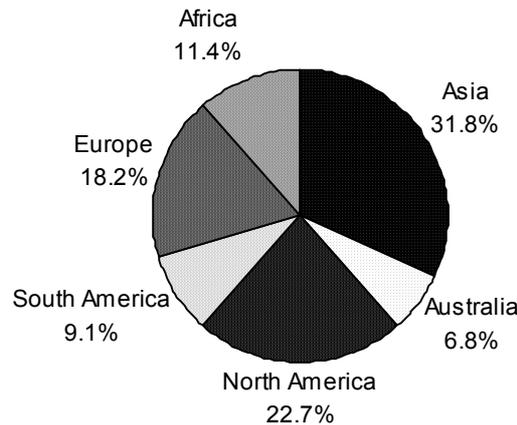
Figure 1 Respondents category



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The respondents are comparatively better from Asia, which constituted almost one-third (31.8%) of the total response, followed by North America (22.7%) and Europe (18.2%). The percentage of respondents for all the continents is given in Figure 2.

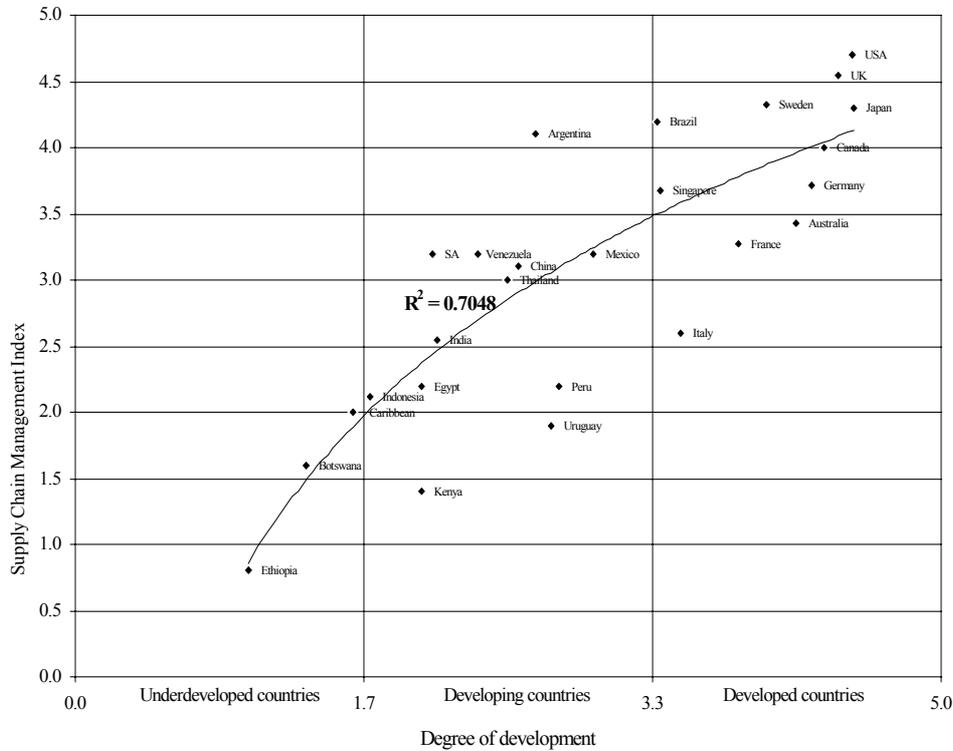
**Figure 2** Percentage of respondents by continental level



#### 4 Analysis

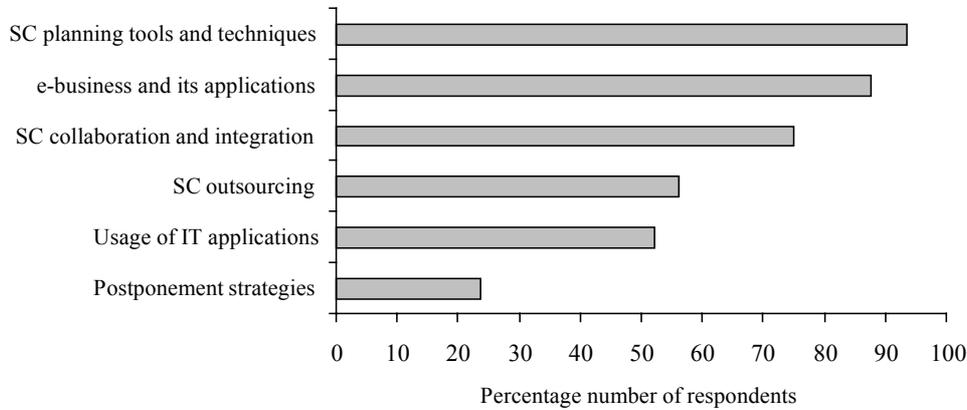
The SCMI for all selected countries was developed from the feedback collected (Figure 3). This figure has the degree of development on the  $X$ -axis and SCMI on the  $Y$ -axis (both axes are drawn on a five-point Likert scale). A regression analysis was performed in order to measure the percentage of variation among data. The regression line of  $Y$  on  $X$  has been drawn with coefficient of determination ( $R^2$ ) = 0.7048, and it defines the proportion of variance in common between two variables ( $X$  and  $Y$ ). From this  $R^2$ , the correlation coefficient value ( $R$ ) was found to be 83.95%. It also gives the quality of least squares fitting to the original data. This analysis shows that a strong positive correlation exists between the two variables and that the national average of SCMI can be improved by increasing the degree of development. Countries having an SCMI of 5 are ideal in nature. This is the target index for all countries irrespective of their present degree of development. Countries like the Caribbean and Indonesia are very close to the margin of the underdeveloped and developing stages, with SCMI of 2.0 and 2.12, respectively. Similarly, the degree of development of Singapore and Brazil are also close to the margin of developing and developed stages, with SCMI of 3.67 and 4.20, respectively. The SCMI of India and Italy are almost equal (2.55 and 2.61), but differ in their degrees of development (2.08 and 3.5). The gap between the present SCMI and the ideal SCMI (five points) is the focus of all countries. This gap is very large for Ethiopia (4.2) and very small for the USA (0.3). In order to reduce the gap and improve the present SCMI, all countries need to look at their respective potential areas for improvement.

**Figure 3** Locations of countries on supply chain scale



The experts' feedback plotted in Figure 4 shows the potential practices that would increase the national average of SCM indexes. These various potential practices have been ranked in the order of importance given by the respondents. However, there is no statistical difference at the significance level between the first and the last of these practices. All of the potential areas are of equal standing in the eyes of respondents. Even though the current utilisation of supply chain planning and control tools and techniques is at a relatively moderate level, many of these tools and techniques are in their infancy (Olhager and Selldin, in press). More interestingly, the high awareness of Supply Chain Planning Tool and Techniques (SCPTT) (such as Vendor Managed Inventory (VMI), Advance Planning and Scheduling (APS) and Collaborative, Planning, Forecasting and Replenishment (CPFR)) was preferred by more than 90% of the respondents. Currently, many **MNCs** have invested in global electronic mail and **ERP** systems but have missed out on the international dimensions of supply chains. Recently, MNCs such as Welcome and P&G moved one step further to adopting CPFR principles in item promotions (Tyana and Wee, in press). By implementing proper supply chain planning tools, e-business tools and IT-enabled applications, the national average of SCMI can be improved drastically. Most of the responses iterated the need for these practices.

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**Figure 4** Potential areas for improvement

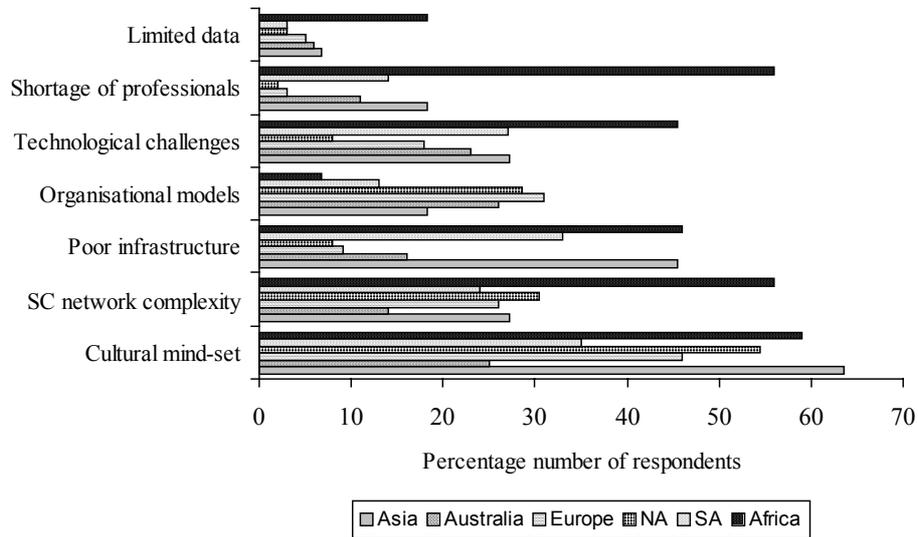
## 5 The critical global supply chain challenges

For a company to be competitive, its supply chain must be cost efficient, responsive, flexible and agile and must support customer requirements to receive the product they need in the right quantity, at the right time and at the right place. Ensuring the presence of all these characteristics is difficult anywhere. But in Asia – a region of enormously diverse languages, cultures, currencies, regulations, taxes, infrastructures, business practices, organisational forms and economic-development levels – attempting to optimise the supply chain can seem almost futile. Complicating matters further, this diversity exists not only among countries, but also among cities within the same country, in countries such as China and India.

The SCM concept is nascent in India (Vrat, 1998). The increasing uncertainty of supply networks, globalisation of businesses, proliferation of product varieties and shortening of product life cycles have forced Indian organisations to look beyond their four walls to collaborate with supply chain partners. On the other hand, African countries are facing many critical challenges. Most of the African countries are in the margin of the underdeveloped and developing stages. Expert feedback from Africa shows that it undergoes a series of challenges, like inferior logistics infrastructure, shortage of professionals, technological challenges and the present economy of the countries (Msimangira, 2003), whereas state-of-the-art technology, excellent infrastructure, availability of professionals and a developed economy are the strengths of countries like the USA, the UK, Sweden, Singapore, Argentina and Germany (Quayle, 2003). Hence, the SCMI of these countries are relatively improved.

Among the list of challenges (Figure 5), cultural mindset and supply chain network complexity are perhaps the most challenging factors irrespective of the countries' economic and geographic behaviours. Trust plays a major role in cultural mindset and is the foundation upon which information sharing and collaboration are built. Hence trust between supply chain partners plays a crucial role. The shortage of professionals is perhaps the least challenging factor for developed economies (European and US countries); on the other hand, it is a crucial factor for the least developed economies (African countries). Poor infrastructure is almost an equally challenging factor between most of the Asian and African countries.

**Figure 5** Supply chain challenges of each continent



A misaligned supply chain and misaligned flow of information can distort shareholder value. For example, at Christmas 1994, there was a disaster for the mobile phone maker Motorola. Owing to bad SCM, the company underestimated demand and ran out of mobile phones. Its distributors were fuming, and so were customers. Hence, at Christmas 1995, Motorola decided not to repeat the mistakes of the previous year and manufactured three times the stock. Again, Motorola did not communicate with their distributors, who over-ordered in anticipation of scarce stock. The result was the highest sales that Motorola had ever encountered. The stock market reacted and Motorola’s share prices shot through the roof in that quarter. But in the next quarter, Motorola announced a huge drop in sales and profits, as distributors were saddled with excess Christmas stock and the market supply readjusted itself. The mobile phone company’s share price dived. From then onwards, investors saw Motorola as unstable stock.

## 6 The weak links

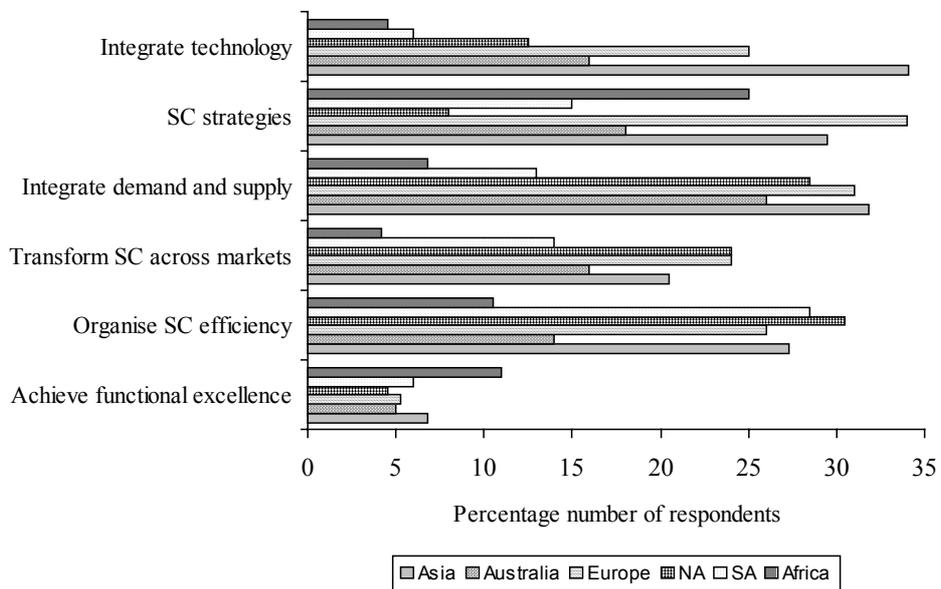
The strength of the supply chain is determined by its weakest link. What are these weak links? How can they be identified? When does a chain lose its strength? It is a great challenge for the managers to govern its flow from upstream to downstream. All supply chain challenges (including the floating challenges, like labour strike, trust between suppliers, uncertain government, internet security) may become weak links when their impact on the global chain reduces the chain’s strength. To give an example, the 17-day labour strike in March 1996 at the Delphi brake plant in Dayton resulted in a big shutdown of 26 General Motors Corporation assembly plants and affected the company’s first-quarter earnings by nearly \$1 billion. It emphasised the importance of maintaining healthy labour relations (Fitzgerald and Craig, 1996).

Banks are crucial in the third element, since money flow is one of the vital parts of the supply chain. They are the enablers of payment and settlement, and providers of finance and trust. In order to have smooth material and information flow, good understanding between the nodes of the supply chain is a must. But experts believe that this element is missing most of the time.

### 7 The global supply chain opportunities

With few exceptions, supply chains in Asia are more fragmented and less competitive than those in the USA and Europe. Depending on the country and the industry, supply chains in Asia lag three to five years behind the West in terms of creating efficiencies and improving effectiveness (Pyke *et al.*, 2000). Companies that do business in Asia need to aggressively work to close this performance gap and to look at the various opportunities. A golden opportunity for the present GSCM is the development of recent IT and communication, which leads to integrating the technology and system architecture (refer to Figure 6). But companies in Asia often embark on multiple supply chain projects without a coherent guiding supply chain strategy (Lamming, 2000). In fact, almost one-third of companies in India have no supply chain strategy (Sahay *et al.*, 2003). A more strategic SC approach leads to tax and duty optimisation and better end-of-life product management, which can reduce inventory obsolescence.

**Figure 6** Supply chain opportunities of each continent



This research shows that almost one-third of experts (75%, population mean) strongly believe in demand and supply integration across the enterprise. This can be seen in the case of the Toyota supply chain in Japan. The cost of variability of demand can be seen to be disproportionately higher in the UK than the negligible cost to the Toyota supply chain in Japan (Hines, 1998). This variability of demand as it moves from downstream to upstream in an SC is called the bullwhip effect and is discussed in detail in the latter part of this paper. Effective integration of supply and demand is a cornerstone of supply chain success. It is intuitive that companies striving for supply chain competitiveness must first organise for efficiency. This means optimising the whole and not its constituent parts.

Companies operating in European and US countries are signing in its functional excellence and technological competence. This acts as a great asset for them. Introduction of the Euro and free trade between selected European countries have added to their supply chain strength. With increased centralisation and added transparency, Accenture Inc. sees significant rationalisation opportunities and the emergence of supply chain shared-service centres in Asia and Europe. Across Asia, major opportunities exist for industries and companies to collaborate with the objective of enhancing their joint supply chain efforts. The experiences in the USA, Europe and Australia show that industry-level collaboration around data standards, protocol and pallet and container standards can lead to significant savings and efficiency.

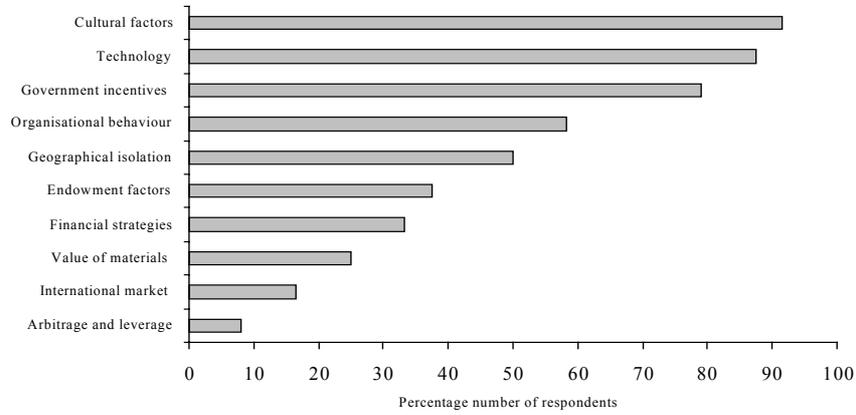
## 8 Factors influencing GSCM

The various factors affecting GSCM are geographical isolation, endowment factors, technology, arbitrage and leverage, *etc.*; Figure 7 depicts the percentage of number of respondents versus the various factors. Among the list of factors, cultural factor was responded to as the factor that most affects GSCM, with 91.6% favourable responses. Variations in cultural practices can cause errors in communication between the various nodes in a supply chain (Murphy and Dalenburg, 1989). Technology was considered the second most-critical factor next to cultural factor, with 87.5% favourable responses. Multinationals are more likely to employ advanced technologies than their domestic counterparts (Sum and Yang, 1993). Moreover, there needs to be a mechanism that allows for the flow of ideas, drawings and designs, and technical reports among the various nodes. For example, if engineers in Brazil find a new way to reduce process variability, that information should be promptly accessible to engineers in France in spite of the language barriers. The geographical isolation of Japan and New Zealand greatly affects their local manufacturers' in competing with global MNCs (Basnet *et al.*, 2003).

Government officials have realised the importance of having their country be a part of various MNC value chains (Prasad and Sounderpandian, 2003). Governments provide an array of incentives to multinationals so as to become a sourcing platform for them. Factors such as arbitrage and leverage (8%) and international markets (16.6%) were considered least important by the respondents. Countries around the world have considerable differences between them and can offer opportunities to gain competitive advantage. A country might be an attractive sourcing platform owing to its endowment and financial factors (the USA and UK). On the other hand, **it** might be a critical challenging factor for economically underdeveloped countries (Ethiopia and Botswana).

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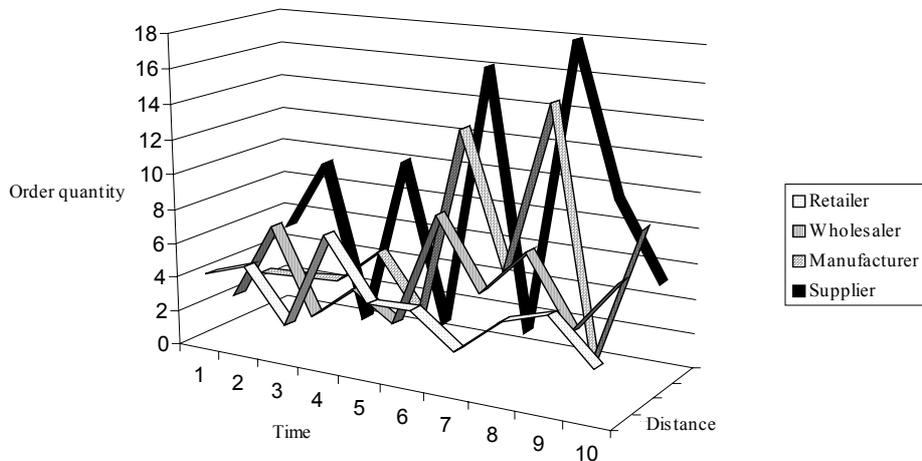
**Figure 7** Factors influencing GSCM



### 9 Bullwhip effect

The bullwhip effect is defined as the phenomenon of an increase in customer orders when it moves from downstream to upstream in a supply chain. The term ‘bullwhip’ is not a new concept. Though it was documented first by Forrester (1961), the name ‘bullwhip’ or ‘whipsaw’ was coined by Lee *et al.* (1997a–b). According to Lee *et al.*, a small variance in the demands of the downstream end customer may cause a dramatic variance in the upstream supplier’s side. The globalisation of supply chains leads to an increase in the time delays and the distances involved, and hence it further increases the bullwhip effect, as shown in 3-D in Figure 8. For example, Hyundai’s assembly plant is located in Chennai, India. Thousands of its spare parts are brought in from various countries and are assembled in this plant. The final quality-tested cars are then sent to European countries. A small amplification of the demand in its downstream side (Madrid) may cause amplified demand in its assembly plant (Chennai) and may be further amplified when it goes to the design centre in Seoul.

**Figure 8** Bullwhip effect in a global supply chain



Excessive inventory investments throughout the SC, poor customer service, lost revenue, variations in the logistics chain, missed production schedule and uncertainty in decision-making are the negative effects of the bullwhip effect. This effect can be reduced by implementing good web-enabled information sharing, just-in-time replenishment, batch ordering, price stabilising and shortage gaming.

## **10 Conclusions**

Supply chain management is an integrated concept. To keep the supply chain competitive, the integrated supply chain network should be monitored continuously and adapted to a dynamic international environment. Information systems are vital to the coordination of supply chain activities. In this paper, SCM indexes were derived through a questionnaire survey and analysis, and hence the strengths of a list of selected countries were identified. The sample size considered in this analysis was limited and the findings are tentative. This survey is able to provide an overview of the status of current SCMI and the degree of development of selected countries. Hence, increasing the sample size and number of countries across the world can extend this research. A detailed investigation considering the impact of the bullwhip effect on global supply chain management can also be carried out for further research. More thorough investigations are required to increase the confidence interval of the current SCMI and the degree of development of various countries. The research suggests that SCMI of any country can be improved by implementing the following strategies subject to its own challenges and opportunities:

- 1 having proper supply chain planning tools and techniques
- 2 defining a supply chain strategy
- 3 using e-business and its application
- 4 harnessing the power of IT
- 5 having inter- and intra-organisational integration
- 6 applying TQM principles in the supply chain from upstream to downstream.

These strategies would help the international managers to gain competitive advantages, such as lower cost of global supply chain operation and differentiation through the processing activities performed and their corresponding linkages with suppliers and buyers.

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